



# **EACTA 2006 Abstracts**

**The 21st Annual Meeting of the  
European Association of Cardiothoracic Anaesthesiologists**

## **Edited by**

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The investigators of these abstracts have stated in their submission letter that prospective studies where patients are involved have institutional or Ethics Committee approval and informed patient consent, and that the studies using experimental animals have institutional approval.

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## Haemostasis

### O-01

#### Recombinant activated factor VII in the treatment of massive bleeding in cardiac surgical patients

N. Trekova, V. Gladisheva, A. Javorovsky, A. Bunatian  
*Russian Research Center of Surgery, Moscow, Russia*

**Introduction:** Severe bleeding is a major complication in cardiac surgery and is associated with a great risk of morbidity and mortality [1]. The novel haemostatic agent recombinant activated factor VII (rFVIIa) (NovoSeven®, NovoNordisk, Denmark) demonstrated high efficacy in the management of acute bleeding in various clinical situations [2]. The aim of this study was to evaluate the efficacy of rFVIIa in the management of severe bleeding during cardiac surgery.

**Method:** rFVIIa was used in 23 patients, age 15–63 years, who underwent open heart surgery (13 pts) or surgery of aortic aneurysm (10 pts) in 2003–2005. All patients had normal coagulation parameters before operation. In these patients bleeding (10–20 mL/min) developed intra-operatively. Haemostatic therapy (fresh frozen plasma, epsilon aminocaproic acid, aprotinin, platelet concentrate) and replacement therapy had failed to stop bleeding. rFVIIa was administered in the first dose 60–90 µg/kg. Laboratory tests were statistically analysed prior and after rFVIIa administration with Student's *t*-test.

**Results:** After administration of the first median dose ( $75.5 \pm 15.0$  µg/kg) the bleeding stopped in 14 patients and markedly decreased (from  $12.3 \pm 3.2$  mL/min to  $3.5 \pm 1.9$  mL/min,  $P < 0.05$ ) in 6 patients. 3 patients who did not benefit from the initial dose of rFVIIa received the second administration of rFVIIa in dose 80–90 µg/kg with good results in 2 patients. There was a considerable reduction in the need of blood transfusion after rFVIIa administration. We had not seen adverse reactions after rFVIIa injection. Analysis of haemostatic tests has shown decreased prothrombin time (PTT) from  $38.4 \pm 3.3$  sec to  $18.0 \pm 1.8$  sec ( $P < 0.01$ ) after rFVIIa administration in 30 min. PTT remained decreased in comparison with the pre-induction level during 24 hours. There were no significant changes of other parameters of haemostasis. **Conclusion:** These data suggest that recombinant activated factor VII is a high effective haemostatic drug for the management of haemorrhage in cardiac surgery when conventional therapy has failed.

#### References:

- Milas BL, Jobses DR, Gorma RC. Management of bleeding and coagulopathy after heart surgery. *Semin Thorac Cardiovasc Surgery* 2000; **12**(4): 326–336. Review.
- Murkin JM. A novel hemostatic agent: the potential role of recombinant activated factor VII (rFVIIa) in anesthetic practice. *Can J Anesth* 2002; **49**(10): S21–S26. Review.

### O-02

#### Tranexamic acid has no effect on hydroxyethyl starch induced coagulation disorder after on-pump cardiac surgery

T. Niemi, R. Suojäranta-Ylilinen, S. Kukkonen, A. Kuitunen  
*Department of Anaesthesiology and Intensive Care Medicine, Helsinki University Hospital, Helsinki, Finland*

**Introduction:** Hydroxyethyl starch impairs haemostasis by decreasing clot strength [1]. The formed clot may be more sensitive to fibrinolytic activity. The aim of the present study was to evaluate the effect of intravenous tranexamic acid on hydroxyethyl starch induced clot strength impairment after on-pump cardiac surgery.

**Method:** 30 patients were randomized to receive either 1 g tranexamic acid or 0.9% saline after the administration of 15 mL/kg of 6% hydroxyethyl starch (HES, MW 200 kDa/degree of substitution 0.5) postoperatively. The rate of colloid administration was based on clinical needs. Tranexamic acid or 0.9% saline was given as a 10-min bolus-infusion. Modified thromboelastometry (ROTEM®) using different activators [intrinsic ROTEM (InTEM); extrinsic ROTEM (ExTEM); fibrinogen ROTEM (FibTEM), calcium (NaTEM)] was carried out at predetermined intervals.

**Results:** Clot formation time was prolonged and maximum clot firmness decreased (all activators of ROTEM) immediately after completion of HES ( $P < 0.001$ , two-factor ANOVA). These abnormalities in blood coagulation persisted without any immediate or late (i.e. 2 hours) effects of tranexamic acid. Maximal lysis (FibTEM), indicative of fibrinolytic activity, was increased after HES but no effect of tranexamic acid was observed. The cumulative chest tube drainage until the first postoperative morning was not different between the groups.

**Conclusions:** HES-induced impairment in clot formation and strength, or increased fibrinolytic capacity, could not be reversed by the administration of tranexamic acid after cardiac surgery. The postoperative administration of tranexamic acid did not decrease chest tube drainage.

#### Reference:

- Niemi TT, Kuitunen AH. Artificial colloids impair haemostasis. An in vitro study using thromboelastometry coagulation analysis *Acta Anaesthesiol Scand* 2005; **49**: 373–378.

### O-03

#### Effects of preoperative treatment with enoxaparin on haemostatic activation in coronary artery bypass grafting

H. Pleym, V. Videm, A. Wahba, A. Åsberg, T. Amundsen, L. Bjella, O. Dale, R. Stenseth

*St. Olav University Hospital, Norwegian University of Science and Technology, Trondheim, Norway*

**Introduction:** Patients with unstable coronary artery disease (CAD) have changes in the haemostatic system indicating the presence of a hypercoagulable state. Treatment with low molecular weight heparin reduces the risk of new ischaemic events in these patients, but does not necessarily ameliorate the observed procoagulative changes. We hypothesized that the observed hypercoagulable state persisted into the intra- and early postoperative phase in patients with unstable CAD scheduled for urgent coronary artery bypass grafting (CABG).

**Method:** The study was approved by the Regional Committee for Medical Research Ethics, and all patients gave written informed consent. Thirty-two patients with unstable CAD treated pre-operatively with enoxaparin, and 32 stable control patients not treated with enoxaparin were included. All patients were scheduled for primary CABG. Blood samples for analysis of platelet count, international normalised ratio, activated partial thromboplastin time, fibrinogen, protein S, protein C, prothrombin fragment 1+2, thrombin-antithrombin complex, antithrombin, plasmin-antiplasmin complex, D-dimer, neutrophil activating peptide (NAP-2), platelet-monocyte complexes, and heparin concentrations were drawn preoperatively, after 30 minutes on cardiopulmonary bypass (CPB), and 30 minutes, 3 and 20 hours postoperatively. Heparin was used for anticoagulation during CPB. The initial dose of heparin was standardized to 3 mg/kg. Thereafter heparin was given as needed to maintain the activated clotting time (ACT) above 480 seconds.

**Results:** Patients treated pre-operatively with enoxaparin had lower peri-operative antithrombin levels compared to control patients. These patients also received significantly more heparin to maintain ACT above 480 seconds, and had significantly higher peri-operative plasma heparin concentrations. In addition, the peri-operative NAP-2 concentrations were significantly higher in patients treated with enoxaparin. There were no significant differences in the other measured variables between the two groups.

**Discussion:** The observed lower levels of antithrombin seen in patients treated with enoxaparin may explain why these patients were less responsive to heparin compared to the control group [1]. Our results do not, however, support the hypothesis that there is a more intense activation of coagulation intra- and postoperatively in patients treated with enoxaparin preoperatively. The larger total dose of heparin given to the patients in the enoxaparin group may explain why the activation of coagulation during and after CPB did not differ between groups. Reasons for the observed difference in platelet activation between the two groups, measured by NAP-2, remain unclear.

#### Reference:

- Ranucci M, Isgrò G, Cazzaniga A, et al. Different patterns of heparin resistance: therapeutic implications. *Perfusion* 2002; **17**: 199–204.

### O-04

#### Is allogeneic blood transfusion a risk factor for sternal dehiscence following cardiac surgery?

T. Vymazal, M. Horacek, R. Durpekt, M. Hladikova, K. Cvachovec  
*University Hospital Motol, Charles University, 2nd School of Medicine, Institute for Postgraduate Medical Education, Praha, Czech Republic*

**Introduction:** Sternal dehiscence following cardiac surgery has a multifactorial etiology [1]. We have focused on the role of allogeneic blood transfusion as a strong immunomodulating agent leading to poor wound healing [2].

**Method:** Between January 2001 and June 2005 we have performed a prospective observational study in 1553 elective and emergency patients who underwent median sternotomy for heart surgery. Patients were divided into groups A – with dehiscence (El Oakley 3a and 3b) [1] and B – with no dehiscence. We compared the two groups.

**Results:** Several risk factors may have contributed to sternal dehiscence: diabetes mellitus (DM) (A 53.6%, B 42.9%,  $P = 0.272$ ), chronic obstructive pulmonary disease (COPD) (A 32.3%, B 12.3%,  $P = 0.033$ ), obesity (Body Mass Index [BMI] A 27.6, B 26.5,  $P = 0.031$ ) or re-exploration due to bleeding or tamponade (A 17.6% B 8.5%,  $P < 0.002$ ). Patients with sternal dehiscence A received 7.6 transfusion units (TU) of allogeneic blood transfusion on average versus 1.6 TU of allogeneic blood transfusion in group B without sternal dehiscence ( $P < 0.00005$ ). The dehiscence affected patients without any other significant risk factor who received 6 or more TU or patients with at least one significant risk factor who received 4 or more TU of allogeneic blood.

**Discussion:** Our results suggest that the number of allogeneic blood transfusions in the perioperative period seem to be the key to risk. We can confirm that COPD [1], obesity [1], or re-exploration [3] result in sternal dehiscence. In contrast to some authors we also focused not only on re-exploration [3] but on the number of allogeneic blood transfusions with or without re-exploration. According to our results, the total amount of allogeneic blood transfused is a major factor contributing to sternal dehiscence regardless of other risk preconditions.

#### References:

- 1 Parisian Mediastinitis Study Group. Risk Factors For Deep Sternal Wound After Sternotomy – prospective multicentre study. *J Thorac Cardiovasc Surg* 1996; **111**: 1200–1207.
- 2 Weber EW, Slappendel R, Prins MH, et al. Perioperative blood transfusions and delayed wound healing after hip replacement surgery: effects on duration of hospitalization. *Anesth Analg* 2005; **100**(5): 1416–1421.
- 3 Karthik S, Grayson AD, McCarron EE, et al. Reexploration for bleeding after coronary artery bypass surgery: risk factors, outcomes, and the effect of time delay. *Ann Thorac Surg* 2004; **78**(2): 527–534. Review.

## O-05

### Prothrombin complex concentrate versus fresh frozen plasma in patients on oral anticoagulant therapy undergoing cardiac surgery with cardio-pulmonary bypass: a randomized clinical trial

S. Gillardin, R. Demeyere, J. Arnout, P. Strengers

University Hospital Gasthuisberg, Leuven; Medical Department CAF-DCF, Brussels, Belgium

**Introduction:** To reverse oral anticoagulant (OAC) therapy, a number of treatment modalities are available. Fresh frozen plasma (FFP) is effective and is currently used for coagulation factor replacement but carries a risk of volume overload, transmission of infective agents and is time consuming. Variable and frequently low potency of clotting factors results in minor haemostatic effects compared with prothrombin complex concentrates (PCCs) which are considered very effective and safe [1]. PCC PPSB-SD<sup>®</sup> has constant, highly concentrated levels of factor II, VII, IX and X compared to FFP. We studied the efficacy of the intra-operative administration of PCC and FFP in patients on OAC therapy undergoing heart surgery with cardiopulmonary bypass. (CPB).

**Method:** After Ethical Committee approval, 40 consenting patients (PCC group  $n = 20$ ) (FFP group  $n = 20$ ) with a pre-operative INR of  $\geq 2.1$  were studied. PCC was supplied as 500 IU factor IX (20 mL) vials. The dose was calculated on the basis of body weight, the initial INR and the target INR aiming at an INR of 1.5 after protamine. Half of this dose was administered before the start of CPB. After weaning from CPB and protamine, the second half dose was given in order to reach a post-operative INR of  $\leq 1.5$ . When the INR value was still too high a further dose of PPSB was given. In the FFP group, each patient received 4 units; half of this dose was given before CPB and the other half after CPB. Additional units were given until the INR had reached a satisfactory level. In case of poor response and/or if there was a danger of volume overload, PCC was given. A portable coagulation monitor (CoaguChek<sup>™</sup>) was used for instantaneous INR measurements. Blood sampling was pre-operative ( $T_{-1}$ ), pre-incision ( $T_0$ ), pre- and post-administration before CPB ( $T_1$ ,  $T_2$ ), during CPB at 15 and 45 min ( $T_3$ ,  $T_4$ ), at the end of CPB ( $T_5$ ), after protamine administration ( $T_6$ ), 15, 60 min, 3 and 16 h post-CPB ( $T_7$ – $T_{10}$ ). Analyses performed were: INR, PT, Hct, ACT, aPTT, clotting factors II, VII, IX, X and FV. The amount of blood lost in the chest tube drainage and the blood products administered were also registered. Statistical evaluations were performed using Student's *t*-test, repeated measurements ANOVA and the Fisher's exact test.

**Results:** The PCC group was more successful in reaching the target INR. In the FFP group 16/20 (80%) patients received an additional dose of PPSB versus 6/20 (30%) in the PCC group. The INR with PCC treatment dropped below 1.5 sooner than in the FFP group. More patients in this group reached the target

INR in the first hour after ending CPB. ( $T_7$   $P < 0.007$ ) with a significant difference between groups in FII ( $P = 0.023$ ) and FX ( $P = 0.008$ ) levels over time.

**Conclusion:** The results of our study support the use of PCC in patients on OAC therapy facing semi-urgent or urgent cardiac surgery. Treatment with PCC reverses anticoagulation safely, more rapidly and effectively than FFP.

#### Reference:

- 1 Makris M, Greaves M, Phillips WS, et al. Emergency oral anticoagulant reversal: the relative efficacy of infusions of fresh frozen plasma and clotting factor concentrate on correction of the coagulopathy. *Thromb Haemost* 1997; **77**: 477–480.

## O-06

### Comparison of tranexamic acid, aprotinin and placebo on blood conservation, fibrinolysis and platelet function with extensive heart surgery: a randomized clinical trial

A. Bosteels, R. Demeyere, J. Arnout

University Hospital Gasthuisberg, Leuven, Belgium

**Introduction:** CPB results in fibrinolysis, reflected by increased plasmin concentrations and fibrin degradation products, both of which have deleterious effects on platelet function [1]. In this study we compared the effects of high dose aprotinin (A), tranexamic acid (TA) and no treatment (P) on blood loss, transfusion of blood products, fibrinolysis and platelet function with heart surgery.

**Method:** After Ethics Committee approval, 60 consecutive consenting patients undergoing combined aortic valve surgery with CABG were studied. They were randomized to either: high-dose A (280 mg loading dose, 70 mg h<sup>-1</sup> infusion rate and 280 mg in the prime;  $n = 20$ ); TA (100 mg kg<sup>-1</sup> loading dose, 1 mg kg<sup>-1</sup> h<sup>-1</sup> infusion rate;  $n = 20$ ); or saline ( $n = 20$ ). The effect of A and TA on some markers of activation of thrombin formation and fibrinolysis was studied (D-dimer, plasminogen,  $\alpha_2$ -antiplasmin, antithrombin and glycofibrin, a platelet-membrane GPIIb/IIIa fragment). Sampling was at induction ( $t_1$ ), at the start and end of CPB ( $t_2$ ,  $t_3$ ), and at 1, 4 and 24 h after CPB ( $t_4$ ,  $t_5$ ,  $t_6$ ). Analysis of variance for repeated measurements was applied for statistical comparisons between groups.  $<0.05$  was considered significant. Data are expressed as mean values  $\pm$  SD.

**Results:** Blood loss and chest tube drainage were significantly less in the A and TA groups compared with the P group at all time points and were accompanied with the use of less blood products, less volume replacement and higher haemoglobin levels. The duration of the surgical post-CPB period was significantly shorter in the A and TA groups ( $55 \pm 18$ ,  $71 \pm 19$  and  $84 \pm 26$  min respectively). Inhibition of fibrinolysis was significant with both antifibrinolytic drugs (D-dimers  $578 \pm 81$ ,  $550 \pm 105$  and  $3603 \pm 440 \mu\text{g mL}^{-1}$  at  $t_4$ ). During and after the operation the D-dimers were much higher in the placebo group.  $\alpha_2$ -antiplasmin levels were higher in the A group compared with the TA and P groups. This effect was present until 24 h after CPB. TA had no effect on this parameter. Plasminogen levels were lower in the TA group at  $t_4$ ,  $t_5$  and  $t_6$ . TA patients more often received additional boluses of heparin to maintain ACT  $> 480$  s during bypass (15/20 patients versus 9/20 and 8/20 patients in the A and P groups respectively). aPTT values were significantly prolonged at the end of CPB in the A group. Antithrombin values were significantly higher in the A group at  $t_3$ ,  $t_4$  and  $t_5$ . There was no difference in platelet count between groups. Glycofibrin values were significantly lower in the P group in the postoperative period.

**Discussion:** TA can inhibit fibrinolytic activity by blocking plasmin(ogen) activity measured as D-dimer, but seems to have no influence on neutralization of plasmin by  $\alpha_2$ -antiplasmin. Both A and TA effectively suppress the appearance of markers of fibrinolysis as compared with placebo. The results also suggest that the antifibrinolytic effects of TA and A can reduce blood loss in patients undergoing extensive CPB surgery.

#### Reference:

- 1 Despotis GJ, Avidan MS, Hogue CW Jr. Mechanisms and attenuation of hemostatic activation during extracorporeal circulation. *Ann Thorac Surg* 2001; **72**: S1821–S1831. Review.

## O-07

### Tranexamic acid reduces postoperative bleeding but not allogeneic transfusion requirements after valve replacement cardiac surgery

E. Moret, A. Flo, A. Escudero, E. Massó, S. Muñoz, X. Ruyra, J. Canet  
Department of Anaesthesia, University Hospital Germans Trias i Pujol, Barcelona, Spain

**Introduction:** The use of tranexamic acid (TA), a synthetic antifibrinolytic drug, decreases perioperative blood loss and blood transfusion in cardiac surgery. Results may vary according to different clinical settings [1]. The aim of our study was to assess the effects of two different doses of TA on postoperative

bleeding and perioperative allogeneic transfusion requirements following primary, elective, valve replacement cardiac surgery.

**Method:** In a double-blind, prospective, placebo-controlled study, 188 patients scheduled for aortic, mitral or combined valve replacement surgery were randomized into three groups. Among exclusion criteria were treatment with platelet inhibitors before surgery as well as coagulopathies and renal dysfunction. Group 1 received placebo (0.9% saline solution). Group 2 received TA 1 g i.v. as a bolus after anaesthetic induction, followed by a constant infusion of 400 mg/h i.v. until the end of surgery and 500 mg on bypass. Group 3 received a bolus of TA 30 mg kg<sup>-1</sup> i.v. after heparin administration. Postoperative bleeding, bank blood products transfused until removal of chest tubes, extubation time, intensive care unit (ICU) stay and thrombogenic complications were recorded. Blood products were transfused if the haematocrit value was <20% on bypass and/or <25% at the end of surgery according to a standardized protocol. Data are presented as means with 95% confidence intervals in brackets and were analysed with ANOVA and  $\chi^2$  test.

**Results:** Preoperative demographics, haemostatic and surgical characteristics were comparable among groups. Blood loss was 495.0 (434.5–555.5) mL in Group 1, 368.1 (315.7–420.4) mL in Group 2 and 369.7 (327.5–411.8) mL in Group 3. Postoperative bleeding was significantly higher in the placebo group compared to the TA groups ( $P = 0.01$ ). Blood loss difference between Group 2 and 3 treated with TA did not reach statistical significance. Blood products administration and final haemoglobin values were not statistically different among the three groups. No differences in extubation time, ICU stay or other postoperative complications were found.

**Conclusion:** In valve replacement surgery the use of our two different doses of tranexamic acid showed a similar significant reduction in postoperative mediastinal bleeding, while transfusion needs remained unchanged compared to a placebo group.

**Reference:**

- 1 Armellini G, Casella S, Guzzinati S, et al. Tranexamic acid in aortic valve replacement. *J Cardiothorac Vasc Anesth* 2001; **15**(3): 331–335.

## Haemostasis B

### O-08

#### Erythrocyte changes in autologous blood of patients undergoing cardiopulmonary bypass

E. Mijerbekov, G. Fedotovskikh, I. Ilyaletdinov

Scientific Center of Surgery, Almaty, Kazakhstan, Kazakhstan

**Introduction:** Intraoperative autologous blood conservation (IABC) is considered to be an effective and safe blood saving technique in cardiac operations with cardiopulmonary bypass (CPB) [1]. Usually collection of autologous blood (AB) is performed before heparin administration with sodium citrate as anticoagulant. The quality of autologous blood storage has not been studied. The purpose of the study was to compare the erythrocyte fragility of AB obtained by four different methods in patients undergoing cardiac surgery with cardiopulmonary bypass.

**Method:** With the approval of the Ethics Committee and informed consent, 49 patients for valve replacement or correction of congenital heart defects underwent CPB with IABC. Four variants of IABC were used. In 11 pts AB was obtained from the central venous catheter and saved in sodium citrate (group 1). In 9 pts AB was taken from the radial artery into a container with sodium citrate (group 2). In 11 pts AB was taken after heparin administration (3 mg · kg<sup>-1</sup>) from the right atrium into a container with sodium citrate (group 3). In 18 pts AB was collected after heparin administration (3 mg · kg<sup>-1</sup>) from the right atrium into container without sodium citrate (group 4). Osmotic fragility (OF) of AB erythrocytes was studied. AB erythrocytes were examined by electron microscopy. Student's *t*-test was used for statistical analysis (mean ± SD).

**Results:** AB was stored in the operation room for not more than 193.5 ± 103.8 minutes. Tests showed higher OF of AB erythrocytes stored in sodium citrate. 0.6% solution of sodium chloride caused 19.9 ± 19.1% haemolysis in gp 1, 18.5 ± 13.6% in gr 2, 47.9 ± 30.5% in gr 3 ( $P < 0.05$  compared with grp 1 and 2), 5.7 ± 6.3% in gp 4 ( $P < 0.05$  compared with gps 1, 2 and 3). 0.55% solution of sodium chloride caused 59.8 ± 29.5% haemolysis in gp 1, 56.3 ± 26.1% in gp 2, 72.3 ± 24.9% in gp 3, 11.5 ± 11.9% in gp 4 ( $P < 0.05$  compared with gps 1, 2 and 3). Electron microscopy of AB erythrocyte cuts revealed multifiform multiple changes in gps 1, 2 and 3. Erythrocyte membrane destruction, microvesicle and macrovesicle generation, erythrocyte deformation and degeneration were found when sodium citrate was used. In gp 4 there were less morphological changes.

**Conclusion:** Intraoperative autologous blood conservation with the use of sodium citrate caused erythrocytes damage in patients with cardiovascular disease. Osmotic fragility of erythrocytes significantly increased when sodium citrate was used. Anticoagulation with heparin preserved erythrocytes safely. More studies are need for the wide use of heparin for intraoperative autologous blood conservation in cardiac surgery, since haemostasis can be a considerable problem during cardiac surgery.

**Reference:**

- 1 Jamnicki M, Kocian R, van der Linden P, et al. Acute normovolemic hemodilution: physiology, limitations, and clinical use. *J Cardiothorac Vasc Anesth* 2003; **17**: 747–754.

### O-09

#### Platelet activity after coronary artery bypass surgery; preliminary results from CABARET study (coronary artery bypass and reactivity of thrombocytes)

F. Bednar, T. Vanek, P. Osmancik, M. Jares, H. Mociikova, Z. Motovska, Z. Straka

Clinic of Cardiac Surgery, University Hospital Kralovske Vinohrady, NR8526-3/2005 Group, Prague, Czech Republic; Clinic of Cardiology, 3rd Medical School of Charles University, Prague, Czech Republic; Department of Hematology, University Hospital Kralovske Vinohrady, Prague, Czech Republic

**Introduction:** Hypercoagulability after off-pump coronary artery bypass grafting (CABG) as one of the possible causes of early graft failure, is often discussed [1]. We assessed platelet activity after off-pump and on-pump CABG surgery.

**Method:** Twelve off-pump and twelve on-pump operations were performed in a prospective, randomized study. Blood samples were drawn before surgery, immediately postoperatively, on days 1, 2, 5 and 30 after surgery. Platelet activity was determined by membrane expression of platelet antigen CD41 (part of GpIIb/IIIa integrin), CD42 (von Willebrand factor receptor) and CD 62P (P-selectin) by flow cytometry as mean fluorescence intensity (CD41, 42b) or % of positive cells (CD62P). Platelet aggregability was measured by arachidonic acid (ARA)-aggregometry [2].

**Results:** Baseline characteristics and intraoperative variables were comparable in both group, except for surgery duration and grafts count. Post-operative membrane antigen expression was significantly and transiently increased in off-pump and decreased in on-pump CABG compared with preoperative values. Maximum difference of antigen expression in the off-pump was observed for CD41 on day 5 (12.2 ± 0.8 vs. 11.7 ± 0.9,  $P < 0.05$ ), for CD62P on day 2 (2.5 ± 1.5 vs. 1.0 ± 0.5,  $P \leq 0.05$ ) and for CD42 on day 2 (12.4 ± 1.5 vs. 12.2 ± 1.4,  $P = N.S.$ ). In the on-pump, maximum difference was on day 5 for all measured antigens (CD41: 11.1 ± 0.6 vs. 11.9 ± 0.9,  $P < 0.05$ ; CD42b: 11.7 ± 1.2 vs. 12.2 ± 1.1,  $P < 0.05$ ; CD62P: 1.3 ± 0.4 vs. 1.4 ± 0.4,  $P = n.s.$ ). No changes to preoperative values were evident in both group on day 30. Platelet ARA-aggregation was significantly decreased immediately after operation and on day 1 in both groups (–70%,  $P < 0.05$ ) and the decrease was sustained until day 30. However, there was a surprisingly transient increase of ARA aggregation on day 2 compared to day 1 in off-pump surgeries.

**Discussion:** The platelet hyperactivity determined by membrane expression of platelet antigen seems to be present in the early post-operative period in off-pump, but not in on-pump CABG surgery. Standard antiplatelet therapy with aspirin seems to be insufficient in the early post-operative period in off-pump CABG surgery.

**References:**

- 1 Mariani MA, Gu YJ, Boonstra PW, et al. Procoagulant activity after off-pump coronary operation: is the current anticoagulation adequate? *Ann Thorac Surg* 1999; **67**: 1370–1375.
- 2 Michelson AD. Platelet function testing in cardiovascular diseases. *Circulation* 2004; **110**: 489–493. Review.

### O-10

#### Determinants of complications with recombinant factor VIIa therapy in patients with refractory blood loss after cardiac surgery

A.E. Van Rensburg, M. Meineri, M. Wasowicz, K. Karkouti, S. Beattir  
Department of Anesthesia and Pain Management, Toronto General Hospital, University Health Network, Toronto, Canada

**Introduction:** Refractory blood loss after cardiac surgery is associated with significant morbidity and mortality. Recently case reports and case control studies have pointed to the possible effectiveness of Recombinant Factor

VIIa (rFVIIa) for the treatment of refractory blood loss after cardiac surgery. The current approved use of this drug is only for haemophilic patients who have developed antibodies against specific coagulation factors.

**Method:** The unadjusted and adjusted complication rates, expressed as observed to expected (O/E) ratios were compared between 114 consecutive cardiac surgical patients who received rFVIIa and 549 patients who did not receive rFVIIa after developing refractory excessive blood loss. Similarly the outcomes of early versus late therapy with rFVIIa were compared (8 units of packed red blood cells being the cut off point).

Primary outcome was a composite of death, stroke, renal failure, myocardial infarction and major vein thrombosis. For risk adjustment, a logistic regression model for this outcome was constructed using perioperative predictors and adverse events, and finally consisted of only three variables: cardiopulmonary bypass (CPB) duration, number of units of red blood cells transfused during hospitalization and CPB duration.

**Results:** The unadjusted O/E complication ratio was 1.81 (95% CI 1.51–2.11), compared to the risk adjusted ratio of 1.06 (95% CI 0.86–1.26). Data analysed according to timing of therapy revealed an unadjusted O/E complication ratio of 1.33 (95% CI 0.87–1.80) for early therapy versus 2.23 (95% CI 1.69–2.77) for late therapy. Risk adjustment did not eliminate this difference. (O/E 0.82; CI 0.52–1.12 for early versus O/E 1.26; CI 0.96–1.56 for late therapy).

**Conclusion:** In this observational study, cardiac surgical patients with excessive blood loss who received rFVIIa had higher adverse event rates than those who did not receive the drug. This was due to confounding clinical variables. Early rather than late therapy may be more beneficial.

#### References:

- Karkouti K, Beattie WS, Wijesundera DN, et al. Recombinant factor VIIa for intractable blood loss after cardiac surgery: a propensity score-matched case-control analysis. *Transfusion* 2005; **45**: 26–34.
- Despotis G, Avidan M, Lublin DM. Off-label use of recombinant factor VIIa concentrates after cardiac surgery. *Ann Thorac Surg* 2005; **80**: 3–5.

## O-11

### Plavix and TEG<sup>®</sup> Platelet Mapping

P. Prati, D.F. Colella, M. Moresco, M. Flaminio, P. De Vico, V. Ajello, L. Chiariello, A.F. Sabato

*Policlinico Tor Vergata; Anaesthesiology, University of Tor Vergata; Cardiac Surgery, University of Tor Vergata, Rome, Italy*

**Introduction:** Clopidogrel is widely used in cardiac surgery. Its use has been associated with a decrease in the incidence of restenosis after PTCA as well as improved outcome during treatment of coronary syndromes (including mortality reduction). However, the impact of such an antiplatelet agent on postoperative bleeding is still uncertain [1]. As a consequence, a careful study of the effects of clopidogrel on platelet function is vital to clarify this topic. In this study we used Platelet Mapping<sup>®</sup> to monitor the effects of clopidogrel on platelet function in patients undergoing CABG.

**Method:** Platelet Mapping<sup>®</sup> is a new thrombelastographic assay which measures the percentage of platelet inhibition of some antiplatelet drugs, like clopidogrel (ADP receptor antagonist) or ASA (arachidonic acid antagonist). 60 patients undergoing CABG have been recruited. 30 patients on clopidogrel 75 mg/day, were divided into two groups depending on inhibition percentage of platelet function by clopidogrel: platelet inhibition >60% of the maximal amplitude (MA) (Group A) and platelet inhibition <60% of MA (Group B). The remaining 30 patients not on antiplatelet drugs were Control Group C. Statistical analysis was performed using two ways ANOVA for numerical data and Chi squared test for categorical data.

**Results:** There were no differences between demographic and preoperative data.

**Table.** Preoperative TEG<sup>®</sup> data:

	A (18 pt) %MA <sub>ADP</sub> > 60%	B (12 pt) %MA <sub>ADP</sub> < 60%
R (min)	6.6 ± 1.6	7.7 ± 1.4
K (min)	1.8 ± 0.5	1.9 ± 0.5
α angle (°)	65.5 ± 5.9	65.1 ± 5.6
MA (mm)	65.3 ± 5.9	67 ± 4
G dyn/cm <sup>2</sup>	8.5 ± 4.4	10.4 ± 1.6
LY 30 (%)	0	0

In only 18 patients (60%) of 30 taking clopidogrel platelets were really inhibited by the drug. Heparin Dose Response Test (Hepcon<sup>®</sup> HMS plus<sup>™</sup>) curve slope was greater and requested heparin was lower in group A than in groups B or C (91 ± 13 vs. 75 ± 17 or 71 ± 15 s/U/mL; 253 ± 62 vs.

301 ± 44 or 312 ± 40 U). Blood loss in ICU was greater in group A than other groups even if no surgical re-exploration was needed (344 ± 112 vs. 250 ± 84 or 265 ± 89 mL). Group A had less antithrombin and platelet count reduction than the other groups (18 ± 2.3 vs. 24 ± 3.1 or 26 ± 3.2%; 20 ± 2.5 vs. 26 ± 3.4 or 27 ± 3.3%).

**Discussion:** Platelet Mapping<sup>®</sup> shows that clopidogrel does not have full antiplatelet activity in every patients. An appropriate platelet function monitor is useful to assess which patients really respond to clopidogrel and have inhibited platelets. In such patients we have to use different strategies (less heparin, tranexamic acid, aprotinin, heparin coated circuits) to reduce blood loss and transfusion of packed erythrocytes.

#### Reference:

- Shore-Lesserson L, Tanaka KA. Antiplatelet agents and bleeding after cardiac surgery. *Anesth Analg* 2004; **99**: 947–948.

## O-12

### Comparison of aprotinin and tranexamic acid concerning postoperative blood loss in uncomplicated on-pump cardiac surgery: aprotinin is more effective in CABG but not in aortic valve surgery

R. Busley, W. Dietrich, S. Braun, R. Hollweck

*Department of Anesthesia, Deutsches Herzzentrum München/TU München; Institut für Medizinische Statistik und Epidemiologie/TU München, Munich, Germany*

**Introduction:** There is much data about blood sparing effects of antifibrinolytics in cardiac surgery. Most studies refer to aprotinin (AP) [1], but tranexamic acid (TA) also reduces bleeding [2]. Only a few studies compared the efficacy of these drugs directly [3].

**Method:** This randomized, double-blind clinical interventional trial was performed after ethics committee approval and patients' informed consent. 220 patients received either high-dose AP or 75 mg/kg TA during on-pump cardiac surgery for first-time coronary artery bypass grafting (CABG) or aortic valve replacement (AVR). Primary endpoint was postoperative 24 h chest tube output. Secondary endpoints were requirements for allogeneic blood transfusion and time to close the chest. Data were compared between groups using non-parametric statistical testing. The independent influence of different variables on chest tube drainage was tested with multivariate analysis.

**Results:** Groups were comparable regarding age, gender, morbidity and duration of extracorporeal circulation.

Type of Surgery	All (n = 220)		AVR (n = 86)		CABG (n = 134)	
	AP	TA	AP	TA	AP	TA
Antifibrinolytic 24 h blood loss [mL]	500	565	340	325	500*	675
	300/700	300/800	225/600	250/550	463/888	343/755

Data shown as median and 25/75 percentile;

\*P < 0.05 vs. TA in CABG-group.

In the entire intention-to-treat population, multivariate testing revealed male gender, CABG, and higher preoperative risk scoring as independent factors increasing 24 h blood loss. In AP- compared to TA-patients chest closure was significantly shorter (56.1 vs. 60.1 min) and the proportion of patients not requiring allogeneic blood transfusion was significantly higher (53% vs. 39%).

**Conclusion:** The analysis of the application of AP vs. TA in uncomplicated on-pump cardiac surgery revealed that a significant reduction in postoperative blood loss can be achieved when applying AP instead of TA in coronary artery bypass grafting but that there is no difference in blood loss after aortic valve replacement.

#### References:

- Levi M, Cromheecke ME, de Jonge E, et al. Pharmacological strategies to decrease excessive blood loss in cardiac surgery: a meta-analysis of clinically relevant endpoints. *Lancet* 1999; **354**: 1940–1947.
- Henry DA, Moxey AJ, Carless PA, et al. Anti-fibrinolytic use for minimising perioperative allogeneic blood transfusion. *Cochrane Database Syst Rev* 2001; CD001886. Review.
- Diprose P, Herbertson MJ, O'Shaughnessy D, et al. Reducing allogeneic transfusion in cardiac surgery: a randomized double-blind placebo-controlled trial of antifibrinolytic therapies used in addition to intra-operative cell salvage. *Br J Anaesth* 2005; **94**: 271–278.

## Echocardiography

### O-13

#### Epicardial real time three-dimensional echocardiography in the intraoperative evaluation of patients undergoing cardiac surgery

V.S. Salandin, E.C. Cavarretta, A.M.C. Camata, B.P. Persi, L.S. Salvador, S.D.C. De Castro

Regional Hospital, Treviso; University La Sapienza, Rome, Italy

**Introduction:** Transoesophageal two-dimensional intraoperative echocardiography (2DTOE) is a widely accepted method to guide surgical procedures. However, to date, the technology does not allow real time three-dimensional echo (RT3DE) acquisition with the TOE probe. The aim of our study was to assess the incremental value of intraoperative epicardial RT3DE in the same setting.

**Method:** 39 consecutive patients undergoing cardiac surgery (17 aortic valve and ascending aorta replacements, 10 coronary artery grafts, 10 mitral valve repairs and 2 combined procedures) underwent intraoperative 2DTOE and epicardial RT3DE [1] before and after cardiopulmonary bypass (CPBP). A new matrix transthoracic probe detects "live" RT3DE images that are immediately shown on the screen, while the "full volume" images require an off-line elaboration of almost 5 minutes. 2DTOE, epicardial "live" and "full volume" images were compared in the degree of concordance with the surgical anatomy. 2DTOE and RT3DE were also compared regarding the capability of influencing surgical strategies.

**Results:** The comparison with the surgical findings regarding valvular lesions are listed below:

Valvular lesion	2D	3D	Surgery	False negative
Mitral valve prolapse	10	10	10	
Mitral leaflets perforation	2	4	4	
Coaptation defects	2	4	4	
Calcifications	5	5	5	
Chordae rupture	8	9	10	1
Bicuspid aortic valve	7	8	9	1

Different observers judged RT3DE images far superior to 2DTOE in depicting the morphology of the following cardiac structures: mitral prolapsing and flail leaflets, fibrous trigone, annular prosthetic ring, native and artificial chordae, papillary muscles, left ventricular outflow tract and its spatial relationship with the mitral apparatus, aortic cusps and intimal tear and flap of the aorta. However, since for none of the patients epicardial RT3DE changed the surgical planning based on the 2DTOE exam, this approach has not demonstrated to date its superiority as a guide to surgical indications. Technical problems are related to the limits of epicardial echo views of the cardiac apex, due to the surgical field.

**Discussion:** In our preliminary study, epicardial RT3DE has demonstrated an important incremental value in improving the anatomic definition of several cardiac pathologies, in particular with the "full volume" technique. The sometimes exciting quality of the images and their realistic features stimulate researchers towards further experiences in order to support surgical strategies.

#### Reference:

- Eltzschig HG, Kallmeyer JJ, Mihaljevic T, et al. A practical approach to a comprehensive epicardial and epiaortic echocardiographic examination. *J Cardiothorac Vasc Anesth* 2003; 17: 422–429.

### O-14

#### Right ventricular function after on-pump versus off-pump coronary artery bypass graft surgery, a TDI study

I. Michaux, M. Filipovic, K. Skarvan, D. Bolliger, M.D. Seeberger

University Hospital of Basel, Basel, Switzerland; Mont-Godinne University Hospital, Université Catholique de Louvain, Yvoir, Belgium

**Introduction:** Impairment of right ventricular (RV) function has been observed after on-pump coronary bypass graft (CABG) surgery [1]. The use of cardiopulmonary bypass and perioperative myocardial ischaemia have been discussed as possible reasons for this problem. We hypothesized that avoiding cardiopulmonary bypass by performing off-pump coronary artery bypass (OPCAB) surgery would better preserve RV function.

**Method:** With approval from the institutional ethics committee and informed written consent, we equally randomized 50 elective coronary surgical patients to CABG or OPCAB surgery. Transthoracic echocardiography was performed the day before and 3 months after surgery. The parasternal

short-axis view was used to record the ejection signal of the right ventricle (pulsed wave (PW) Doppler) and the apical 4-chamber view to record the tricuspid inflow velocities (PW Doppler), and the peak systolic velocity (Sa) and peak diastolic velocity (Ea) of the lateral tricuspid annulus (PW tissue Doppler imaging, TDI). The time interval from cessation to onset of two consecutive tricuspid inflow signals (Time A) and the time interval from onset to cessation of the RV ejection signal (Time B) were used to calculate the RV myocardial performance index (RV-MPI) as (Time A – Time B)/Time B. Analysis of the continuous variables was performed by non-parametric tests (Mann-Whitney *U* test or Wilcoxon's signed rank test) on an intention to treat basis. Data are mean ± S.D. [median].

**Results:** Surgery was completed according to randomization in 48/50 patients. Conversion to cardiopulmonary bypass was performed in two of the 25 patients randomized to the OPCAB group because of haemodynamic instability. Four patients were lost from follow-up, 3 in the CABG and 1 in the OPCAB group. The echocardiographic data are shown in the Table.

	CABG group		OPCAB group		Intergroup comparison at 3 months <i>P</i> value
	Baseline	3 Months	Baseline	3 Months	
RV-MPI	0.33 ± 0.11 [0.32]	0.34 ± 0.16 [0.32]	0.32 ± 0.12 [0.31]	0.31 ± 0.14 [0.27]	0.37
Sa (cm/s)	14.7 ± 2.7 [14.2]	10.7 ± 0.5 [10.6] <sup>‡</sup>	14.3 ± 3.4 [14.4]	10.8 ± 2.1 [10.8] <sup>‡</sup>	0.91
Ea (cm/s)	10.8 ± 3.0 [10.1]	8.4 ± 1.9 [8.2] <sup>*</sup>	10.5 ± 3.4 [11.0]	9.5 ± 3.2 [8.6]	0.41

<sup>\*</sup>*P* ≤ 0.05; <sup>‡</sup>*P* < 0.001: compared with baseline values (intragroup comparison)

**Discussion:** Three months after surgery, systolic RV function was similarly impaired in both groups. Diastolic RV function, as indicated by Ea, was impaired in the CABG group only but inter-group differences did not reach statistical significance. Overall RV function, as indicated by the MPI, was preserved in both groups. We conclude that the choice of surgical intervention had only minimal influence on RV function 3 months after surgery.

#### Reference:

- Alam M, Hedman A, Nordlander R, et al. Right ventricular function before and after an uncomplicated coronary artery bypass graft as assessed by pulsed wave Doppler tissue imaging of the tricuspid annulus. *Am Heart J* 2003; 146: 520–526.

### O-15

#### Acceptance of a training simulator for transoesophageal echocardiography (TOE) among anaesthesiologists

M. Weidenbach, F. Wild, H. Drachler, G. Grunst, V. Razek, T. Berlage, J. Ender, J. Janousek

Department of Paediatric Cardiology, Department of Anaesthesiology, Heart Center Leipzig, Leipzig; Fraunhofer Institute for Applied Information Technology, St. Augustin, Germany

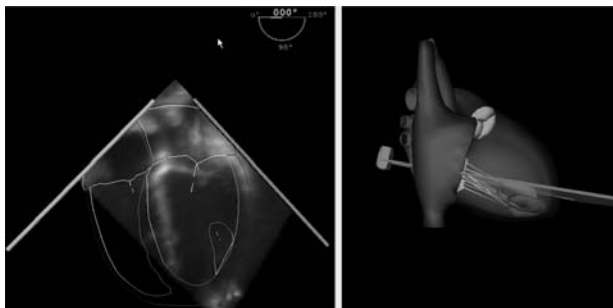
**Introduction:** We evaluated the acceptance of a newly developed TOE simulator.

**Method:** The simulator consists of a dummy patient and dummy probe. A tracking system attached to the probe tip is connected with a PC on which a three-dimensional (3D) virtual heart model and 3D echocardiographic data sets are stored. According to the position data of the probe 2D echocardiographic images are calculated from the stored 3D data sets. During board certified courses for TOE we introduced the simulator to experts in TOE (defined as having done more than 100 TOE examinations) and to beginners (defined as having done less than 10 examinations). All participants were anaesthetists. Using a standardized questionnaire and rating scales of 1–5 (1-absolute disagreement, 5-absolute agreement), experts were asked to judge the realism of the simulator and the usefulness of the simulator. Beginners were asked to judge the easiness of use and the usefulness to support understanding and adjustment of TOE image planes.

**Results:** A total of 25 experts and 30 beginners participated. Results are expressed as percent of positive answers (4 or 5 on the rating scale). Most experts graded the dummy torso as adequate (89%), the handling of the dummy probe as comparable to a real TOE probe (67%) and the echocardiographic image as realistic (74%). All recommended the use of the simulator for TOE training and all thought that proficiency could be achieved faster using the simulator. 87% of the beginners judged the simulator as easy to understand. 90% of the beginners said that the simulator helped in understanding the spatial relationship between heart, probe and echocardiographic image

and 95% said it helped in adjusting TOE standard planes. 96% said that the virtual heart model supported their spatial understanding and helped in adjusting the image plane.

**Discussion:** Both experts and beginners judged the simulator very positively. Our simulator is especially useful for beginners in TOE since not only a realistic 2D echocardiographic image is presented but also the position of the probe tip and the image plane in reference to a virtual heart model.



## O-16

### Comparison between ECG- and TOE-guided placement of the central venous catheter

E. Krohmer, C. Mukherjee, J. Banusch, U. Birnbaum, J. Ender

Department of Anaesthesiology and Intensive Care Medicine II, University Leipzig, Heartcenter, Leipzig, Germany

**Introduction:** To reduce serious complications with central venous catheters (CVC), control of its correct position immediately after placement in the operating room (OR) is important. In the last years ECG-guided positioning of CVC is of growing interest [1]. This study was designed to compare the ECG-guided positioning of the CVC with TOE finding in the bicaval standard view.

**Method:** After approval by the local ethics committee and informed patient consent a total of 200 patients (pts) with sinus rhythm were enrolled in this prospective study. After routine induction of anaesthesia the right internal jugular vein was cannulated and correct position of the catheter was confirmed by intra-atrial ECG (IECG; Pajunk, Germany). In phase I the TOE probe was inserted and the ECG-guided position of the CVC was controlled by transoesophageal echocardiography (TOE; Sonos 5500, Philips) in the bicaval standard view, where the crista terminalis (CT) defines the transition between the right atrium and the superior vena cava (SVC). In phase II the position of the CVC was TOE-guided corrected, so that the tip of the CVC was 1–2 cm above the crista terminalis. Changes in intra-atrial ECG were recorded. Differences of the position between phase 1 and 2 are expressed as mean with standard deviation.

**Results:** All CVC could be placed under ECG-guidance. In phase I the tip of the CVC could be seen  $3.2 \pm 1.0$  cm above the CT by TOE in 63 pts. In 137 pts the tip of the CVC could not be seen by TOE because the visible distance of the SVC cranial to the CT was  $>3.3 \pm 0.8$  cm. In phase II all CVC could be placed under TOE-guidance  $1.5 \pm 0.4$  cm cranial to the CT. For this the CVC had to be advanced  $2.7 \pm 1.4$  cm as compared to the position in phase I ( $P < 0.001$ ). In this position the IECG shows elevated p-wave in all pts.

**Conclusion:** Correct ECG-guided placement of CVC according to the recommendations of the manufactures of these devices resulted in more cranial positioning of the tip of the CVC in the SVC as compared by positioning with the help of TOE.

#### References:

- Koscielniak-Nielsen ZJ, Otkjaer S, Hansen OB, et al. CVP catheter electrocardiography: an alternative to radiographic control after cannulation of central veins? *Acta Anaesthesiol Scand* 1991; **35**: 762–766.
- Shanewise JS, Cheung AT, Aronson S, et al. ASE/SCA guidelines for performing a comprehensive intraoperative multiplane transoesophageal echocardiography examination. *Anesth Analg* 1999; **89**: 870–884.

## O-17

### Does flow propagational velocity reflect left ventricular diastolic function preload-independently?

H.D. Tschernich, N. Baumgartner, M. Haisjackl, M. Hiesmayr

Clinical Department of Cardiothoracic and Vascular Anaesthesia and Intensive Medicine, Medical University of Vienna, Vienna, Austria

**Introduction:** Left ventricular (LV) diastolic dysfunction (DD) has been recognized as the leading pathology in developing heart failure in over 30%. For

quantification, conventional echocardiographic diastolic parameters have been shown as preload dependent. Therefore they are not reliable for monitoring diastolic function during major load changes caused by medical treatment, during anaesthesia or surgical procedures. Recently flow propagational velocity ( $V_{prop}$ ) has been described as a parameter reflecting LV-compliance. Early studies suggested  $V_{prop}$  to be load independent [1]. The goal of the study was to evaluate preload-dependency of  $V_{prop}$  under conditions of lower body negative pressure (LBNP).

**Method:** Sixteen healthy volunteers were studied under different levels of LBNP (–20, –40, –80 mbar) in a randomized order. Baseline pressure levels (0 mbar) were applied in the beginning, in the end and in between each of the negative pressure levels. Duration of each level was 10 minutes and duration of one study case 70 minutes. The observer was blinded to the amount of LBNP. Haemodynamic measurements included heart rate and blood pressure. Echocardiographic measurements included mitral flow pattern (E, A, E/A, DT, IVRT, Adur),  $V_{prop}$ , and aortic valve (AV)-flow (VTI).

Statistical analysis was performed using ANOVA to compare the effects of treatment over time and multiple regression analysis to test the relationship of  $V_{prop}$  and VTI with  $P < 0.05$  to be statistically significant.

**Results:** No changes were found in overall haemodynamics over the time and load changes.  $V_{prop}$  decreased significantly with different levels of LBNP compared to baseline ( $P < 0.0001$ ) and from –40 to –80 mbar ( $P = 0.04$ ) (Fig. 1). VTI across the AV dropped significantly with different levels of LBNP.  $V_{prop}$  changes correlated significantly with decreasing VTI. (Fig. 2)

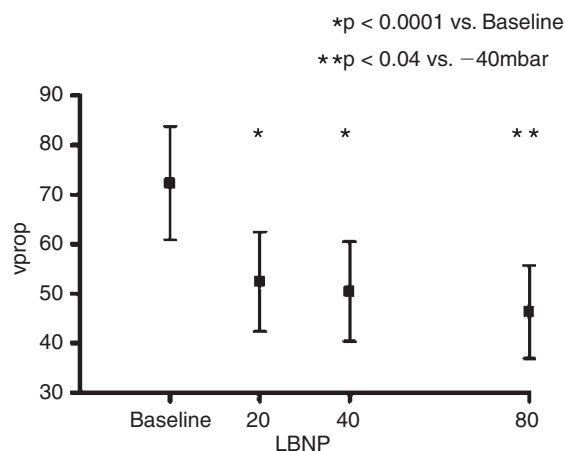


Figure 1.

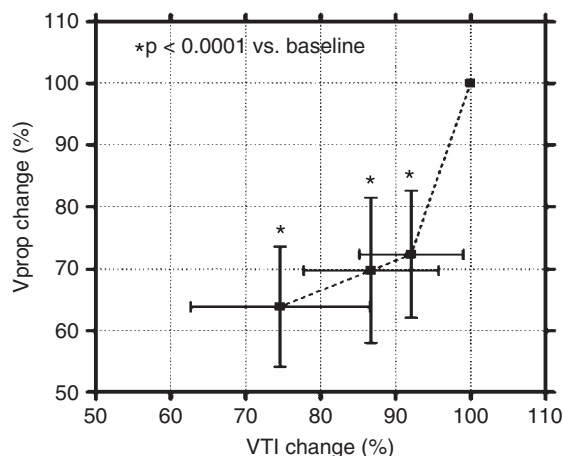


Figure 2.

**Conclusion:** As  $V_{prop}$  changed with different levels of LBNP it is considered to be a load dependent parameter of LV diastolic function.

#### Reference:

- Garcia MJ, Palac RT, Malenka DJ, et al. Color M-mode Doppler flow propagation velocity is a relatively preload-independent index of left ventricular filling. *J Am Soc Echocardiogr* 1999; **12**(2): 129–137.

## O-18

### Intra- and postoperative evaluation of echocardiographic findings in patients undergoing mitral valve repair

C. Mukherjee, D. Haentschel, D. Mueller, F.W. Mohr, J. Ender

Department of Anaesthesiology and Intensive Care Medicine, University Leipzig, Heartcenter; Clinic for Cardiac Surgery, University Leipzig, Heartcenter, Leipzig, Germany

**Introduction:** Evaluation of the cause and exact localisation of mitral valve dysfunction in patients undergoing mitral valve repair is essential, as well as intraoperative assessment of the surgical repair [1]. The aim of our study was to look for the agreement of intra- and postoperative findings in the clinical routine.

**Method:** For quality management purposes we compared intraoperative and postoperative echocardiographic findings on the basis of the echocardiographic protocols routinely used in our institution and the surgical evaluation in 50 pts undergoing minimal invasive mitral valve repair. We assessed for the agreement of the preoperative transoesophageal echocardiographic evaluation (Sonos 5500, Philips) of the valve and the performed surgical procedures using the Carpentier classification. Additionally we looked for residual mitral regurgitation and we also measured the mitral valve area. This was performed with TOE immediately after weaning from cardiopulmonary bypass and by transthoracic echocardiography at our echo lab. one day

before discharge from the hospital (8–10 days postoperative). For statistical purpose the Wilcoxon and Chi squared tests were used.

**Results:** In 88% of the pts there was a total agreement of the preoperative echocardiographic and intraoperative surgical evaluation. In 2 patients a prolapse of the A1 segment, in 1 pt a prolapse of the A2 segment, in 1 pt a prolapse of P2 and in another pt a prolapse of P3 were not seen in TOE as compared to the surgical findings. There was a mild underestimation of the residual mitral regurgitation (MR), which was not statistically significant: In 4 pts with no regurgitation on intraoperative TOE, a minimal regurgitation on TTE before discharge was seen. In 2 pts with minimal MR immediately after repair, a MR grade I on TTE was found at the echo lab. The measurement of the mitral valve area after repair were  $3.2 \text{ cm}^2 \pm 0.8 \text{ cm}^2$  on TOE versus  $3.4 \text{ cm}^2 \pm 0.7 \text{ cm}^2$  on TTE. There was no statistical significant deviation.

**Conclusion:** The method proposed by Lambert et al for evaluation of the mitral valve has a good validity in clinical routine practice as reflected by the findings of our study. Assessment of the residual mitral regurgitation as well as measurement of the mitral valve area immediately after weaning from bypass has a good correlation with the TTE findings at the echo lab before discharge of the patient.

#### Reference:

- Lambert AS, Miller JP, Merick SH. Improved evaluation of the location and mechanism of mitral valve regurgitation with a systematic transoesophageal echocardiography evaluation. *Anesth Analg* 1999; **88**: 1205–1212.

## Monitoring

## O-19

### The cardiac pump-vascular system coupling in patients undergoing CABG

A. Rossi, S.M. Romano, C. Sorbara, M. Chiostrì, A.A. Conti, G.F. Gensini

University Hospital Careggi, Firenze, Italy

**Introduction:** Left ventricular performance should be assessed by beat-to-beat systolic function, useful both as an index of contractility and of ventricular functional reserve. The Preload-Adjusted Peak Power (PAPP) is an index of contractile ventricular performance, based on the hydraulic concept of ventricular work and power generation. The Cardiac Cycle Efficiency (CCE) is obtained from objective analysis of the arterial waveform, and it reflects the interaction cardiac pump/arterial system. In this study we clinically analysed the PAPP, the CCE and the Ejection Fraction (EF) as indices of global ventricular function.

**Method:** 14 consecutive patients undergoing elective coronary artery bypass grafting (CABG) were studied during operation. All patients had preoperative EF > 35%, good cardiac valve function and no contraindication to transoesophageal echocardiography (TOE). The arterial transducer was connected to monitor PRAM (Pressure Record Analytical Method) to measure cardiac index (CI), stroke volume index (SVI) and CCE, by pressure wave analysis. TOEs were obtained using a Philips Sonos 5000 with a multiplane transoesophageal probe (Omniplane 5-MHz probe). PAPP was obtained by the product of peak systolic aortic pressure and peak velocity of the aortic blood flow. EF was estimated from end-diastolic and end-systolic area in the mid-papillary transgastric view. The parameters from PRAM and from TOE were recorded simultaneously, and performed during apnoea, after induction of anaesthesia, and after cardiopulmonary bypass (CPB). In 8 patients dobutamine  $2.5 \text{ mcg kg}^{-1} \text{ min}^{-1}$  was infused before CPB to assess ventricular reserve.

**Results:** All patients had a good outcome from operation, without inotropic and/or vasopressor drugs, and were discharged from intensive care in the first postoperative day. No significant difference was found between preoperative (pre) and postoperative (post) haemodynamic data. There was a good correlation PAPPpre vs. CCEpre ( $R^2$  0.80;  $P < 0.001$ ), and PAPPpre vs. EFpre ( $R^2$  0.92;  $P < 0.001$ ). The same good correlation was found for postoperative data between PAPPpost vs. CCEpost ( $R^2$  0.94;  $P < 0.001$ ), PAPPpost vs. EFpost ( $R^2$  0.90;  $P < 0.001$ ), PAPPpre vs. SVIpre ( $R^2$  0.90;  $P = 0.001$ ) and PAPPpost vs. SVIpost ( $R^2$  0.90;  $P = 0.001$ ). There was an improvement of PAPP value after infusion of dobutamine in all 8 patients where it was made, but the small sample did not allow statistical analysis in this preliminary study.

**Discussion:** PAPP, CCE and EF could be used during integrated monitoring to assess ventricular and ventricular-arterial performance in clinical practice. This is attractive because the new low-invasive monitoring system PRAM and TOE allow the on-line beat-to-beat assessment of these cardiac performance indices, so they could give a quick and specific diagnosis and permit an integrated treatment of the multiple aspects of cardiovascular performance.

## O-20

### Cardiac output measurement by two different pulse contour analysis devices in patients after off-pump coronary artery bypass grafting: preliminary results

C.K. Hofer, D. Button, A. Jacomet, R. Alpiger, A. Zollinger

Triemli City Hospital, Zurich, Switzerland

**Introduction:** Pulse contour analysis calibrated by transpulmonary thermodilution ( $PiCCO_{plus}$ , Pulsion Medical Systems, Munich, Germany) has shown to be a reliable alternative to the pulmonary artery catheter for cardiac output (CO) assessment [1]. A new pulse contour analysis device, which does not need an external calibration (*FloTrac/Vigileo*, Edwards Lifesciences, Irvine CA, USA) became available recently. The aim of this study was to compare CO determined by the *FloTrac sensor* (FCO) and by the  $PiCCO_{plus}$  system (PCO) with CO assessed by intermittent thermodilution (ICO).

**Method:** Patients after off-pump coronary artery bypass grafting were studied in the ICU. For one set of data (**A** = "haemodynamic stable") CO was assessed following haemodynamic stabilization and calibration of the  $PiCCO_{plus}$ . Triplicate FCO and PCO values were recorded within 3 min before ICO was determined by 3 repeated injections at 4 time points with intervals of 15 min. For the second set of data (**B** = "haemodynamic changes") FCO, PCO and ICO measurements were recorded 15 min after inducing CO changes by different body positions (supine, 30° head-up, 30° head-down, supine). ANOVA and Bland-Altman analysis for absolute CO values and % changes ( $\Delta$ ) of CO during **A** and **B** were calculated.  $P < 0.05$  was considered statistically significant.

**Results:** 72 matched sets of data were obtained from 9 patients. CO values recorded during **A** ranged from 3.30 to  $6.56 \text{ L min}^{-1}$ , no significant CO changes between measurement points were recorded ( $\Delta\text{FCO} = -0.8 \pm 14.8\%$ ,  $\Delta\text{PCO} = -0.9 \pm 15.3\%$ ,  $\Delta\text{ICO} = -1.9 \pm 12.8\%$ ). Bland-Altman analysis revealed a mean bias  $\pm 2\text{SD}$  (limits of agreement) of  $-0.13 \pm 1.08 \text{ L min}^{-1}$  for FCO-ICO and of  $0.08 \pm 0.91 \text{ L min}^{-1}$  for PCO-ICO. Differences of  $\Delta\text{CO}$  were comparable (mean bias  $\pm 2\text{SD} = 1.1 \pm 24.8\%$  for  $\Delta\text{FCO}-\Delta\text{ICO}$  and  $1.0 \pm 24.8\%$  for  $\Delta\text{PCO}-\Delta\text{ICO}$ ). A range of CO values from 2.85 to  $8.60 \text{ L min}^{-1}$  were obtained during **B** with significant CO changes between the measurement points (table).

* $P < 0.05$	30° head-up	30° head-down	supine
$\Delta\text{FCO}$	$-22.1 \pm 24.8\%^*$	$+30.2 \pm 17.1\%^*$	$-20.8 \pm 18.0\%^*$
$\Delta\text{PCO}$	$-12.0 \pm 7.3\%^*$	$+17.5 \pm 4.4\%^*$	$-10.8 \pm 2.3\%^*$
$\Delta\text{ICO}$	$-12.6 \pm 8.0\%^*$	$+20.3 \pm 6.7\%^*$	$-13.9 \pm 4.8\%^*$

Mean bias  $\pm 2\text{SD}$  was  $-0.14 \pm 1.82 \text{ L min}^{-1}$  for FCO-ICO and  $-0.17 \pm 1.13 \text{ L min}^{-1}$  for PCO-ICO. Mean bias  $\pm 2\text{SD}$  was  $-2.8 \pm 36.4\%$  for  $\Delta\text{FCO}-\Delta\text{ICO}$  and  $0.9 \pm 13.2\%$  for  $\Delta\text{PCO}-\Delta\text{ICO}$ .

**Conclusions:** These preliminary results indicate that CO in the patients investigated so far can be reliably monitored by both tested pulse contour analysis devices (*FloTrac* and *PiCCO<sub>plus</sub>* system) during stable haemodynamic conditions. The *FloTrac* system showed a tendency to overestimate rapid CO decreases and increases when compared to the *PiCCO<sub>plus</sub>* system.

**Reference:**

- 1 Felbinger TW, Reuter DA, Eltzhig HK, et al. Cardiac index measurements during rapid preload changes: a comparison of pulmonary artery thermodilution with arterial pulse contour analysis. *J Clin Anesth* 2005; **17**: 241–248.

## O-21

### Fluid-responsiveness assessment in OPCAB surgery: a comparison between LiDCO, TOE and PAC modified

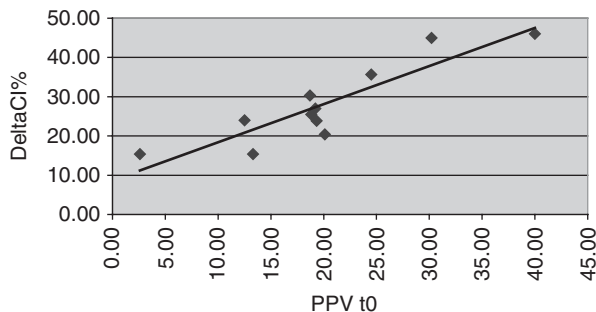
L. Belloni, A. Pisano, A. Natale, G. Ismeno, L. Piazza, G. De Martino

*Cardiac Anaesthesia and ICU, Cardiac Surgery, "S. Sebastian" Hospital, Caserta; Department of Anaesthesiology "Federico II" University of Naples, Naples; South Italy Campania, Italy*

**Introduction:** The use of an adequate monitoring system is the primary goal to maintain haemodynamic stability during OPCAB surgery. Early control of volume and catecholamine regimens avoids deterioration of the cardiac pump function. The aim of the study was to verify the reliability of markers of fluid-responsiveness.

**Method:** With informed consent and approval by the ethics committee, 19 patients with a preoperative EF > 30% ( $53\% \pm 5.1$ ) were monitored. PAC parameters (CVP, MPAP, PCWP, CI), LiDCO parameters ( $DO_2$ , CO, CI, SV, SVR, PPV, SVV, SPV) and TOE [1] parameters (LVEDA, LVEDV, LVESV, RVEDA,  $\Delta VAo$ ) were measured before (t0) and after (t1) a fluid challenge with 7 mL/Kg of HES, 20 minutes after induction of anaesthesia, before sternotomy and without inotrope infusion. SPSS version with Fisher's-test for correlation and regression analysis was used for statistical analysis. All data are expressed as mean value and standard deviation.

**Results:** Two groups of patients were identified: the responders (Re:  $\Delta CI\% > 15\%$ ) after the challenge (t1), and the non-responders (nRe). Mean PPV at t0 was 19.93 (Re) vs. 8.49 (nRe) ( $P = 0.006$ ) and mean SVV (t0) was 18.61 (Re) vs. 8.96 (nRe) ( $P = 0.0$ ). No statistical significance was shown in the two groups for SPV, LVEDA and LVEDV. Mean  $\Delta VAo$  was lower in group Re (16.55) than in group nRe (18.11), without statistical significance. Within the group of Re correlation index (r) between  $\Delta CI\%$  and the different markers was calculated: PPV ( $r = 0.896$ ;  $p = 0.0001$ ; see figure), SVV ( $r = 0.779$ ;  $P = 0.0002$ ), SPV ( $r = 0.818$ ), LVEDA ( $r = -0.834$ ), LVEDV ( $r = -0.712$ ), LVESV ( $r = -0.656$ ),  $\Delta VAo$  ( $r = 0.391$ ;  $P = ns$ ). An r of 0.793 was observed between  $\Delta CI\%$  and PPV, an r of 0.809 for SVV and an r of 0.766 for SPV within all 19 patient. No correlation between CVP and PCWP (Re  $12.8 \pm 2.2$ ; nRe  $11.4 \pm 2.8$ ) was found.



**Discussion:** Dynamic parameters by LiDCO are highly sensitive for assessment of intravascular volume status before and during the displacement of the heart during OPCAB surgery. No significant correlation between  $\Delta VAo$ (TOE) and  $\Delta CI\%$  was found, probably due to the source of error (strongly operator dependant).

**Reference:**

- 1 Feissel M, Michard F, Mangin, Ruger O, Faller J-P, Teboul J-L. Respiratory changes in aortic blood velocity as an indicator of fluid responsiveness in ventilated patients with septic shock. *Chest* 2001; **119**: 867–873.

## O-22

### Transcutaneous PCO<sub>2</sub>/SpO<sub>2</sub> measurements with a digital ear sensor in adult patients after cardiac surgery

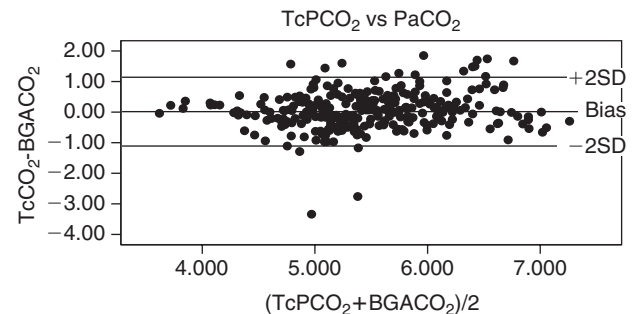
W. Baulig, P. Schütt, E.R. Schmid

*Division of Cardiac Anaesthesia, University Hospital, Zurich, Switzerland*

**Introduction:** Recently, the first digital ear sensor for continuous and combined transcutaneous assessment of oxygen saturation (SpO<sub>2</sub>) and carbon dioxide tension (TcPCO<sub>2</sub>) has been introduced (V-Sign™, SenTec) [1]. The goal of this study was to validate this sensor in adult patients after cardiac surgery.

**Method:** With ethical committee approval and written informed patient consent, 21 patients were enrolled. Simultaneous measurements with the V-Sign™ sensor, a Nellcor Durasensor (Model DS-100A) for the opposite ear lobe and a Nellcor Durasensor (Model DS-100A) with a finger clip were compared with blood gas analyses, first during hyper-, normo- and hypocapnoea and at different pulse rates (PR) using a pacemaker, and then two hourly up to 8 hours. Agreement was assessed by Bland-Altman analysis.

**Results:** Regarding TcPCO<sub>2</sub> data, 3 patients had to be excluded because of calibration failure of the device. TcPCO<sub>2</sub> (median [range]) was 5.49 [3.3–7.6] kPa and PaCO<sub>2</sub> 5.4 [3.6–7.4] kPa. Corresponding mean (SD) bias was +0.05 ( $\pm 0.62$ ) kPa, the limits of agreement (2SD) were  $-1.2$  and  $+1.3$  kPa (fig. 1). During normo- and hypoventilation, TcPCO<sub>2</sub> agreed well with PaCO<sub>2</sub>; mean (SD) bias was +0.02 and +0.04 kPa, limits of agreement were  $-0.67/+0.69$  and  $-0.81/+0.88$  kPa, respectively. In 10 patients an initial overshoot of TcPaCO<sub>2</sub> was observed. The mean (SD) bias of SpO<sub>2</sub> and PR was close to zero ( $-1.5\%$  and  $+0.001$  bpm), but the limits of agreement were  $-21.4/+18.4\%$  and  $-22.3/+22.3$  bpm.



**Figure 1.** Agreement between TcPCO<sub>2</sub> and PaCO<sub>2</sub> in 18 patients (273 data pairs)

**Discussion:** TcPCO<sub>2</sub> measured by the V-Sign™ sensor showed only a moderate agreement with PaCO<sub>2</sub>. Detection of PR and SpO<sub>2</sub> was poor. Additional efforts are necessary to eliminate calibration failures and the initial overshoot of TcPCO<sub>2</sub>, as well as to improve detection of SpO<sub>2</sub> and PR.

**Reference:**

- 1 Kocher S, Rohling R, Tschupp A. Performance of a digital PCO<sub>2</sub>/SpO<sub>2</sub> ear sensor. *J Clin Monit Comput* 2004; **18**: 75–79.

## Cardiopulmonary Bypass

## O-23

### Comparison of minimally invasive closed circuit versus standard extracorporeal circulation for aortic valve replacement: safety profile and clinical results

F. Pappalardo, A. Franco, A. Castiglioni, N. Colangelo, A. Zangrillo

*Departments of Cardiovascular Anesthesia, Department of Cardiac Surgery, Perfusion Service, San Raffaele Hospital, Milan, Italy*

**Introduction:** The aim was to evaluate the safety and clinical results of aortic valve replacement performed with a minimally invasive, closed circuit extracorporeal circulation technique (MECC system) compared to standard cardiopulmonary bypass.

**Method:** Forty consecutive patients undergoing isolated aortic valve replacement at a single institution were randomly assigned to either a miniaturized closed circuit CPB with the Maquet-Cardiopulmonary MECC System® (Study group, n = 17) or to a standard cardiopulmonary bypass (Control



group,  $n = 23$ ). The MECC system is a low priming circuit with no blood-air interface. The technical feasibility, with particular care to the potential entry of air in the circuit, and the clinical results were prospectively evaluated.

**Results:** Demographic characteristics and operative data were similar in the two groups. Patients in the study group showed lower chest tube drainage ( $217 \pm 62$  mL vs.  $420 \pm 219$  mL,  $P < 0.05$ ) and need for blood products (5.1% vs. 43.4%,  $P < 0.02$ ) than patients in the control group. Moreover, the time course of haematocrit showed a significantly higher value at all time points during operation and hospital stay in the study group ( $P < 0.02$ ). Similarly, platelet count at ICU arrival was significantly higher in the study group ( $140 \pm 29 \times 10^9 \text{ L}^{-1}$  vs.  $119 \pm 37 \times 10^9 \text{ L}^{-1}$ ,  $P < 0.05$ ). Peak postoperative cTroponin I release was significantly lower in the study group ( $4.74 \pm 2.82$  vs.  $8.43 \pm 6.25$  ng/dL,  $P = 0.033$ ). There was a major neurological event on the fourth postoperative day in one patient operated with the MECC system which might have been secondary to severe aortic calcification.

**Conclusion:** The MECC system is suitable for aortic valve replacement and provides better clinical results in terms of need for blood products, platelets consumption and myocardial damage as compared to standard cardiopulmonary bypass.

## O-24

### Anaerobic metabolism during cardiopulmonary bypass: the predictive value of carbon dioxide – derived parameters

M. Ranucci, G. Isgrò, F. Romitti, S. Mele, B. Biagioli, P. Giomarelli  
Policlinico S. Donato, Milan, and University of Siena, Italy

**Introduction:** Hyperlactataemia during cardiopulmonary bypass (CPB) is a common event and is associated with a high morbidity and mortality following cardiac operations [1–3]. The present study is aimed at identifying the possible predictors of hyperlactataemia during CPB amongst a series of oxygen and carbon dioxide derived parameters measured during CPB.

**Method:** A prospective observational study was made on 54 patients undergoing cardiac surgery with CPB. Hyperlactataemia was defined as an arterial lactate concentration higher than  $3 \text{ mmol L}^{-1}$ . Serial blood lactate assays have been performed during CPB, and their association with a number of oxygen and carbon dioxide derived parameters was explored with a univariate analysis (Student's  $t$  test or Pearson chi-squared when appropriate). The predictive ability of the variables being associated with hyperlactataemia was explored using a receiver operating characteristic analysis.

**Results:** Arterial blood lactate concentration was positively correlated to the CPB duration, the carbon dioxide elimination, the respiratory quotient, and negatively correlated to the presence of aortic cross-clamping, body surface area, ratio between the oxygen delivery and carbon dioxide production, and the arterial oxygen saturation. Predictors of hyperlactataemia during CPB were a carbon dioxide production higher than  $60 \text{ mL min}^{-1} \text{ m}^{-2}$ , (sensitivity 76%, specificity 71%,  $P < 0.001$ ), a respiratory quotient higher than 0.9, (sensitivity 76%, specificity 77%,  $P < 0.001$ ), and a ratio between oxygen delivery and carbon dioxide production lower than 5 (sensitivity 79%, specificity 74%,  $P < 0.001$ ).

**Discussion:** Carbon dioxide derived parameters are representative of hyperlactataemia during CPB as a result of the carbon dioxide produced under anaerobic conditions through the buffering of protons by the bicarbonate system. The carbon dioxide elimination rate measured at the exhaled site of the oxygenator may be used for an indirect assessment of the metabolic state of the patient.

#### References:

- Maillet JM, Le Besnerais P, Cantoni M, et al. Frequency, risk factors, and outcome of hyperlactataemia after cardiac surgery. *Chest* 2003; **123**: 1361–1366.
- Demers P, Elkouri S, Martineau R, et al. Outcome with high blood lactate levels during cardiopulmonary bypass in adult cardiac operation. *Ann Thorac Surg* 2000; **70**: 2082–2086.
- Boldt J, Piper S, Murray P, et al. Case 2-1999. Severe lactic acidosis after cardiac surgery: sign of perfusion deficits. *J Cardiothorac Vasc Anesth* 1999; **13**: 220–224.

## O-25

### An unusual case of metabolic acidosis and hyperkalaemia during cardiopulmonary bypass: case report

A. Banu, C. Bilge, K. Meral, E. Yalcin, O. Murat, Y. Mustafa, A. Ulku  
Hacettepe University Medical Faculty Anaesthesiology and Reanimation, Ankara, Turkey; Hacettepe University Medical Faculty Thoracic and Cardiovascular Surgery, Ankara, Turkey

The development of metabolic acidosis and hyperkalaemia during cardiopulmonary bypass (CPB) is well recognized but poorly understood. It is believed to be the result of hypoperfusion, but it appears to be iatrogenic in nature. After CPB without problems, the acid base imbalance returns to normal limits

by itself or by intervention. We report an unusual case, with hyperkalaemia and metabolic acidosis resistant to all types of treatment.

**Case report:** A 70 year old man who had undergone aorta-bifemoral bypass operation 10 years ago, was scheduled for coronary artery bypass grafting due to acute coronary syndrome. In the morning of operation day, coronary angiography was performed via the right brachial artery. (LMCA occlusion 99%, LAD 70%, RCA 60%). The acid-base and ion balance were all within normal limits at the beginning of CPB which lasted 87 minutes, with a cross-clamp time of 42 minutes. During rewarming, the invasive arterial pressure monitor connected to the right radial artery failed to read because of damping so the right femoral artery was cannulated through the vascular prosthetic graft.

Towards the end of CPB metabolic acidosis and hyperkalaemia were detected, resistant to all interventions and it was not possible to wean from CPB. We decided to perform haemodialysis which lasted 2 hours until closure of the thorax after which we discovered that the right upper extremity was extremely swollen and cyanotic. The right brachial artery was explored through an antecubital incision and bleeding from the catheterization site was repaired with suture. Fasciotomy was performed which resulted in a decrease of potassium and normal acid-base balance. But due to the prolonged CPB time ( $87 + 570$  min and cross-clamp time of  $42 + 37$  min) lactate levels was found to be increased. With the aid of high dose inotropes and intra-aortic balloon pump, the patient was weaned from CPB and transferred to the ICU. Unfortunately, he died 8 hours after operation.

**Discussion:** Potential causes of hyperkalaemia and acidaemia during CPB to be considered are haemolysis, tissue ischaemia, necrosis, and high  $\text{K}^+$  solutions. In our patient; acid-base and potassium imbalances were due to tissue ischaemia and necrosis of the right upper extremity due to compartment syndrome caused by brachial artery laceration, aggravated with heparin.

**Conclusion:** As realized in our patient, the cause of acid-base imbalance and hyperkalaemia is usually iatrogenic. In order to prevent these problems it is necessary to control the previous intervention site.

#### Reference:

- Casaletto JJ. Differential diagnosis of metabolic acidosis. *Emerg Med Clin North Am* 2005; **23**(3): 771–787. Review.

## O-26

### Does off-pump coronary artery bypass reduce the inflammatory response and oxygenation compared with on-pump coronary artery bypass? A randomized trial

B.S. Rasmussen, H. Laugesen, S.E. Rees, E. Toft, E. Tønnesen  
Aalborg Hospital, Aarhus University and Aalborg University, Aalborg, Denmark

**Introduction:** The immune response and postoperative organ dysfunction are probably influenced by the use of cardiopulmonary bypass (CPB). An inflammatory response of the lungs after CPB has been described [1]. The aim of the study was to evaluate the effect of CPB on the systemic and pulmonary cytokine response as well as on postoperative oxygenation.

**Method:** Thirty-two patients scheduled for coronary artery bypass grafting were randomly assigned to either off-pump or on-pump surgery. The systemic cytokine response were measured in the radial artery (RA) the day before operation, at closure of sternum, 4, 16 and 44 h later. The cytokine response was simultaneously measured in the pulmonary artery (PA) at closure of sternum, 4 and 16 h later. Two parameters of oxygenation, shunt (%) and ventilation-perfusions mismatch described by  $\Delta\text{P}\text{O}_2$  (kPa), were estimated the day before operation, 4 h, day 3 and 5 after surgery. Analysis of variance (ANOVA) was used to test the significance of differences between the two groups.

**Results:** The systemic inflammatory response was significantly different between the groups with a higher level of IL-10 ( $P = 0.003$ ) and IL-8 ( $P = 0.001$ ) after on-pump surgery. There was no difference between the groups in IL-6, IL-1beta, TNF-alpha and IFN-gamma response. The ratio of pulmonary arterial to radial arterial concentration (PA/RA) showed a significant difference between the groups for IL-10 ( $P = 0.01$ ), IL-8 ( $P = 0.0003$ ) and IL-6 ( $P = 0.004$ ). Radial arterial blood is assumed to be representative for pulmonary venous blood as all patients were circulation stable at all measurements. After off-pump surgery the PA/RA ratio was  $>1.0$ , whereas the PA/RA ratio was lower after on-pump surgery. Shunt fraction was significantly higher after off-pump surgery ( $P = 0.005$ ). Changes in  $\Delta\text{P}\text{O}_2$  were equal in the two groups ( $P = 0.36$ ). There was no correlation between immune response and oxygenation.

**Discussion:** Off-pump as well as on-pump surgery induces a systemic cytokine response with marked differences. The cytokine response of the lungs showed evidence of consumption of cytokines after off-pump surgery contrary to no change or a production of cytokines after on-pump surgery. An unrelated change in oxygenation was seen in both groups. Therefore,

CPB in itself is not solely responsible for the immune reaction and oxygen impairment after cardiac surgery. The pulmonary cytokine response and the increased shunt fraction after off-pump surgery might be explained by local tissue injury, which could be due to direct trauma to the ventilated lung during the surgical procedure.

#### Reference

- 1 Massoudy P, Zahler S, Becker BF, et al. Evidence for inflammatory responses of the lungs during coronary artery bypass grafting with cardiopulmonary bypass. *Chest* 2001; **119**: 31–36.

## O-27

### Is deep hypothermia necessary during circulatory arrest?

A. Levit, T. Buldakova, Y. Petrishchev, O. Korin, K. Nikitin

Regional Hospital 1, Ekaterinburg, Russia

**Introduction:** The main task facing the anaesthesiologist is prevention of ischaemic neurological damage during circulatory arrest in aortic arch surgery. Conventional deep hypothermic circulatory arrest has some disadvantages that considerably limit its application. The purpose of the present paper is to analyse the necessity of applying deep hypothermia during continuous retrograde cerebral perfusion (CRCP) for brain protection in case of circulatory arrest.

**Method:** After approval of the Hospital Ethical Committee 11 patients undergoing surgery in 2004–2005 were included in the research. All the male patients aged 41–67 yr (average 50.4) underwent H. Borst surgery performed by the same team of surgeons. A standard anaesthesia procedure was used. CPB was performed with  $\alpha$ -stat management and a constant cold (10°C) blood retrograde cardioplegia. To protect the brain during circulatory arrest a continuous retrograde cerebral perfusion (17.5°C) of 350 ± 25 mL/min

via the superior vena cava by means of a separate roller pump equipped with an extra heat exchanger, was used. The criteria of adequacy of cerebral perfusion were the parameters of blood flow velocity along the middle cerebral artery with transcranial Doppler and the pressure in the superior vena cava. We used standard haemodynamic monitoring during the procedure. The cerebral metabolic rates of oxygen uptake and lactate production were evaluated. The patient's mental status was examined before and after surgery.

The patients were divided into 2 groups. In Group A (5 pts) the rectal temperature during the circulatory arrest was 20.0 ± 0.5°C, in Group B (6 pts) it was 26.0 ± 0.5°C.

#### Results:

	Group A	Group B
CPB time, min	255 ± 18	200 ± 25
CRCP time, min	31 ± 10	32 ± 9
Mechanical ventilation (MV) time, h	48 ± 6	20 ± 4
Length of stay in ICU (LOS), h	100 ± 8	44 ± 4

With the same duration of cerebral perfusion, the duration of MV and LOS in ICU in Group A was significantly ( $P = 0.0001$ ) longer than in Group B. When discharged from ICU none of the patients showed neurological complications, although the recovery period with Group A patients was longer. There were no strokes, seizures, or hospital deaths.

**Conclusion:** The adequacy of retrograde cerebral perfusion is considered to be cerebral blood-flow velocity along the middle cerebral artery within 18–25 mm/sec and superior vena cava pressure not lower than 26 mm Hg. According to our not very long experience, cerebral perfusion plays a dominant role in brain protection.

## Myocardial Protection/Drugs

## O-28

### Transmyocardial release of CK-MB and troponin I during off-pump coronary artery surgery

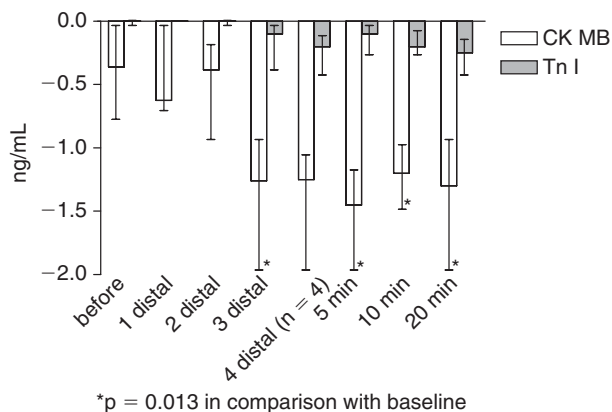
I. Karu, T.A. Sulling, M. Alver, R. Loit

Clinic of Anesthesiology; Center of Cardiac Surgery, North Estonia Regional Hospital, Tallinn, Estonia; Clinic of Anesthesiology and Intensive Care, University of Tartu, Tartu, Estonia

**Introduction:** Myocardial injury can be assessed by release of troponin I (TnI) and creatine kinase MB isoenzyme (CK-MB). Concentrations of TnI have prognostic value for morbidity and mortality [1] and duration of lactate release predicts low cardiac output syndrome after cardiac surgery [2]. The aim of the study was to evaluate myocardial injury during revascularization on the beating heart (OPCAB).

**Method:** 8 patients underwent OPCAB with construction of 3–4 distal anastomoses. Intracoronary shunts were used in all cases. Blood for TnI, CK-MB mass and lactate was simultaneously sampled from radial artery and coronary sinus (CS) cannulae before starting the grafting, 1 minute after restoration of blood flow to each grafted artery and at 5, 10 and 20 minutes after completion of the last anastomosis. Arterial-CS differences were calculated.

**Results:** Release of Tn I and CK MB is shown on the figure (median, interquartile range).



Release of lactate was maximal after the 4th distal anastomosis [–0.21(–0.37–0.05) mmol/L], and was not detectable by the 10th reperfusion minute.

**Discussion:** OPCAB surgery is associated with temporary development of anaerobic metabolism and minor irreversible myocardial injury, although coronary blood flow is not interrupted during the procedure.

#### References:

- 1 Fellahi JL, Gue X, Richomme X, et al. Short- and long-term prognostic value of post-operative cardiac troponin I in patients undergoing CABG. *Anesthesiology* 2003; **99**: 270–274.
- 2 Rao V, Ivanov J, Weisel RD, et al. Lactate release during reperfusion predicts low cardiac output syndrome after coronary bypass surgery. *Ann Thorac Surg* 2001; **71**: 1925–1930.

## O-29

### In vivo monitoring of myocardial tissue metabolism during surgical emergency revascularization

J. Pöling<sup>1</sup>, W. Rees<sup>1</sup>, S. Klaus<sup>3</sup>, L. Bahlmann<sup>3</sup>, V. Ziaukas<sup>1</sup>, V. Mantovani<sup>2</sup>, H. Warnecke<sup>1</sup>

<sup>1</sup>Department of Cardiac Surgery, Schüchtermann-Klinik Bad Rothenfelde,

<sup>2</sup>Department of Cardiac Surgery, University of Insubria-Varese,

<sup>3</sup>Department of Anesthesiology, Medical University of Lübeck

**Introduction:** Microdialysis allows the in vivo biochemical analysis of interstitial fluids [1–3]. During and after open emergency revascularization in four patients with acute myocardial infarction and complicating haemodynamic instability we assessed the dynamic changes of the myocardial tissue metabolism (group 1; n = 4).

**Method:** A microdialysis catheter was placed into the area of infarction. Lactate and glucose were analysed at time intervals before, during and up to 6 hours after cardiopulmonary bypass (CPB). Glucose-lactate-ratio (GLR) was calculated as an indirect marker of tissue hypoxia. The data were compared with those from patients undergoing elective CABG procedures (group 2; n = 10).

**Results:** The postoperative course in all patients was uneventful. During CPB the GLR in group 1 initially was low and did not change significantly (0.6 ± 0.1 vs. 0.5 ± 0.09). The GLR in group 2 started with significant higher values (2.6 ± 0.6 vs. 0.6 ± 0.1,  $P < 0.05$ ), which then declined until the end of clamping (0.7 ± 0.1). Thereafter both groups showed a similar course, with an increase of the GLR.

**Discussion:** Myocardial GLR in patients with infarction showed different values compared to the elective CABG patients with a compensated myocardial tissue metabolism. The emergency patients started with a low GLR at the beginning of the procedure with an initial hypoxic tissue metabolism. During reperfusion in both groups a fast recompensation to a normal metabolic state was observed. Myocardial microdialysis is feasible and could be an interesting tool to observe the effect of CABG on myocardial tissue over time. More studies should be performed to gain more data.

## References:

- 1 Kennergren C, Mantovani V, Strindberg L, et al. Myocardial interstitial glucose and lactate before, during and after cardioplegic heart arrest. *Am J Physiol Endocrinol Metab* 2003; **284**: E788–794.
- 2 Bahlmann L, Misfeld M, Klaus S, et al. Myocardial redox state during coronary artery bypass grafting assessed with microdialysis. *Intensive Care Med* 2004; **30**(5): 889–894.
- 3 Fink MP. Bench-to-bedside review: Cytotoxic hypoxia. *Crit Care* 2002; **6**: 491–499.

## O-30

### Myocardial tissue microdialysis during and after coronary artery revascularization in patients with low left ventricular ejection fraction

J. Pöling<sup>1</sup>, W. Rees<sup>1</sup>, L. Bahlmann<sup>3</sup>, S. Klaus<sup>3</sup>, V. Mantovani<sup>4</sup>, S. Röthemeyer<sup>2</sup>, H. Warnecke<sup>1</sup>

<sup>1</sup>Department of Cardiac Surgery, Schüchtermann-Klinik Bad Rothenfelde;

<sup>2</sup>Department of Cardiology, Schüchtermann-Klinik Bad Rothenfelde;

<sup>3</sup>Department of Anesthesiology, Medical University of Lübeck; <sup>4</sup>Department of Cardiac Surgery, University of Insubria-Varese

**Introduction:** Microdialysis allows the biochemical analysis of interstitial fluids [1]. We investigate the dynamic changes of myocardial metabolism from patients with ischaemic heart disease and with low left ventricular ejection fraction (EF < 40%).

**Method:** In 30 patients undergoing coronary artery bypass grafting a microdialysis catheter was inserted in the left heart in an area of abnormal ventricular contraction, which was identified by contrast MRI. A second catheter was placed in the normal tissue of the right ventricle. Microdialysis measurements were performed at time intervals before, during and 24 hours after cardiopulmonary bypass (CPB). Microdialysis samples were analysed for lactate and pyruvate.

**Results:** The microdialysis catheters were placed without any complications such as bleeding, infections, arrhythmias, etc. Clinically and enzymatically none of the patients showed signs of a perioperative myocardial infarction. During aortic cross clamping the myocardial lactate-pyruvate-ratio (LPR) increased significantly in the ischaemic region of the left heart from initially  $28 \pm 11$  to  $66 \pm 21$  ( $P < 0.05$ ) until the end of CPB, while the ratio in the right ventricle only rose from  $24 \pm 8$  to  $35 \pm 16$ . After CPB the LPR in both areas decreased to normal range. Plasma LPR showed no essential changes during the whole examination.

**Discussion:** It was possible to reveal data about the metabolic changes of the myocardium during and after CPB by bedside monitoring. Microdialysis results were concordant to MRI results. The ischaemic areas of the left myocardium showed a different metabolic course compared to the normal tissue of the right ventricle. During CPB in both groups we observed signs of poor tissue oxygenation. More studies should be performed to evaluate the technique of microdialysis in monitoring myocardial tissue metabolism during open CABG.

## Reference:

- 1 Ungerstedt U. Microdialysis – principles and applications for studies in animals and man. *J Intern Med* 1991; **230**: 365–373. Review.

## O-31

### Levosimendan to treat severe heart failure in patients undergoing CABG surgery

M. Di Nardo, C. Cariello, A. Danella, C. Vullo, M. Stefani, L. Doroni, R. Baldassarri, A. Boldrini, C. Pasquini, F. Guarracino

Cardiothoracic Anaesthesia & ICU, University Hospital, Pisa, Italy

**Introduction:** Levosimendan is a troponin calcium sensitizer that enhances myocardial contractility and induces venous, arterial and coronary vasodilatation. We compared levosimendan with standard inotropic treatment in patients with severely depressed left ventricles undergoing CABG.

**Method:** Thirty patients (ASA 3–4, age:  $60 \pm 6$  yr, mean EF  $26 \pm 1\%$ ) undergoing CABG were enrolled in this study. Pre-operatively all patients showed a diastolic dysfunction by transthoracic echocardiography (TTE) with mitral pulsed-wave Doppler E/A ratio  $2.2 \pm 0.4$ , decelerating time (DT)  $128 \pm 5$  sec and mitral flow propagation velocity (Vp)  $37 \pm 3$  cm/sec. Haemodynamic parameters were taken after anaesthetic induction (T0) in stable haemodynamic conditions, and then every hour after weaning from cardiopulmonary bypass (CPB) for the first 24 hours, then twice daily until 2nd p.o. day (T1). After the first haemodynamic recordings pts were randomized to receive levosimendan infusion ( $0.1 \mu\text{g}^{-1} \text{kg}^{-1} \text{min}^{-1}$  for 24 hours) or dopamine 5 to  $10 \mu\text{g}^{-1} \text{kg}^{-1} \text{min}^{-1}$ . All the following variables were measured: HR, MAP, CVP, CO, PCWP, SVR, SVO<sub>2</sub>, and SV by a Swan-Ganz catheter. Transoesophageal echocardiography (TOE) was performed during surgery. TTE was performed every 24 h during ICU stay. The paired-samples t-test was used to compare

variables measured before and after treatment. The same operator performed TOE and TTE.

**Results:** As shown in the Table.

	T0 Levo n = 15	T1 Levo infusion	T0 Dopa n = 15	T1 Dopa infusion
MAP	$77 \pm 3$	$70 \pm 4$	$75 \pm 2$	$60 \pm 2$
CO	$2.9 \pm 0.3$	$3.8 \pm 0.2$	$2.89 \pm 0.4$	$3.1 \pm 0.2$
PCWP	$23 \pm 1$	$18 \pm 1.5$	$22 \pm 2$	$20 \pm 0.2$
SVO <sub>2</sub>	$61 \pm 1.5$	$70 \pm 2$	$62 \pm 1$	$67 \pm 1$
HR	$75 \pm 4$	$82 \pm 3$	$74 \pm 3$	$85 \pm 5$
SV	$38 \pm 3$	$47 \pm 3$	$36 \pm 3$	$40 \pm 0.5$
	pre-op. TTE	postop TEE	pre-op. TTE	postop TEE
E/A	$2.1 \pm 0.5$	$1 \pm 0.5$	$2.2 \pm 0.5$	$1.7 \pm$
DT	$120 \pm 5$	$140 \pm 4$	$122 \pm 3$	$130 \pm 4$
Vp	$27 \pm 5$	$40 \pm 3$	$26 \pm 6$	$32 \pm 2$
EF%	$25 \pm 1$	$30 \pm 1.3$	$24 \pm 2$	$26 \pm 0.5$

Levosimendan treated pts showed a better haemodynamic response, with improvement of systolic and diastolic parameters, in comparison with standard treatment.

**Conclusion:** Perioperative Levosimendan infusion seems to improve both systolic and diastolic heart function in pts with preoperative severely depressed EF. This effect is more effective than dopamine one.

## Reference:

- 1 Cavana M, Pignataro C, Fraticelli A, Mebazaa A. The clinical experience with levosimendan in anaesthesiology and in the intensive care unit. *Ital Heart J* 2003; **4** (Suppl2): 61s–64s. Review.

## O-32

### Effects of levosimendan on myocardial ischaemia-reperfusion injury via activation of KATP channels in rats

D. Yapici, Z. Altunkan, M. Ozeren, E. Bilgin, E. Balli, L. Tamer, N. Doruk, H. Birbicer, D. Apa, U. Oral

Department of Anaesthesiology, Mersin University Medical Faculty, Cardiovascular Surgery, Histology, Biochemistry and Pathology, Mersin, Turkey

**Introduction:** Levosimendan is a new positive inotropic drug that has a dual mechanism of action, increasing myocardial contractility and inducing coronary and systemic vasodilatation via activation of adenosine triphosphate – regulated potassium KATP channels. The aim of this study was to evaluate the efficacy of levosimendan when added to the Krebs-Henseleit Buffer (KHB) solution, on myocardial ischaemia-reperfusion injury after hypothermic cardioplegic arrest.

**Method:** Twenty-one Wistar rats were randomly divided into three groups ( $n = 7$  each). The hearts were quickly excised, the aorta cannulated and the hearts then mounted on a Langendorff perfusion system. The coronary circulation was started by retrograde aortic perfusion using KHB solution at a flow rate of  $10 \text{ mL kg}^{-1} \text{ min}^{-1}$ ,  $37^\circ\text{C}$  and  $40 \text{ mmHg}$  for 15 min in all groups. Control hearts (group 1) received no further treatment. Levosimendan ( $24 \text{ mg/kg}$ ) was added to KHB solution used in group 3. Then in groups 2 and 3, hearts were arrested with hypothermic ( $4^\circ\text{C}$ ) St. Thomas' cardioplegic solution at a flow rate of  $15 \text{ mL kg}^{-1} \text{ min}^{-1}$  for 3 min. After 60 min of total cardioplegic arrest, KHB solution ( $10 \text{ mL kg}^{-1} \text{ min}^{-1}$ ) was re-administered for reperfusion at  $37^\circ\text{C}$  for 30 min. Levosimendan was added to KHB ( $0.2 \text{ mg kg}^{-1} \text{ min}^{-1}$ ) used in group 3. At the end of the reperfusion period the hearts were divided for biochemical assays and for histological analysis carried out using electron microscopy.

**Results:** One heart was excluded in each group because of aortic injury and difficult cannulation. Significant differences among the three groups existed in tissue myeloperoxidase (MPO), Na-K ATPase enzyme activity and in concentration of malonyaldehyde (MDA). Group 1 showed significant changes in the levels of MDA ( $P = 0.000$  vs.  $P = 0.006$  respectively) in comparison with Group 2 and Group 3, MPO ( $P = 0.005$ ) and ATPase activity ( $P = 0.003$ ) between Group 2. Significant changes were also found in the levels of MDA ( $P = 0.019$ ), MPO ( $P = 0.004$ ) and ATPase ( $P = 0.027$ ) activity between Group 2 and Group 3. Normal cardiomyocytic morphology was observed in Group 1. Electron microscopic examination of the hearts in Groups 2 and 3 detected definite cardiomyocytic degeneration at the myofibril (thinning and disruption), mitochondria and sarcoplasmic reticulum (widening). Intracellular stoplasmic vacuolization were observed at perinuclear localisation. The severity of these findings were more extensive in Group 3.

**Conclusion:** Our results suggest that Levosimendan pre-treatment provided better cardioprotection during 60 min. hypothermic cardioplegic arrest in the isolated rat hearts. This was possibly achieved by opening the K(ATP) channels during ischaemia.

## Anaesthetic Techniques

### O-33

#### Ropivacaine vs. levobupivacaine in thoracic epidural (TEA) for coronary artery surgery

L. Salvi, G. Juliano, C. Brambillasca, G. Merli, M.R. Marino, S. Gregu, E. Sisillo

IRCCS Centro Cardiologico Monzino, Milano, Italy

**Introduction:** Local anaesthetics (LA) have the potential to inhibit cardiac contractility. The choice between different LA for high thoracic epidural anaesthesia (HTEA) for coronary artery bypass (CABG) surgery should consider the less harmful. There are no studies comparing ropivacaine and levobupivacaine for HTEA. Therefore in this double blind randomized trial we studied their analgesic and haemodynamic effects.

**Method:** Patients scheduled for CABG were randomized to receive ropivacaine (R) or levobupivacaine (L) 0.5% bolus ( $0.1 \text{ mL kg}^{-1}$ ) followed by 0.2% infusion during surgery in an epidural catheter inserted at the T1-T2 or T2-T3 interspace; sufentanil (suf)  $2.5 \mu\text{g mL}^{-1}$  and  $1 \mu\text{g mL}^{-1}$  were respectively added to the bolus and the infusion solution. The onset time to achieve a T1-T6 block was recorded. General anaesthesia was then induced with fentanyl, thiopental and pancuronium. Anaesthesia was maintained by a continuous epidural infusion of 0.2% LA and suf  $1 \mu\text{g mL}^{-1}$  ( $0.1 \text{ mL kg}^{-1} \text{ h}^{-1}$ ) and inhalation of sevoflurane in an air-oxygen mixture. Upon arriving in ICU, LA 0.1% with suf  $1 \mu\text{g mL}^{-1}$  epidural infusion was started at  $0.1 \text{ mL kg}^{-1} \text{ h}^{-1}$  and subsequently modified, aiming to maintain incident VAS  $\leq 4$  in the first 24 postoperative hours. MAP and HR were maintained respectively  $\geq 70 \text{ mmHg}$  and  $\leq 70 \text{ beats min}^{-1}$  with norepinephrine (NA) infusion and or metoprolol boluses. The total amount and the rate of LA infusion and of NA were recorded at ICU arrival, at awakening and after 4, 8, 12, 24 hours as well as HR, MAP, VAS, rectal temperature, and motor block. Additionally, time of awakening, intubation time, episodes of PONV and pruritus were recorded. Variables were compared with *t*-test,  $\chi^2$ -test and Wilcoxon's test as appropriate.  $P < 0.05$  was considered statistically significant.

#### Results:

	Ropi (n = 31)	Levo (n = 31)	P
Onset T1-T6 (min)	14.0 $\pm$ 4	13.3 $\pm$ 3	0.48
Norepineph. in OR (mL)	20.8 $\pm$ 15	23.2 $\pm$ 20	0.77
Total Local Anaesth. (mg)	485 $\pm$ 172	462 $\pm$ 193	0.45
Norepineph.in ICU (mL)	28.4 $\pm$ 33	51.2 $\pm$ 54	0.16
Time of awakening (h)	1.9 $\pm$ 1.1	2.5 $\pm$ 1.5	0.12
IPPV time (h)	5.0 $\pm$ 2.1	6.0 $\pm$ 2.5	0.12

**Discussion:** No important differences were seen between groups, therefore in this setting 0.5% R and L are equianalgesic, providing excellent analgesia and sympathetic blockade. Side effects (PONV and pruritus) were limited. R has been reported to be less myocardial depressant than L [1]. This study would not address this issue because more discriminating echocardiographic data were required. Nevertheless anaesthetic and haemodynamic effects appears similar in this clinical setting.

#### Reference:

- Groban L, Deal DD, Vernon JC, et al. Does local anesthetic stereoselectivity or structure predict myocardial depression in anesthetized canines? *Reg Anesth Pain Med* 2002; 27: 460-468.

### O-34

#### Arterial hypotension in patients undergoing coronary revascularization with high thoracic epidural anaesthesia

S. Casalino, F. Mangia, C. Sozio, E. Stelian, E. Novelli, G. Lanzillo, M. Diena, U.F. Tesler

Department of Anaesthesia, Department of Cardiac Surgery, Department of Biostatistics, Clinica San Gaudenzio, Novara, Italy

**Introduction:** Hypotension in patients who received high thoracic epidural anaesthesia during on-pump coronary revascularization has been correlated with various patient variables [1].

**Method:** The study population consisted of 106 consecutive patients (Table I). General anaesthesia was achieved with alfentanil, propofol and vecuronium. Through an epidural catheter bupivacaine ( $0.15 \text{ mg} \cdot \text{cm}^{-1}$  body length) and alfentanil ( $6 \text{ mcg cm}^{-1}$  body length) were delivered, followed by a continuous infusion of bupivacaine ( $0.06 \text{ mg} \cdot \text{cm}^{-1} \text{ h}^{-1}$ ) and alfentanil ( $3 \text{ mcg} \cdot \text{cm}^{-1} \cdot \text{h}^{-1}$ ). Hypotension was defined as 30% decrease of mean arterial pressure compared with basal levels or mean absolute blood pressure  $\leq 60 \text{ mmHg}$  for  $\geq 5$  minutes.

**Results:** 15 patients developed hypotension during the 30 minutes following administration of local anaesthetic. Relationships between patient variables and onset of hypotension are shown in Table I. Multivariate logistic regression model showed that only female gender is statistically correlated with hypotension ( $P = 0.034$ ), with an odds ratio of 2.82 (95% CI, 1.109-7.174).

Table 1.

Variable	No hypotension (n = 91)	Hypotension (n = 15)	P
Female Gender (%)	23.1	53.3	0.034
Age (yr)	66.7 $\pm$ 10.0	69.8 $\pm$ 7.5	0.257
Body Mass Index ( $\text{kg} \cdot \text{m}^{-2}$ )	26.5 $\pm$ 3.7	25.8 $\pm$ 4.4	0.550
Log EUROscore	7.4 $\pm$ 5.9	9.3 $\pm$ 6.3	0.740
PAD (%)	12.1	6.7	0.862
EF%	52.6 $\pm$ 8.9	54.7 $\pm$ 6.5	0.266
History of Myocardial infarction (%)	12.2	12.4	0.517
Arterial Hypertension (%)	47.5	48.4	0.598
Beta-blockers (%)	73.8	78.8	0.792
Ca-channel blockers (%)	31.4	51.9	0.041
ACE inhibitors (%)	62.5	66.7	0.891

**Discussion:** Bivariate statistical analysis demonstrated the correlation between postoperative hypotension, female gender and preoperative use of calcium channel blockers. In a logistic regression model, only female gender was found to be correlated with hypotension. The reason for this cannot be explained by the present study: Additional variables (such as unrecognized thyroid disease, hormonal profile, etc.) will be included in a larger sample of patients to clear these findings.

**Conclusions:** Hypotension induced by anaesthetic blockade during high thoracic epidural anaesthesia may occur more frequently in females.

#### Reference:

- Williams J. Thoracic epidural anesthesia for cardiac surgery. *Can J Anesth* 2002; 49 (Suppl 1): 7R.

### O-35

#### High thoracic epidural anaesthesia and analgesia during and early after CAGB surgery

Zs. Ulakcsai, I. Györmolnár, L. Papp

Heart Institute, University of Pécs, Pécs, Hungary

**Introduction:** Thoracic epidural anaesthesia (TEA) provides perioperative analgesia, resulting in thoracic sympathectomy and a decrease of stress during surgery. However, the use of TEA is not altogether popular due to the possible complications [1, 2, 3].

**Method:** We performed an open, prospective, randomized, controlled study of the incidence of major organ complications in 200 patients undergoing routine coronary artery bypass grafting surgery with or without high thoracic epidural anaesthesia and analgesia (TEA). The patients were divided into two groups: Group TEA (100 pts) having general anaesthesia with TEA and Group GA (100 pts) having only general anaesthesia. TEA after surgery was maintained for 72 hours. For the first 24 hours a continuous TEA infusion (levobupivacaine 7.5 + alfentanil) and for the next 24-72 hours intermittent TEA were administered. In the Group of GA, however, continuous i.v. morphine was administered for the first 24 h and intermittently for the next 24-72 h. Per os NSAID analgesia was continued in both groups following these initial treatments.

**Results:** The incidence of postoperative supraventricular arrhythmia was significantly lower in the group with TEA (12%) as compared to the group with GA (26%,  $P < 0.04$ ). The TEA group showed a significantly shorter extubation time (1.96 h. in TEA vs. 6.7 h in GA,  $P < 0.001$ ) and lower number of pulmonary complications (TEA = 5% vs. GA = 15%,  $P < 0.022$ ). Furthermore the TEA group showed a lower incidence of postoperative neurological complications (TEA = 3% vs. GA = 20%,  $P < 0.0002$ ). Neither epidural haematoma nor local neurological complications were observed following TEA.

**Discussion:** Our study clearly demonstrates the advantages of TEA during the intra and postoperative phases of patients having CABG surgery. The incidence of postoperative organ complications was significantly reduced, the perioperative analgesia was excellent and the intervention of TEA did not increase the number of complications.

#### References:

- Scott NB, Turrey DJ, Ray DA, et al. A prospective randomized study of the potential benefits of thoracic epidural anesthesia and analgesia in patients undergoing coronary artery bypass grafting. *Anesth Analg* 2001; 93(3): 528-538.

- Royse C, Royse A, Soeding P, et al. Prospective randomized trial of high thoracic epidural analgesia for coronary artery bypass surgery. *Ann Thorac Surg* 2003; **75**(1): 93–100.
- Priestley MC, Cope L, Halliwell R, et al. Thoracic epidural anesthesia for cardiac surgery: the effects on tracheal intubation time and length of hospital stay. *Anesth Analg* 2002; **94**: 275–282.

### O-36

#### Does thoracic epidural analgesia influence the postoperative care after coronary bypass surgery? A prospective study

M.K. Jensen, M.D. Nielsen, M. Hüttel, H. Schmidt, C. Andersen

Odense University Hospital, Denmark

**Introduction:** Thoracic epidural analgesia (TEA) used as a supplement to general anaesthesia for coronary artery bypass surgery (CABG) makes early extubation possible and provides good pain relief [1,2]. The influence of early postoperative extubation and good pain management on the postoperative care and hospital stay is nevertheless debated [1,2]. The aim of this study was to compare TEA with conventional postoperative pain therapy (CPT) regarding extubation, VAS-scores, mobilization and lengths of stay in the intensive care (ICU) and hospital stay.

**Method:** After Ethical Committee approval and written informed consent, consecutive patients for first time CABG were prospectively included and randomized. The TEA group received TEA intraoperatively and until the 3rd postoperative morning. Postoperative intubation time, VAS-score, mobilization and pain medications were registered, as were lengths of stay in the ICU and hospital. For statistical analysis, non-parametric statistics were used.

**Results:** 149 patients were studied of which 71 received TEA. They were extubated (130–453 min) and mobilized significantly earlier than the CPT group. VAS-scores until the 1st postoperative morning were also lower. Subsequently, we found no difference between the two groups regarding VAS-score and mobilization. Concerning pain medication, the TEA group had a lower request for supplementary morphine during hospital stay and at discharge (26% in the TEA group and 63% in the CPT). We found no difference in length of stay in the ICU or hospital.

**Discussion:** The use of TEA allowed early extubation and gave good pain relief. The patients with TEA were generally more alert and therefore earlier mobilized at the ICU. Although the TEA group had a reduced request for morphine, the difference in mobilization disappeared after return to the ward, as did the difference in pain control judged by VAS-scores. The explanation might be that focus had been on intervention relating to pain management, not to mobilization. TEA did not influence the length of hospital stay [2], but the length of stay in the ICU might have been reduced. Further studies are needed on this topic.

#### References:

- Royse C, Royse A, Soeding P, et al. Prospective randomized trail for high thoracic epidural analgesia for coronary artery bypass surgery. *Ann Thorac Surg* 2003; **75**: 93–100.
- Priestley MC, Cope L, Halliwell R, et al. Thoracic epidural anesthesia for cardiac surgery: the effects on tracheal intubation time and length of hospital stay. *Anesth Analg* 2002; **94**: 275–282.

### O-37

#### Monitoring level of sedation during hypothermic cardiopulmonary bypass: a comparison between Bispectral Index and EEG-Entropy

W. Baulig, P. Schütt, E.R. Schmid

Division of Cardiac Anaesthesia, University Hospital of Zurich, Switzerland

**Introduction:** Recently, spectral entropy EEG monitoring has become available for monitoring anaesthetic drug effect [1]. The goal of this study was to compare the behaviour of the spectral entropy parameters Response Entropy (RE) and State Entropy (SE) (S/5 Entropy™ Module, Datex Ohmeda) and Bispectral Index EEG (BIS) in patients undergoing coronary artery bypass graft surgery (CABG) with hypothermic cardiopulmonary bypass (CPB).

**Method:** With ethical committee approval and written informed patient consent, 15 patients were enrolled. BIS, RE, SE, delta ratio and burst suppression ratio (BSR) were collected at 22 time points for 2 min. in epochs of 10 sec. At expected painful periods 20 words were visualized with a video glass and simultaneously spoken aloud. Agreement between BIS and RE was analysed by Bland Altman, correlation of BIS, RE and SE to BSR, delta ratio and BIS to SE were determined by linear regression analysis ( $P < 0.05$ ). Postoperatively a standardized interview and a word stem completion test (WSCT) were conducted.

**Results:** RE and SE behaved similarly to BIS during anaesthesia (fig 1). RE and SE correlated well with BIS ( $r = 0.83$  and  $0.8$ , respectively). RE and BIS showed a satisfactory agreement (mean bias  $+1.2$ , limits of agreement (2SD)  $-17/+19.4$ ). During mild hypothermia, while BIS was intentionally held at 40, RE and SE decreased significantly ( $P = 0.03$ ). In the BSR range 0 to 30%, BIS did not detect burst suppression states, but at BSR  $> 30\%$ , BIS correlated linearly. RE and SE presented no detection failure during mechanical or electrical stimulation. Neither explicit nor implicit memory was observed.

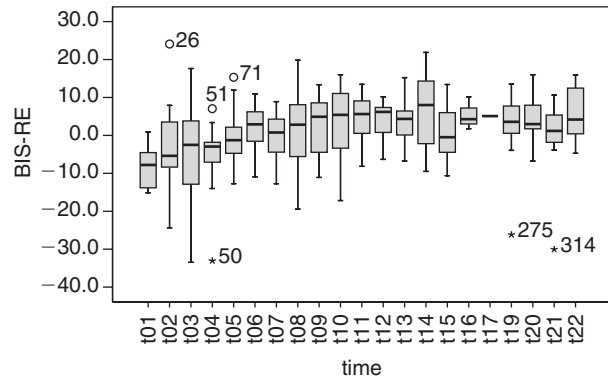


Figure 1. Difference between BIS and RE during different anaesthetic states.

**Conclusion:** Spectral entropy is comparable with BIS to detect different states of electrical activity in the brain during anaesthesia in cardiac surgery with hypothermic CPB. Contrary to BIS, RE and SE were resistant against electrical and mechanical artefacts.

#### Reference:

- Vakkuri A, Yli-Hankala A, Talja P, et al. Time-frequency balanced spectral entropy as a measure of anesthetic drug effect in central nervous system during sevoflurane, propofol, and thiopental anaesthesia. *Acta Anaesthesiol Scand* 2004; **48**: 145–153.

### O-38

#### On-pump cardiac surgery in conscious patients – 5 years experiences in 200 cases

M. Sritesky, M. Semrad, M. Porizka, D. Rubes, M. Lips

General Teaching Hospital, Prague, Czech Republic

**Introduction:** Thoracic epidural anaesthesia as the sole anaesthetic technique was used in our institution for patients undergoing on-pump cardiac surgery procedures. We present our results with this cardio-anaesthetic approach.

**Method:** From March 1999 to September 2005, 200 awake patients were operated on, 146 on-pump and 54 off-pump. A thoracic epidural block at the Th 2–Th 4 level was performed one hour prior to incision. The medial approach was used for the block and the hanging-drop method was routinely employed for epidural space detection.

**Results:** There were 120 male and 80 female patients with a mean age of 68.4 years. 73 patients had an aortic valve replacement, 33 underwent on-pump coronary bypass grafting (CABG), 9 underwent mitral valve replacement and 27 patients had sternal wound re-exploration. Off pump there were 54 CABG patients and one for aortic valve replacement with aortic arch reconstruction. Aortic valve replacement together with CABG was performed three times. There were 16 conversions to general anaesthesia and there was no deaths. Mean duration of stay in the intensive care unit was 9.6 hours and in the hospital 6.2 days. We did not observe low cardiac output syndrome, stroke, renal insufficiency or pulmonary dysfunction in patients who underwent adequate thoracic epidural anaesthesia. Less pain at assessment was demonstrated (Visual Analgesic Score = 3.5).

**Discussion:** The recent interest in rapid recovery and early out-patient care of patients after cardiac surgery has prompted investigations into the use of neuraxial analgesia for these procedures. The above mentioned technique would be beneficial for patients with preoperative pulmonary dysfunction and may be particularly useful in endoscopic cardiac surgery.

#### References:

- Karagoz HY, Kurtoglu M, Bakaloglu B, et al. Coronary artery bypass grafting in the awake patient: three years' experience in 137 patients. *J Thorac Cardiovasc Surg* 2003; **125**(6): 1401–1404.
- Aybek T, Dogan S, Neidhart G, et al. Coronary artery bypass grafting through complete sternotomy in conscious patients. *Heart Surg Forum* 2002; **5**(1): 17–21.

## Miscellaneous

### O-39

#### Off-pump cardiac surgery causes less systemic inflammation but this does not translate into less organ dysfunction

J. Heijmans, A. Liem, J. Maessen, P. Roekaerts

Department of Anesthesiology, Department of Cardio-Thoracic Surgery, University Hospital Maastricht, Maastricht, Netherlands

**Introduction:** Cardiac surgery causes a systemic inflammatory response syndrome (SIRS). Cardiopulmonary bypass (CPB) may augment this response. The SIRS can lead to organ dysfunction and therefore affect outcome. The present study was designed to assess whether a presumed reduced SIRS associated with off-pump procedures causes less organ dysfunction.

**Method:** After hospital ethics committee approval and written informed consent, forty CABG-patients were randomized into an off-pump and an on-pump group. The anaesthetic technique was standardized using a membrane-oxygenator and a heparin-coated circuit. Arterial in-line filters were used. At predetermined regular intervals, inflammatory mediators in arterial blood and in tracheo-bronchial aspirate were measured and the oxygen quotient and pulmonary EVLW (PICCO system, Pulsion) determined. Statistics: analysis of variance with repeated measurements was used. Significance  $P < 0.05$ .

**Results:** The CPB-group had significantly higher IL-8 and TNF-alpha plasma levels after arrival in the ICU (IL-8:  $19.45 \pm 10.8^*$  vs.  $6.31 \pm 5.3$  pg/mL; TNF-alpha:  $3.68 \pm 2.5^*$  vs.  $2.20 \pm 1.2$  pg/mL). Pulmonary measurements: no differences were observed in inflammatory mediators (IL-8:  $2102 \pm 1433$  vs.  $1587 \pm 1602$  pg/mL; TNF-alpha:  $5.01 \pm 6.44$  vs.  $7.76 \pm 12.84$  pg/mL); in EVLW (after arrival in the ICU:  $522 \pm 119$  vs.  $544 \pm 147$  mL) and in oxygenation ratios  $32 \pm 10$  vs.  $39 \pm 18$ ).

**Conclusions:** Cardiac surgery with CPB is associated with a more severe SIRS as shown by the blood samples of IL-8 and TNF-alpha. However, this augmented systemic response appears to be too weak to cause more pronounced pulmonary damage, as evidenced by the measured pulmonary inflammatory mediators, the amount of EVLW and the oxygenation ratio.

#### Reference:

- 1 Sakka SG, Ruhl CC, Pfeiffer UJ, et al. Assessment of cardiac preload and extravascular lung water by single transpulmonary thermodilution. *Intensive Care Med* 2000; **26**: 180-187.

### O-40

#### Pain measurement tools for the elderly after cardiac surgery

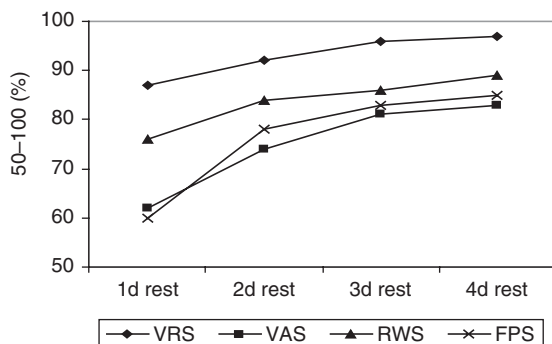
A. Pesonen, R. Suojaranta-Ylinen, P. Tarkkila, P.H. Rosenberg

Department of Anesthesiology and Intensive Care Medicine, Helsinki, Finland

**Introduction:** We studied the feasibility of Red Wedge Scale (RWS 0-50 cm) [1] and Facial Pain Scale (FPS 0-6) [2] in comparison with five-point Verbal Rating Scale (VRS) and 10 cm Visual Analogue Scale (VAS) in 160 elderly patients after cardiac surgery.

**Method:** Patients undergoing elective surgery were randomized to RWS ( $n = 80$ ) or FPS ( $n = 80$ ) group. Pain was assessed at rest and after movement on the first four days after extubation. VRS and VAS served as controls in both groups. The assessment of RWS and FPS was repeated after ten minutes.

**Results:** The proportion of successful pain measurements with different scales were as follows: VRS 87%, VAS 62%, RWS 76% and FPS 60% on the first day after extubation. The patients succeeded with all pain scales better during the following three days (Fig). Pain measurement with RWS and FPS correlated well with VRS and VAS ( $P < 0.01$ ). Also control measurement with RWS and FPS ( $P < 0.01$ ) correlated well with initial measurements.



**Figure.** The proportion of successful pain measurements with different pain scales during the first four days after extubation.

**Discussion:** Elderly patients with acute pain after cardiac surgery can express their pain most reliably with VRS and RWS. VAS and FPS are not ideal tools for the cardiac surgical patients.

#### References:

- 1 Tigerstedt I, Tammisto TA. Modified visual analogue scale (VAS) for evaluation of pain intensity during immediate postoperative recovery. *Schmerz Pain Douleur* 1988; **9**: 27-31.
- 2 Herr KA, Mobily PR, Kohout FJ, et al. Evaluation of the Faces Pain Scale for use with the elderly. *Clin J Pain* 1998; **14**: 29-38.

### O-41

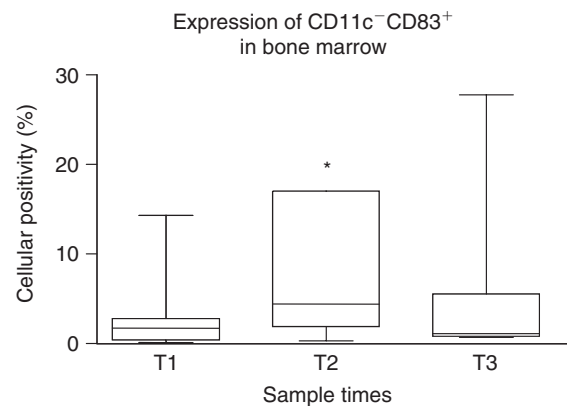
#### Plasmacytoid dendritic cells are activated at cardiac surgery

M.A. Armstrong, V. Sharma, C. Austin, N. Kahlil, F. Gibson, T.J. McMurray, A. Graham, W.T. McBride

Queen's University, Belfast, N. Ireland, United Kingdom; Royal Victoria Hospital, Belfast, N. Ireland, United Kingdom

**Introduction:** Immunity to endotoxin protects against post operative SIRS [1]. The Myeloid subset of Dendritic Cells (MDC) are important in this perioperative immune response to endotoxin and impaired MDC function may predispose to SIRS. In vitro studies indicate that type 1 interferons produced by the plasmacytoid subset of DCs (PDC) can modulate MDCs [2]. In contrast to MDCs, PDCs (CD11c<sup>-</sup>/CD83<sup>+</sup>) are highly specialized for viral recognition. We investigated the hypothesis that bone marrow PDC activation takes place at cardiac surgery as a novel mechanism for MDC suppression and susceptibility to SIRS.

**Method:** 7 patients undergoing low risk coronary artery revascularization surgery were studied. Anaesthesia and surgical techniques were standardized. Bone marrow was obtained from the open sternum at T1 (after sternotomy), T2 (before CPB), T3 (before sternal closure). Percentage CD11c<sup>-</sup>/CD83<sup>+</sup> cells was determined by flow cytometry. Within group comparison with baseline T1 was with Friedman's Test followed by Wilcoxon's Test.



**Figure 1.** Graph showing percentage number of cells expressing the CD11c<sup>-</sup>/CD83<sup>+</sup> phenotype. (\* $P < 0.01$ )

**Results:** CD11c<sup>-</sup>/CD83<sup>+</sup> cells were increased significantly at T2.

**Discussion:** The CD11c<sup>-</sup>/CD83<sup>+</sup> phenotype denotes activated plasmacytoid DC and suggests the presence of a subclinical virus infection. Our results indicate that this cell population is increased at T2 in bone marrow. From this timescale it is likely that exposure occurred before commencement of surgery. Subclinical viral infection may be a novel mechanism for unexplained SIRS post cardiac surgery.

#### References:

- 1 Stephens RC, O'Malley CM, Frumento RJ, et al. Low dose endotoxin elicits variability in the inflammatory response in healthy volunteers. *J Endotoxin Res* 2005; **11**(4): 207-212.
- 2 Duddy ME, Dickson G, Hawkins SA, et al. Monocyte-derived dendritic cells: a potential target for therapy in multiple sclerosis (MS). *Clin Exp Immunol* 2001; **123**(2): 280-287.

### O-42

#### Interventricular septum echinococcosis: case report

H.E.B. El. Baghdady, A. Ballotta, A. Pazzaglia, F. Belloli, C. Bianchini, T. DeLa Torre, H. Kandil, F. Bettini, G. Pome, D. De Benedetti, C. Bellucci

Cardio-thoracic Intensive Care, Department of Cardiac Surgery, Istituto Policlinico San Donato, San Donato Mil, Ese-Milan, Italy

Hydatid disease is a parasitic infection caused by echinococcus. Hydatid cyst in the heart is uncommon, with cardiac involvement occurring in about 0.2 to 3% of all cases of human hydatidosis. The interventricular septum location accounts for no more than 7%.

**Case Report:** A 35 year old male from North Africa, working as a farmer in the Italian countryside, was admitted to our centre with acute chest pain referred to both sides of the chest for 4 hours, of 8/10 severity, not relieved by rest. He had previous similar attacks in the last 6 months without seeking medical advice. Family and medical history are irrelevant.

On admission physical examination showed tachypnoea and tachycardia with pH 7.26, PaO<sub>2</sub> 8 kPa, PaCO<sub>2</sub> 6.7 kPa. Investigations for myocardial ischaemia were negative. Echocardiography and chest CT were immediately scheduled and both demonstrated multiple rounded cysts in the interventricular septum strongly suspicious for echinococcosis.

A couple of hours after admission, the chest pain increased with signs of circulatory shock and respiratory wheezing which needed an infusion of epinephrine and admission to ICU for continuous positive pressure airway ventilation for the first hours, followed by intubation and mechanical ventilation. Magnetic resonance imaging confirmed the diagnosis showing the presence of cysts in the pulmonary tree too. After a cardiac surgical consultation, surgical excision was recommended. During surgery performed with extracorporeal circulation, some cysts were found peripherally along the pulmonary tree although the excision of those in the interventricular septum had been carried out easily without any rupture. The patient was never weaned from the extracorporeal circulation because of anaphylactic shock. Post-mortem biopsy confirmed the diagnosis of hydatid cysts of echinococcosis.

Hydatidosis of the heart is uncommon and is characterized by a high incidence of sudden life-threatening complications. After the diagnosis, surgery should be performed on an emergency basis because of the risk of rupture with consequent pulmonary embolization. In our patient unfortunately, although there was correct excision of the septum, anaphylactic shock occurred from the probable rupture of previously dislocated cysts.

## O-43

### Remote ischaemia-reperfusion associated acute lung injury is not reduced by ischaemic preconditioning in a model of aortic surgery

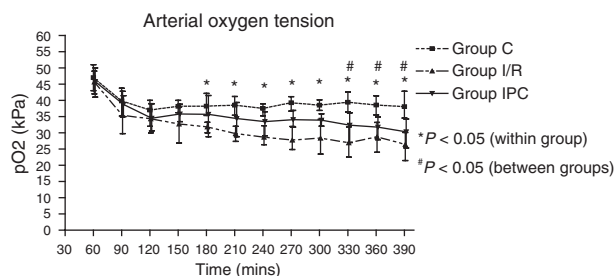
R.C. Baker, M.A. Armstrong, F.C. Campbell, A.A.B. Barros D'Sa, W.T. McBride

Queen's University of Belfast, Belfast, United Kingdom

**Introduction:** Ischaemic preconditioning (IPC) has been shown to reduce skeletal muscle damage as a consequence of prolonged ischaemia [1]. Furthermore, IPC prior to prolonged hind-limb ischaemia-reperfusion has been shown to protect against remote organ injury [2]. However the clinical relevance of this remains unclear. We therefore developed an animal model of infra-renal aortic ischaemia-reperfusion which would generate an acute lung injury and attempted to modulate this with IPC.

**Method:** Twenty-four pigs underwent laparotomy, fluid resuscitation for 60 min followed by 3 cycles of 10 min ischaemia/10 min reperfusion and then 120 min of infra-renal aortic cross-clamping followed by 150 min reperfusion. Arterial samples for blood gas analysis were obtained as follows: baseline (60 min after induction of anaesthesia) and every 30 min thereafter until the end of reperfusion at 390 min. Pigs were randomized to 3 groups. Group C (no ischaemia-reperfusion), group I/R (ischaemia-reperfusion only) and group IPC (ischaemia-reperfusion and preconditioning). Analysis between groups – Kruskal-Wallis; within groups – Friedman's test.

**Results:** There were no haemodynamic differences between groups. Compared to baseline, no significant fall in arterial oxygen tensions was observed in group C. The addition of ischaemia-reperfusion led to a significant reduction in arterial oxygen tensions in both groups I/R and IPC ( $P < 0.05$ ; 330–390 min respectively as compared with group C). However the addition of IPC did not significantly change this fall.



**Discussion:** Our model successfully simulated aortic ischaemia-reperfusion associated acute lung injury. However, this study failed to demonstrate a significantly beneficial effect of prior IPC in ameliorating remote acute lung injury.

## References:

- Pang CY, Yang RZ, Zhong A, et al. Acute ischaemic preconditioning protects against skeletal muscle infarction in the pig. *Cardiovasc Res* 1995; **29**: 782–788.
- Harkin DW, Barros D'Sa AA, McCallion, et al. Ischemic preconditioning before lower limb ischemia-reperfusion protects against acute lung injury. *J Vasc Surg* 2002; **35**(6): 1264–1273.

## O-44

### Cerebral lesion and reduced ejection fraction as indicators for intra-aortic balloon pulsation (IABP) to increase cerebral blood flow (CBF)

M. Schmidt, H. Gulbins, M. Balci, G. Steinbach, A. Hannekum, A. Pritisanac

University of Ulm, Ulm, Germany

**Introduction:** Ischaemic cerebral complications represent the leading cause of morbidity and excessive costs after cardiac operations. In cardiac patients with reduced ejection fraction, CBF and cerebral autoregulation might be compromised. Intra-aortic balloon pulsation (IABP) offers haemodynamic stabilization and might prevent irreversible damage to the brain. The effects of IABP on cerebral perfusion are still discussed controversially. With the growing importance of neuroprotective strategies, the current study was designed to evaluate the effect of IABP on cerebral blood flow and cerebral autoregulation response by means of transcranial Doppler-sonography.

**Method:** In 11 anaesthetized and ventilated patients receiving IABP support following coronary bypass grafting, blood flow velocities in the middle cerebral artery (MCA) were assessed by transcranial Doppler-sonography (Multidop P, DWL, Germany). Systemic haemodynamics (MAP, CO, CVP) and blood gases were monitored. Measurements were performed without support and at three different IABP settings: assist ratio 1:1, 1:2 and 1:3. Additionally hyper- and hypoventilation manoeuvres were performed to investigate the cerebral autoregulation response by means of transcranial Doppler-sonography. Protein S100 (ElecSys® S 100, Roche Diagnostics, Germany) was measured to evaluate the pre-existing cerebral cell damage associated with cardiopulmonary bypass and surgical intervention.

**Results:** In 11 patients (age  $61 \pm 10$  yr, weight  $82 \pm 14$  kg) with decreased ejection fraction (EF) ( $31 \pm 16\%$ ) and elevated Protein S100 levels as a sign of a cerebral lesion, balloon pulsation caused an averaged increase of blood flow in the MCA by +18% with general haemodynamic parameters within the physiologic range. Mean flow velocity in the middle cerebral artery significantly increased from  $49 \pm 14$  cm s<sup>-1</sup> (no IABP support) to  $59 \pm 14$  cm s<sup>-1</sup> (IABP assist ratio 1:1). During hyper- and hypoventilation manoeuvres with and without IABP support there was a normal autoregulatory response with a significant increase in mean blood flow velocity from  $45 \pm 15$  cm s<sup>-1</sup> to  $64 \pm 16$  cm s<sup>-1</sup> (no IABP support) and  $49 \pm 15$  cm s<sup>-1</sup> to  $68 \pm 16$  cm s<sup>-1</sup> (with IABP augmentation 1:1), ( $P < 0.05$ ).

**Conclusion:** We conclude that IABP may play an important role for increasing cerebral blood flow in cardiac patients with postoperative cerebral cell lesions and reduced left ventricular pump function. In addition the preserved cerebral autoregulation during IABP is an important safety feature for metabolism related cerebral perfusion.

## O-45

### Surgical treatment for chronic thromboembolic pulmonary hypertension: the Danish experiences with the first 50 cases

C. Lindskov, K. Severinsen, H. Kirkegaard, A.G. Lorentzen, L. Folkersen, K.E. Klaaborg, L. Ilkjaer, J.E. Nielsen-Kudsk, M. Egeblad, B. Oestergaard  
Skejby Sygehus, Aarhus University Hospital, Aarhus, Denmark

**Introduction:** The aim was to evaluate survival and functional outcome in patients treated by pulmonary endarterectomy (PEA) for chronic thromboembolic pulmonary hypertension (CTEPH) in Denmark.

**Method:** Prospective observation study of the first 50 patients (age 59 years (24–72)) undergoing surgery for CTEPH at our institution in the period from 1994 to 2004. Prior to operation all patients were in World Health Organization (WHO) function class III ( $n = 33$ ) or IV ( $n = 17$ ). The mean pulmonary artery pressure was 50 mmHg (range 25–76), cardiac index

1.8 L min<sup>-1</sup> m<sup>-2</sup> (range 0.8–2.8), pulmonary vascular resistance 819 dyns cm<sup>-5</sup> (range 241–3067).

Anaesthesia was induced with midazolam, sufentanil and ketamine. The patients were monitored with intra-arterial pressure, a pulmonary artery catheter, TOE, ECG and EEG. Surgery was performed as described by Jamieson et al [1]. Besides hypothermia, the cerebral protection consisted of thiopental 8 mg/kg and solumedrone 30 mg/kg.

The patients were sedated and ventilated for the first 24 postoperative hours. When X-ray of the chest did not show signs of pulmonary hyperperfusion and the patients oxygenated well, they were weaned from the ventilator. 71% of the patients were extubated within 48 h. Pulmonary vascular resistance dropped from a median value of 819 to 362 dyns cm<sup>-5</sup> (56%)

within the first postoperative day. The median duration of stay in the ICU department was 4 days. In the observation period 15 patients died. Twelve (24%) died before discharge. Ten of the in-hospital deaths occurred in the early surgical period: 1994 and 1999. In contrast, only 2 of 23 patients (9%) died in-hospital after year 2000.

**Conclusion:** Pulmonary endarterectomy has been successfully implemented in Denmark. The perioperative mortality declined over time suggesting a learning curve. We recommend that all patients with suspected CTEPH should be referred to a specialized centre for evaluation to undergo PEA.

#### Reference:

- 1 Jamieson SW, Kapelanski DP, Sakakibara N, et al. Pulmonary endarterectomy: experience and lessons learned in 1,500 cases. *Ann Thorac Surg* 2003; **76**: 1457–1462.

## Anaesthesia/Organ Function and Protection

### O-46

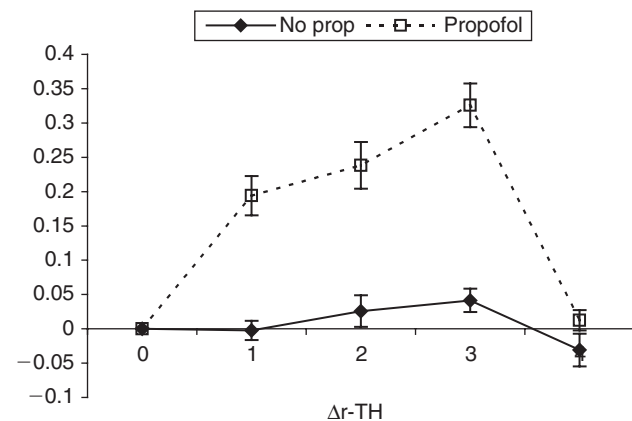
#### Serum tocopherols level in total intravenous anaesthesia with propofol during cardiac surgery

E. Sisillo, N. Rondello, S. Salis, G. Juliano, L. Zingaro, C. Brambillasca  
Centro Cardiologico Fondazione, Monzino, Milan, Italy

**Introduction:** It has been proposed, mostly in vitro and in experimental animals, that propofol exerts antioxidant activity. The antioxidant capability has been related to its similar chemical structure to tocopherols which are the main lipophilic antioxidant in biological membrane [1]. The aim of the study was to assess the influence of propofol, used as an anaesthetic in cardiac surgery, on the level of  $\alpha$ -TH,  $\gamma$ -TH (the main forms of tocopherols) and the individual antioxidant capability (IAC).

**Method:** Thirty consecutive patients scheduled for cardiac surgery were randomized into two groups: Group A patients were given total intravenous anaesthesia with propofol; Group B patients were given sevoflurane (midazolam during CPB) as anaesthesia. Group B also received the same drug solvent as the propofol group. Plasma levels of  $\alpha$ -TH,  $\gamma$ -TH and IAC were measured before, during and after surgery.

**Results:** Sixteen patients were included in Group A, and 14 in Group B. No significant differences were found between the two group in perioperative characteristics. During surgery a significant increase in  $\gamma$ -TH was observed in the propofol group only ( $P < 0.0001$ ), while  $\alpha$ -TH and IAC decreased similarly in the two groups.



**Conclusion:** Cardiac surgery and the reperfusion of ischaemic myocardium have been associated with the formation of oxygen free radicals [2]. Despite no significant changes regarding the individual antioxidant capability, this study shows that propofol increases the level of  $\gamma$ -tocopherol in patients undergoing cardiac surgery and this may result in positive effects of attenuating the pro-inflammatory reaction occurring during this kind of surgery.

#### References:

- 1 Green TR, Bennett SR, Nelson VM. Specificity and properties of propofol as an antioxidant free radical scavenger. *Toxicol Appl Pharmacol* 1994; **129**: 163–169.
- 2 Clermont G, Vergely C, Jazayeri S, et al. Systemic free radical activation is a major event involved in myocardial oxidative stress related to cardiopulmonary bypass. *Anesthesiology* 2002; **96**: 80–87.

### O-47

#### Comparison of the effects of sevoflurane and propofol in off-pump heart surgery

N. Kosmac, I. Knezevic, V. Paver Erzen  
University Medical Centre, Ljubljana, Slovenia

**Introduction:** Ischaemic preconditioning protects the heart from damage during longer periods of ischaemia. The cardio-protection of sevoflurane was observed in laboratories and in coronary artery surgery with and without cardiopulmonary bypass (CPB) (off-pump heart surgery). In off-pump heart surgery we compared the effects of sevoflurane and propofol on the heart and kidneys and hypothesized that sevoflurane is more protective than propofol.

**Method:** The study approved by the Committee for Ethics in Medicine of the Republic of Slovenia included 40 patients, 24 in group A and 16 in B. Patients signed an informed consent. In A, the patients were induced with propofol and anaesthesia was maintained with sevoflurane. In B, propofol was used for the induction as well as for the continuation of anaesthesia. The protection of the heart and kidneys was assessed during and after the operation by the release of troponin I and cystatin C. Blood samples were taken before, during, at the end of revascularization of the heart, on admission and 12, 24 and 48 hours after the admission to the intensive therapy unit (ITU). For the two observed parameters we used a two-way mixed ANOVA and the exact version of Mann-Whitney test. We categorized the values of troponin I and cystatin C. Fisher's exact test was used.

**Results:** For troponin I ANOVA showed neither a group effect ( $P = 0.507$ ) nor the interaction effect ( $P = 0.585$ ). For cystatin C the main effect of group ( $P = 0.017$ ) and the effect of the interaction ( $P = 0.050$ ) between the groups and time were statistically significant. For both parameters we found higher values in group B in the last three measurements (12, 24, 48 hours after the admission to the ITU). With parametric multivariate testing and nonparametric univariate testing we found a statistically significant difference between the groups for cystatin C but not so for troponin I.

**Discussion:** From our data we estimated a sample size (presumed equal in both groups) needed to achieve a statistical significance with 80% power and 5%  $\alpha$  level with a two-tailed test for these two parameters. Even a huge sample (over 1000 patients) would not suffice to prove any differences between the two groups concerning troponin I. There was a single surgeon and a single anaesthesiologist performing the whole surgery. We conclude that our precise work contributed to good results.

#### References:

- 1 Conzen PF, Fischer S, Dettler C, et al. Sevoflurane provides greater protection of the myocardium than propofol in patients undergoing off-pump coronary artery bypass surgery. *Anesthesiology* 2003; **99**(4): 826–833.
- 2 Julier K, da Silva R, Garcia C, et al. Preconditioning by sevoflurane decreases biochemical markers for myocardial and renal dysfunction in coronary artery bypass graft surgery: a double-blinded, placebo-controlled, multicenter study. *Anesthesiology* 2003; **98**: 1315–1327.

### O-48

#### Effects of norepinephrine-induced variations in perfusion pressure on jejunal mucosal perfusion in vasodilatory shock after cardiac surgery

A. Nygren, A. Thorén, S-E. Ricksten  
Sahlgrenska University Hospital, Göteborg, Sweden

**Introduction:** Clinical septic shock and the vasodilatory shock syndrome after cardiac surgery are characterized by a profound arteriolar vasodilation.



Norepinephrine (NE) is the recommended and commonly used agent for treatment of hypotension in volume-resuscitated hyperdynamic septic shock [1]. The optimal perfusion pressure with respect to systemic, regional or local perfusion is, however, not yet established.

**Method:** Eight mechanically ventilated patients with septic/post-cardiotomy, vasodilatory shock, a cardiac index more than  $2.5 \text{ L min}^{-1} \text{ m}^{-2}$  and multiple organ failure after cardiac surgery, were included. The study was approved by the local ethics committee and informed consent was obtained from the closest relative. The mean arterial pressure (MAP) was randomly and sequentially changed from a baseline MAP of 75 mmHg to reach target MAP of both 60 and 90 mmHg by changing the NE infusion rate. Data on central haemodynamics (pulmonary artery catheter), jejunal mucosal perfusion (JMP), (endoluminal laser Doppler flowmetry) as well as gastric-arterial  $\text{PCO}_2$  gradient (gastric tonometry) and splanchnic oxygen and lactate extraction (hepatic vein catheter) were obtained during a 30 min period at each target MAP. Analysis of variance for repeated measurements (ANOVA) was used for statistical evaluation.

#### Results:

	MAP 60	MAP 75	MAP 90	ANOVA
NE ( $\mu\text{g kg}^{-1} \text{ min}^{-1}$ )	0.27 $\pm$ 0.26	0.38 $\pm$ 0.23	0.57 $\pm$ 0.44	–
MAP (mmHg)	62 $\pm$ 4	76 $\pm$ 3	91 $\pm$ 2	–
CI ( $\text{L min}^{-1} \text{ m}^{-2}$ )	2.8 $\pm$ 0.3	3.0 $\pm$ 0.4	3.1 $\pm$ 0.5	0.03
SVRI	1430 $\pm$ 290	1714 $\pm$ 318	1983 $\pm$ 335	0.0001
CVP (mmHg)	13.2 $\pm$ 2.8	13.5 $\pm$ 2.6	15.3 $\pm$ 2.3	0.001
JMP (PU)	262 $\pm$ 65	273 $\pm$ 75	269 $\pm$ 47	0.79
$\text{PCO}_2$ -gradient	2.0 $\pm$ 0.7	1.9 $\pm$ 0.7	2.0 $\pm$ 0.9	0.55
Spl $\text{O}_2$ extr (%)	71.5 $\pm$ 16.2	70.7 $\pm$ 15.8	69.2 $\pm$ 17.6	0.61
Spl.lact.extr (%)	34 $\pm$ 18	36 $\pm$ 23	33 $\pm$ 28	0.90

Cardiac index, SVRI, systemic oxygen delivery, central venous pressure increased significantly, while heart rate and global oxygen consumption did not change with increasing NE infusion rates. JMP, gastric-arterial mucosal  $\text{PCO}_2$  gradient, splanchnic oxygen and lactate extraction were not affected by increasing infusion rates of NE.

**Conclusions:** NE-induced variations in MAP between 60 and 90 mmHg have systemic haemodynamic effects but do not affect intestinal mucosal perfusion, global splanchnic or gastric oxygen demand/supply relationship in patients with vasodilatory shock after cardiac surgery.

#### Reference:

- Task Force of the American College of Critical Care Medicine SoCCM. Practice parameters for hemodynamic support of sepsis in adult patients in sepsis. *Crit Care Med* 1999; **27**: 639–660.

## O-49

### Reno-protective effect of TGF- $\beta$ 1 on TNF- $\alpha$ mediated HK<sub>2</sub> cell necrosis

R. Gupta, W.T. McBride, J.S. McLay, T.J. McMurray, M.A. Armstrong  
Queen's University, Belfast; Royal Victoria Hospital, Belfast, Ireland;  
University of Aberdeen, Aberdeen, Scotland, United Kingdom

**Introduction:** Previous research suggests that increases in pro-inflammatory cytokines during the perioperative period, play an important role in mediating reotoxicity [1]. Our prior work has shown a correlation between sub-clinical renal injury at cardiac surgery and plasma TNF- $\alpha$  concentration [1]. We have demonstrated that TNF- $\alpha$  leads to necrosis of renal proximal tubular cells in vitro [2]. We have demonstrated that urinary TGF- $\beta$ 1 increases at cardiac surgery [3]. The effect of anti-inflammatory cytokines like TGF- $\beta$ 1 has not been fully investigated although we hypothesized that TGF- $\beta$ 1 imparts cytoprotection in TNF- $\alpha$  treated renal tubule cells.

**Method:** HK<sub>2</sub> cells (porcine renal tubular cells transfected with HPV-16) in the presence of 5%  $\text{CO}_2$  were incubated for 18–24 hours at 37°C with TNF- $\alpha$  at concentrations of 5, 10, 15, 20 and 40 pg/mL. TGF- $\beta$ 1 concentrations of 20 pg/mL was used throughout and the cells were further incubated for 18–24 hours at 37°C to assess the cytoprotective potential. Cell viability was assessed using the trypan-blue exclusion method. Statistical analysis by ANOVA and Mann-Whitney *U* Test.

**Results:** TGF- $\beta$ 1 had cytoprotective effect in the presence of different concentrations of TNF- $\alpha$ . This effect of TGF- $\beta$ 1 reduces at higher concentration of TNF- $\alpha$ .

TNF $\alpha$ conc.	Control (HK <sub>2</sub> + TNF- $\alpha$ )	Treatment (HK <sub>2</sub> + TNF- $\alpha$ + 20 pgTGF- $\beta$ 1)	<i>P</i> value
5 pg	73.25 ( $\pm$ 2.98)	97 ( $\pm$ 0.57)	0.047
10 pg	75.75 ( $\pm$ 1.70)	94.6 ( $\pm$ 1.00)	0.05
15 pg	77.75 ( $\pm$ 6.07)	95 ( $\pm$ 1.15)	0.05
20 pg	76.5 ( $\pm$ 6.13)	92.6 ( $\pm$ 0.57)	0.052
40 pg	0	92 ( $\pm$ 4.35)	< 0.01

**Conclusion:** Our results demonstrate the renoprotective effect of TGF- $\beta$ 1 in the presence of pro-inflammatory cytokines on renal proximal tubular cells.

#### References:

- Gormley SM, McBride WT, Armstrong MA, et al. Plasma and urinary cytokine homeostasis and renal dysfunction during cardiac surgery. *Anesthesiology* 2000; **93**: 1210–1216.
- Gupta R, McBride WT, McClay J, et al. Methylprednisolone reduces TNF- $\alpha$ -mediated HK<sub>2</sub> cell necrosis. *Brit J Anaesth* 2003; **91**(3): 462P.
- McBride, WT, Allen S, Gormley SM, et al. Methylprednisolone favourably alters plasma and urinary cytokine homeostasis and subclinical renal injury at cardiac surgery. *Cytokine* 2004; **27**(2–3): 81–89.

## O-50

### Volatile anaesthetic preconditioning in patients undergoing mitral surgery: a randomized controlled study

G. Landoni, M.G. Calabrò, M. De Luca, A.M. Scandroglio, E. Cerchierini, T. Bove, F. Pappalardo, A. Zangrillo

Department of Cardiovascular Anaesthesia and Intensive Care, Vita-Salute University of Milano, San Raffaele Hospital, Milano, Italy

**Introduction:** Myocardial ischaemic damage is reduced by volatile anaesthetics in patients undergoing coronary artery bypass grafting [1,2], but it is uncertain whether these benefits exists in patients undergoing valvular surgery with the ischaemia-reperfusion injury related to cardioplegic arrest and cardiopulmonary bypass. We compared cardiac troponin [3] release in patients receiving either volatile anaesthetics or total intravenous anaesthesia for mitral surgery with or without concomitant coronary artery disease.

**Method:** We performed a randomized controlled study (59 patients received the volatile anaesthetic desflurane while 61 received the intravenous anaesthetic propofol in addition to an opiate based anaesthesia) and measured peak postoperative troponin I release as a marker of myocardial necrosis after mitral surgery. The Ethical Committee approved the study and all patients signed a written informed consent.

**Results:** Patient mean age was 60 years and 54 percent were men. There was no significant reduction in postoperative peak of troponin in the overall population while, in a pre-specified subgroup of 19 patients who had concomitant coronary artery disease we observed the expected reduction ( $P = 0.02$ ) of median (25th 75th percentiles) peak of troponin I in patients receiving volatile anaesthetics 14.0 (9.7–17.3) ng/dL compared to patients receiving total intravenous anaesthesia 31.6 (15.7–52.0) ng/dL.

**Discussion:** Myocardial damage measured by cardiac troponin release is not reduced by volatile anaesthetics in patients undergoing mitral valve surgery while it is reduced in a subgroup of patients with concomitant coronary artery disease.

#### References:

- Weber NC, Preckel B, Schlack W. The effect of anaesthetics on the myocardium: new insights into myocardial protection. *Eur J Anaesthesiol* 2005; **22**: 647–657. Review.
- De Hert SG, Van der Linden PJ, Cromheecke S, et al. Choice of primary anesthetic regimen can influence intensive care unit length of stay after coronary surgery with cardiopulmonary bypass. *Anesthesiology* 2004; **101**: 9–20.
- Alpert JS, Thygesen K, Antman E, Bassand JP. Myocardial infarction redefined—a consensus document of The Joint European Society of Cardiology/American College of Cardiology Committee for the redefinition of myocardial infarction. *J Am Coll Cardiol* 2000; **36**: 959–969.

## O-51

### Clinical pharmacodynamics of AQUAVAN® injection, a water-soluble prodrug of propofol, compared to lipid formulated propofol for cardiac anaesthesia

J. Fechner, H. Ihmsen, D. Braitman, J.J. Vornov, J. Schüttler

Department of Anaesthesiology, Friedrich-Alexander-University, Erlangen, Germany; MGI Pharma, Baltimore, United States

**Introduction:** AQUAVAN® (fospropofol disodium) injection is a novel water-soluble prodrug of propofol with a unique pharmacokinetic/pharmacodynamic profile [1]. Compared to lipid formulated propofol (Diprivan®), hydrolysis of AQUAVAN® increases time to maximum propofol concentration and reduces its peak. This study compared pharmacodynamics, safety and tolerability of AQUAVAN® with Diprivan® during cardiac anaesthesia.

**Method:** After written informed consent 16 patients scheduled for coronary vascular surgery were randomized to receive either a target controlled infusion (TCI) of AQUAVAN® or Diprivan®. Alfentanil was used for analgesia. Anaesthesia was introduced with a propofol target concentration of 2.5  $\mu\text{g/mL}$  for AQUAVAN® and 3.0  $\mu\text{g/mL}$  for Diprivan®. During surgery, propofol target concentrations were adjusted to maintain BIS® values in the range 40 to 60. Times, side effects, propofol concentrations, haemodynamics, and BIS® were compared using unpaired *t*-test, MWU-test or Fisher's exact test.

**Results:** Reported as mean and [95% confidence interval].

	AQUAVAN®	Diprivan®
LOC (min)	3.3 [2.1.4.4]	2.5 [1.2.3.9]
MAP (%) phase 1	-18 [-25. -12]	-16 [-20. -11]
HR (%) phase 1	-17 [-20. -15]*	-13 [-16. -10]
MAP (%) phase 2	-13 [-16. -11]	-13 [-14. -12]
HR (%) phase 2	-7 [-10. -5]*	-12 [-15. -9]
Cardiac index (L.min <sup>-1</sup> .m <sup>-2</sup> )	2.5 [2.2.2.7]	2.2 [1.9.2.5]
BIS phase 1	54 [53.55]*	45 [44.47]
BIS phase 2	45 [44.45]*	44 [44.45]
Propofol conc. (µg/mL)	1.5 [1.0.2.0]*	3.9 [0.8.7.0]
Pain on injection	0	3
Paraesthesia on injection	6*	0

MAP, HR: relative changes to baseline, phase 1: induction to skin incision, phase 2: skin incision to bypass, \*  $P < 0.05$ .

**Discussion:** AQUAVAN® and Diprivan® were similarly well tolerated for cardiac anaesthesia. Propofol from AQUAVAN® showed a higher potency than propofol from Diprivan® at comparable BIS® levels. No clinically relevant haemodynamic differences were detected.

#### Reference:

- 1 Fechner J, Ihmsen H, Hatterscheid D, et al. Comparative pharmacokinetics and pharmacodynamics of the new propofol prodrug GPI 15715 and propofol emulsion. *Anesthesiology* 2004; **101**: 626–639.

## O-52

### A safe and effective protocol to control perioperative glycaemia in cardiac surgical patients

P. Lecomte, L. Foubert, F. Nobels, G. Cammu, J. Coddens, P. Van Crombrugge, S. Platteau, G. Nollet, T. Deloof

Department of Anaesthesiology & Intensive Care; Department of Endocrinology, OLV Hospital, Aalst, Belgium

**Introduction:** Perioperative tight glucose control reduces mortality and morbidity in cardiac surgical patients [1,2]. We evaluated the performance of the Bode protocol [3] during and after cardiac surgery with extracorporeal circulation in 300 patients (241 non-diabetics and 59 diabetics). Target glycaemia ranges were 4.67–7.15 mmol/L during surgery and 4.67–6.05 mmol/L in ICU, using a 4.67–6.05 mmol/L protocol. To improve the performance of the Bode protocol, the latter was adjusted to anticipate rapid perioperative changes in insulin requirement and resistance typical for cardiac surgery.

**Method:** The Bode protocol adjusts insulin dosage to both absolute values and changes in blood glucose levels (BGL). It consists of rows (glycaemia

ranges) and correlates insulin range in columns (insulin dosage). The columns correct for the patients' intrinsic needs (Col 0: low need for insulin; Col 10: high need for insulin). The protocol presents an upper and lower limit of normoglycaemia. At a glycaemia above (below) this limit, one higher (lower) column is used. Based on our own preliminary data, intravenous insulin was started in column 4 at induction together with infusion of 5% dextrose at 1 mL.kg<sup>-1</sup>.h<sup>-1</sup>. At the time of rewarmed, 3 columns were added to anticipate the rise in glycaemia. These 3 columns were again subtracted at an oesophageal temperature of 36°C. At arrival in ICU, insulin infusion was decreased by one column. BGL was measured every 30 minutes perioperatively and every hour in ICU.

**Results:** A total of 9789 BGL were measured. Perioperatively mean BGL was within preset limits at all time points for all patients. In ICU mean BGL was out of target during the first 8 h in diabetics only.

	Surgery		ICU	
	ND	DM	ND	DM
Pts within target at end surgery/ICU (%)	87.8	79.2	86.3	90.1
Hypoglycaemic insults* on total BGL (%)	0.1	0.6	0.7	0.6
Patients with hypoglycaemia* (%)	1.2	5.1	10.4	13.6
Lowest BGL (mmol/L)	3.05	3.77	2.89	2.60
Highest BGL (mmol/L)	8.93	16.54	10.99	10.10
Mean insulin consumption (IU/h)	2.7	3.8	2.1	3.1

\*hypoglycaemic insult = blood glucose level < 3.8 mmol/L

In non-diabetics perioperative mean insulin consumption was significantly higher with fasting BGL  $\geq 5.5$  vs BGL < 5.5 mmol/L (2.9 vs. 2.4 IU/h,  $P < 0.01$ ). Similarly, corresponding ICU values were 2.3 and 1.9 IU/h ( $P = 0.0002$ ).

**Discussion:** Our modifications of the Bode protocol allow for simple and effective control of perioperative glycaemia in cardiac surgical patients with minimal risks for hypoglycaemic events. Non-diabetics with a fasting BGL  $\geq 5.5$  mmol/L have increased perioperative insulin needs.

#### References:

- 1 van den Berghe G, Wouters P, Weekers F, Verwaest C, Bruyninckx F, Schetz M, Vlasselaers D, Ferdinande P, Lauwers P, Bouillon R. Intensive insulin therapy in the critically ill patients. *NEJM* 2001; **345**: 1359–1367.
- 2 Ouattara A, Lecomte P, Le Manach Y, Landi M, Jacqueminet S, Platonov I, Bonnet N, Riou B, Coriat P. Poor intraoperative blood glucose control is associated with a worsened hospital outcome after cardiac surgery in diabetic patients. *Anesthesiology* 2005; **103**: 687–694.
- 3 Bode B, Braithwaite S, Steed R, Davidson P. Intravenous insulin infusion therapy. *Endocr Pract* 2004; **10** (Suppl 2): 71–80.

## Organ Transplantation/Thoracic and Vascular Anaesthesia

## O-53

### Thoracic and thoraco-abdominal aortic aneurysm repair

E. Bignami, S. Magrin, A. Carozzo, R. Fiori, J. Nzepa Batonga, A.M. Scandroglio, A. Zangrillo

S.Raffaele Hospital, Vita-Salute University, Milan, Italy

**Introduction:** Open surgical repair of unruptured thoraco-abdominal aortic aneurysm (TAAA) is associated with an operative mortality rate of 4% to 16% in specialist centres. Significant morbidity (cardiac complications, acute renal failure, haemorrhage and spinal cord ischaemia) occurs in more than 50% of patients. Compared with open TAAA repair, endovascular thoracic aortic aneurysm (ATA) repair reduces the operating time, blood transfusions, intensive care stay and overall length of hospitalization.

**Method:** From January 2005 to November 2005 we prospectively entered into a database patients who underwent endovascular thoracic aneurysm repair and open thoraco-abdominal aneurysm repair.

**Results:** Sixty-five patients were treated: 36 (TAAA of II-III-IV type) with open surgery and 29 (ATA) with endovascular technique. The table 1 shows the summary of results.

Table 1.

	TAAA (36)	ATA (29)	P
Female	8 (22%)	6 (21%)	0.5
General anaesthesia	36 (100%)	24 (83%)	0.01
Loco-regional anaesthesia	0	5 (17%)	0.01
Procedure time (min)	258 (95–425)	184 (65–370)	0.002
Mortality	5 (14%)	3 (10%)	0.5
Redo	10 (28%)	6 (21%)	0.4
ICU stay (days)	3 (1–11)	2.5 (1–15)	<0.01
Hospital stay (days)	13 (7–40)	10 (6–25)	<0.01
Paraplegia	3 (8%)	1 (3%)	0.3

The causes of death included continued haemorrhage (2, 1 ATA), bowel ischaemia (1) and multiorgan failure (3, 1 ATA) and sepsis (2, 1 ATA). Sixteen patients required re-intervention, in particular for bleeding, bowel ischaemia and peripheral vascular ischaemia (3).

In the open surgery group, other severe postoperative neurological complications were median nerve damage (1) and cerebellar haematoma with instability (1).

**Discussion:** This study demonstrates that endovascular repair of ATA is feasible and it provides an acceptable and promising alternative to conventional surgical repair in selected patients with a significant reduction in length of the procedure. With advances in graft technology and increasing surgical experience, endovascular repair may become the optimal treatment for patients with ATA.

#### References:

- 1 Anderson JL, Adam DJ, Berce M, et al. Repair of thoracoabdominal aortic aneurysms with fenestrated and branched endovascular stent grafts *J Vasc Surg* 2005; **42**: 600–607.
- 2 Coselli JS, Conklin LD, LeMaire SA. Thoracoabdominal aortic aneurysm repair: review and update of current strategies. *Ann Thorac Surg* 2002; **74** (5): S1881–1884.

## O-54

### Regional anaesthesia in carotid endarterectomy: comparison between superficial and deep cervical plexus block in patients with coronary artery disease

F. Cislighi, M. Munari, C. Savi, A. Delle Fave, C. Ferrari, A.M. Condemi  
Cardioanaesthesia Department, Luigi Sacco Hospital, Milan, Italy

**Introduction:** Carotid endarterectomy (CEA) may be performed with regional anaesthesia using either a deep (DCPB) or superficial cervical plexus block

(SCPb). We compared the analgesic efficacy and the intra-operative and post-operative complications of SCPb versus DCPb, in a group of patients with coronary artery disease (CAD) and/or previous CABG.

**Method:** All patients undergoing CEA since June 2003 through June 2005 with previous CABG or CAD without indication for surgical treatment, were considered. SCPb was performed using bupivacaine 0.375% (maximum dose: 1.4 mg/kg) and lignocaine 1%. The DCPb was performed with bupivacaine 0.5% (maximum dose: 2.0 mg/kg) and lignocaine 1%. During the surgical operation we monitored (i) arterial blood pressure and heart rate (ii) the requirement for sedation and analgesic therapy (the latter also for the postoperative period) (iii) the likely need of further lignocaine 1% given by the surgeon (iv) complications of both anaesthetic techniques. Moreover VAS (visual analogue scale) pain score (0–10) was recorded. *P* values <0.05 were considered statistically significant.

**Results:** Over the study period, 60 consecutive patients underwent CEA: 30 [mean (SD) age 76.7 (6.3) yrs] with SCPb and 30 [mean (SD) age 77.1 (3.5) yrs] with DCPb. No major complications (e.g. nerve injury, phonation and swallowing disturbance) occurred. There were few (4 patients) arterial/venous punctures and no patients experienced intra-operative stroke or TIA. There was no need for either any intravascular shunt device or for conversion to general anaesthesia due to inadequate analgesic level or poor patient tolerance. Mean (SD) arterial blood pressure in the SCPb and DCPb groups were respectively: 102.4 (6.5) and 98.1 (9.1) mmHg (*P* = 0.107). No statistically significant differences were recorded in (i) mean (SD) duration of surgical operation [SCPb: 80' (5.3') vs. DCPb 84' (4.8'), *P* = 0.283]; (ii) carotid cross clamp mean (SD) times [SCPb 25' (3.2'), DCPb 23' (2.7'), *P* = 0.178]; (iii) intra-operative lignocaine supplementation [mean (SD): SCPb 69.9 mg (25.3), DCPb 69.6 mg (34.2) *P* = 0.982]; (iv) intra-operative VAS pain score [mean (SD): SCPb 3.13 (0.94), DCPb 3.85 (0.86)]; (v) the requirement for analgesic drugs in the first 24 hours after surgery (median ketorolac usage: 30 mg i.v. for both groups).

**Discussion:** Despite the high cardiovascular risk, both SCPb and DCPb were effective and no major complications were recorded. At present, in our department, the SCPb is the first choice approach, as correlated with both a low complication rate and a fast learning curve.

#### Reference:

- 1 De Sousa AA, Filho MA, Faglione W. Superficial vs. combined cervical plexus block for carotid endarterectomy: a prospective, randomized study. *Surg. Neurol.* 2005; **63** (Suppl 1): S22–25.

## O-55

### Moxonidine for prevention of perioperative myocardial ischaemia in patients undergoing major vascular surgery

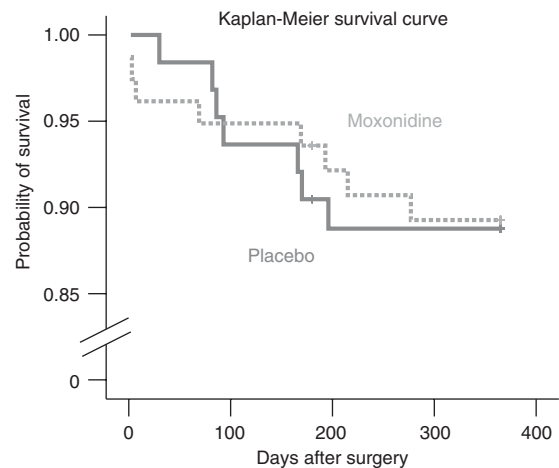
D. Bolliger, R.M. Schumann, H. Schwab, P. Christen, H. Gerber, E. Seeberger, M.D. Seeberger, M. Filipovic

University Hospital, Basel, Switzerland

**Introduction:** Cardiac complications are the leading causes of morbidity and mortality in surgical patients. They are closely associated with the occurrence of perioperative myocardial ischaemia. The objective of this study was to evaluate the effects of moxonidine, a centrally acting sympatholytic agent, on the incidence of perioperative myocardial ischaemia and postoperative mortality in patients with documented or suspected coronary artery disease who were undergoing abdominal aortic or peripheral vascular surgery. Based on a 45% incidence of perioperative ischaemia in a similar population [1], we calculated that a sample size of 180 patients per group was needed to detect a 35% reduction in ischaemia. This abstract presents the results of a predefined interim analysis based on one third of the calculated sample size.

**Method:** This was a prospective, randomized, double-blind, placebo controlled trial. After ethical approval and informed written consent, 141 patients (22 women; mean age 67.5 yr, range 46–84 yr) were randomly assigned to moxonidine (0.2 mg per os) or placebo administered the morning of the day of surgery and on the four days following surgery. Cardiac troponin I (cTnI) levels were analysed before surgery and on days 1, 2, 3 and 7 after surgery. Holter electrocardiography (ECG) was recorded for 48 hours starting immediately before the first administration of the study drug. Patient follow-up was performed by telephone interviews 6 and 12 months after surgery.

**Results:** The incidence of perioperative cTnI elevation and/or ST-segment alteration indicative for myocardial ischaemia in the Holter ECG was 40% (31/78) in the moxonidine and 37% (23/63) in the placebo group ( $\chi^2 = 0.125$ , *P* = 0.83). During a median follow up of 365 days (range 180–365 days), 8 patients (10%) in the moxonidine and 7 patients (11%) in the placebo group died (*P* = 0.89 [log-rank test]).



**Conclusion:** Moxonidine per os failed to have an effect on the incidence of perioperative myocardial ischaemia and on midterm mortality. This finding in the interim analysis resulted in a premature discontinuation of the study.

#### Reference:

- 1 Filipovic M, Jeger R, Probst C, et al. Heart rate variability and cardiac troponin I are incremental and independent predictors of one-year all-cause mortality after major noncardiac surgery in patients at risk of coronary artery disease. *JACC* 2003; **42**: 1767–1776.

## O-56

### Prognostic significance of preoperative brain natriuretic peptide in patients undergoing major vascular surgery

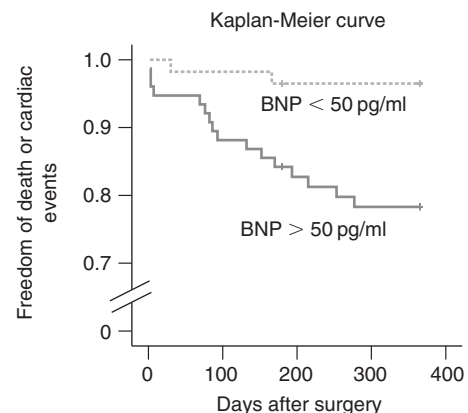
D. Bolliger, B.R. Rupinski, R.M. Schumann, C. Werner, M.D. Seeberger, M. Filipovic

University Hospital, Basel, Switzerland

**Introduction:** B-type natriuretic peptide (BNP) has shown itself to be of great diagnostic and prognostic value in the field of cardiovascular disease [1]. However, little is known about its significance in patients undergoing major surgery. Vascular surgery is associated with a markedly increased risk of perioperative and long-term cardiac morbidity and mortality. The purpose of this study was to evaluate whether elevated BNP levels are associated with increased risk of all-cause mortality and cardiac events in patients undergoing major vascular surgery.

**Method:** BNP levels were measured before induction of anaesthesia in 133 patients undergoing abdominal aortic or peripheral vascular surgery. Patients were visited daily for the first seven days in hospital and followed up with a structured telephone interview at 30 days, 6 months, and 12 months after surgery. The combined endpoint was death or the occurrence of myocardial infarction, acute coronary syndrome, or acute heart failure. A ROC curve was constructed to determine the optimal cut-off point for analysis using the Cox proportional hazards model.

**Results:** 133 patients (20 women; mean age 67.5 yr, range 46–84 yr) were included in the analysis. There was a total of 14 deaths and 4 cardiac events during the median observation period of 365 days (range 180–365 days). After adjusting for sex, age and the ACC/AHA risk classification, BNP levels greater than 50 pg/mL yielded an odds ratio of 5.5 (95% CI = 1.2–24.6; *P* = 0.025; 6 d.f.;  $\chi^2 = 13.3$ ). The negative predictive value was 0.97.



**Conclusion:** Preoperative BNP levels above 50 pg/mL are a powerful and independent predictor of postoperative death and major cardiac events in patients undergoing major vascular surgery. BNP levels below 50 pg/ml indicate event free survival.

**Reference:**

- 1 de Lemos JA, McGuire DK, Drazner MH. B-type natriuretic peptide in cardiovascular disease. *Lancet* 2003; **362**: 316–322.

## O-57

### Combined heart and liver transplantation. What indications? What management?

F. Caramelli, F. Sobaih, M. Baiocchi, S. Pastore, E. Pilato, A. Loforte, G. Grillone

*Department of Cardiothoracic Intensive Care, Department of Cardiac Surgery, S.Orsola-Malpighi University Hospital, Bologna, Italy*

**Introduction:** Combined heart and liver transplantation (CHLT) can be an effective but challenging option when a patient with a metabolic disease, treatable with liver transplantation, develops end stage heart failure e.g. familial amyloidotic polyneuropathy (FAP) or when an end stage condition is concomitant with another failure contraindicating the transplantation. FAP is an autosomal dominant inherited form of amyloidosis associated with a mutant form of protein called transthyretin (TTR) that causes abnormal systemic deposition of fibrils with elective involvement of the peripheral nervous system, but it has been known to determine cardiac, gastrointestinal and urinary tract dysfunction.

**Method:** We report our single centre experience of CHLT for amyloidotic TTR-related cardiomyopathy (5 patients from 2000 to 2005) to discuss the main clinical and technical aspects. Including our 5, there are 9 patients (pts) worldwide who underwent combined heart and liver transplantation because of FAP. We performed another CHLT for end-stage cardiac failure causing secondary severe liver insufficiency that contraindicated the cardiac transplantation.

**Results:** At present 4 of the 6 pts are alive. One pt died of Multiple Organ Failure (MOF) after 60 days of ICU stay, another died 20 months after the operation from complications related to the progression of neurological involvement of the FAP. The other pts were discharged from the hospital on average POD 20 and they are now in excellent condition. All the pts had severe myocardial diastolic dysfunction (+/- systolic dysfunction) with very marked left ventricular thickening. This would have implied an unacceptable risk for heart failure and death during or after orthotopic liver transplantation (as we had previously seen in our experience).

**Discussion:** Differences between survivors and non-survivors seem to lie mainly on the preoperative conditions (above all, the grade of peripheral neurological involvement and autonomic disturbances). Time of ischaemia, quality of graft, or cardiopulmonary bypass time were similar. The patient who died of MOF had the more advanced disease and he experienced irreversible ischaemia of the colon before manipulation of the abdominal organs, in the absence of severe hypotension or cardiac rhythm disturbances. This underlines the importance of the optimal timing for CHLT. Severe malnutrition, orthostatic hypotension and peripheral neuropathy mean limited functional reserve and advanced disease with unchangeable outcome from CHLT. In conclusion, our experience outlines the feasibility of CHLT with good results but keeping in mind that systemic involvement of the FAP in the advanced stages can seriously affect the safety of the procedure.

**Reference:**

- 1 Grazi GL, Cescon M, Salvi F, et al. Combined heart and liver transplantation for familial amyloidotic neuropathy: considerations from hepatic point of view. *Liver Transpl* 2003; **9**(9): 986–992. Review.

## O-58

### Apnoeic oxygenation in complex tracheal surgery

M.J. Jiménez, M. Sadurní, M. Tió, I. Rovira, G. Fita, E. Martínez, J.M. Gimferrer, C. Gomar, P. Macchiaroni

*Hospital Clinic, Universitat de Barcelona, Barcelona Catalunya, Spain*

**Introduction:** Airway management strategies described for complex tracheal surgery and sleeve resections include conventional ventilation via a surgically placed bronchial tube, jet ventilation via distally placed small catheters [1], as well as cardiopulmonary bypass and apnoeic oxygenation [2]. This last was introduced in our hospital during the past year. The aim of this study is to describe the blood gas changes during the procedures and its haemodynamic and neurological repercussions.

**Method:** In the year 2005, 18 patients underwent principal airway resection surgery. Tracheal surgery was performed on 12 patients (10 subglottic) and sleeve resection on 6 patients. All patients received the TIVA technique. Cerebral activity was monitored by BIS and Somanetics® (SrO<sub>2</sub> cerebral). In all cases the ventilation technique during the procedure was apnoeic oxygenation as follows: (1) Before sectioning the airway patients were hyper-oxygenated and hyperventilated with 100% O<sub>2</sub> for 10 minutes (hyper-oxygenation period). (2) The tracheal tube was moved to the vocal cords and a paediatric catheter was placed above the carina by the surgeon through the surgical field delivering a continuous flow of 15 L O<sub>2</sub>/min (apnoeic period). (3) When the reconstruction was completed the tracheal tube was reintroduced and the patient was conventionally ventilated (post-apnoeic period). Blood gases samples were taken every 15 min during these 3 periods.

**Results:** The apnoeic period was 26 to 75 minutes (42 ± 15 min). At 60 min, PCO<sub>2</sub> reached 105 mmHg, the values of PO<sub>2</sub> were 117 mmHg and pH decreased to 7.05. These values were corrected in the post apnoeic period although a slight hypercapnoea remained (table below).

**Table:** shows the evolution in blood gases during these periods only for patients who underwent tracheal surgery (N = 12).

N = 12	A	Apnoeic period				B
		15 min	30 min	45 min	60 min	
pH	7.51 ± 0.5	7.28 ± 0.4	7.20 ± 0.4	7.12 ± 0.6	7.05 ± 0.5	7.35 ± 0.3
PaO <sub>2</sub>	462 ± 72	298 ± 103	231 ± 73	149 ± 65	117 ± 20	214 ± 88
PaCO <sub>2</sub>	29.3 ± 4.8	56.6 ± 7.0	70.1 ± 9.6	84.6 ± 1.1	105 ± 3.6	43.7 ± 2.3
BE	0.7 ± 1.6	-0.8 ± 1.6	-1.2 ± 1.9	-3.3 ± 0.3	-4.0 ± 1.8	-0.8 ± 1.7

A = hyperoxygenated; B = post apnoeic

In the remaining 6 patients (sleeve resection), due to the complexity of surgery we occasionally needed to ventilate via a surgically placed bronchial tube for a short period in order to restore safe O<sub>2</sub> values. No haemodynamic disturbances were found in relation to respiratory changes and no neurological problems were recorded. All patients were extubated within 2 hours of surgery.

**Conclusions:** In our experience apnoeic oxygenation with a small flow of oxygen through a catheter is a safe and valid anaesthetic alternative to the cross-surgical field intubation technique in such a complex surgery, improving surgical exposure.

**References:**

- 1 Williams H, Gothard J. Jet ventilation via a Univent tube for sleeve pneumonectomy. *Eur J Anaesthesiol* 2001; **18**: 407–409.
- 2 Go T, Altmayer M, Richter M, et al. Decompressing manubriectomy under apnoeic oxygenation to release the median thoracic outlet compartment in Bechterew disease. *J Thorac Cardiovasc Surg.* 2003; **126**: 867–869.

## O-59

### Epidural cooling for spinal cord protection during surgical TAA repair

A. Berezin<sup>1</sup>, R. Indeglia<sup>2</sup>

*<sup>1</sup>Rhode Island Hospital, Providence, RI, USA; <sup>2</sup>Department of Cardiothoracic Surgery, Miriam Hospital, Providence, RI, USA*

**Introduction:** The purpose of this study was to assess the efficacy of epidural cooling as a technique to prevent ischemic spinal cord injury during TAA repair.

**Method:** Observational study in a 247-bed community university-affiliated hospital. Epidural cooling was introduced in clinical practice in 1994 [1], since that time there are convincing data of improving protection of spinal cord ischaemia when it was used [2,3].

Outcomes of 62 patients undergoing elective or urgent surgical repair of TA and TAA were analysed. In 32 patients an epidural cooling technique was used to decrease CSF temperature down to 25°C at the moment of aortic cross clamp. In 30 patients epidural cooling was not used.

**Results:** A 50% decrease in the paraplegia rate was observed in the patients where epidural cooling was used, as compared to the control group.

**Conclusion:** Epidural cooling significantly reduces ischaemic spinal cord injury. Epidural cooling is a reliable and efficacious technique which can improve outcome of spinal cord protection during TAA repair.

**References:**

- 1 Davison JK, Cambria RP, Vierra DJ, et al. Epidural cooling for regional spinal cord hypothermia during thoracoabdominal aneurysm repair. *J Vasc Surg* 1994; **20**(2): 304–310.
- 2 Cambria RP, Clouse WD, Davison JK, et al. Thoracoabdominal aneurysm repair: results with 337 operations performed over a 15-year interval. *Ann Surg.* 2002; **236**: 471–479.
- 3 Motoyoshi N, Takahashi G, Sakurai M, et al. Safety and efficacy of epidural cooling for regional spinal cord hypothermia during thoracoabdominal aneurysm repair. *Eur J Cardiothorac Surg.* 2004; **25**(1): 139–141.

## Paediatric Cardiac Anaesthesia and ICU

### O-60

#### Serial lactate determination in blood and subcutaneous microdialysis fluid in children after congenital heart surgery

D. Vlasselaers, J. Dubois, P. Wouters, I. Milants, M. Eerdeken, G. Van den Berghe

ICU, University Hospitals Leuven, Belgium

**Introduction:** Blood lactate concentrations in critically ill patients are used to detect tissue hypoxia and assess severity of illness. In children after congenital heart surgery (CHS), serial lactate measurements yield a reliable prognostic index, accurately predict survival while a progressive decline is strongly associated with a good outcome [1,2]. Frequent blood sampling in children however can be a cause of discomfort and excessive blood loss, necessitating blood transfusions. Microdialysis of the subcutaneous adipose tissue is promoted as a safe alternative for metabolic and biochemical tissue monitoring, avoiding frequent blood sampling [3]. We prospectively investigated the correlation between serial lactate measurements in blood (BL) and microdialysis fluid (MFL) collected from the subcutaneous adipose tissue in children after CHS.

**Method:** 15 children, admitted to the PICU after CHS, were enrolled after informed consent was obtained from the parents and were studied for 48 consecutive hours. A CMA 60 double lumen microdialysis catheter was inserted in the subcutaneous adipose tissue of the abdominal wall. This catheter was continuously perfused at 1  $\mu\text{L}/\text{min}$  with a 5% mannitol solution via the inlet tubing. The microvials connected to the outlet tubing of the catheter and collecting the microdialysate fluid (MF), were changed every hour and immediately stored at  $-80^{\circ}\text{C}$ . At the time when the microvials were changed 0.5 mL of arterial blood was withdrawn and BL was determined. In total, 733 paired samples of BL and MFL were analysed.

**Results:** There were no complications with the microdialysis technique and all children were discharged from the hospital. Mean age was 40 months (range: 4–118 m) and mean bodyweight was 13.7 kg (range: 5.5–25.9 kg). Mean recovery rate of MF was 84% (range: 51–100%). Mean BL and MFL were 1.06 and 9.98 mmol/L respectively. There was a significant difference between BL and MFL ( $P < 0.0001$ ) and the correlation between BL and MFL was poor ( $R^2 = 0.559$ ).

**Conclusion:** Serial monitoring of lactate levels in microdialysis fluid harvested in the subcutaneous adipose tissue is not a reliable method to assess the haemodynamic status and general tissue perfusion in children after CHS.

#### References:

- 1 Charpie JR, Dekeon MK, Goldberg CS, et al. Serial blood lactate measurements predict early outcome after neonatal repair or palliation for complex congenital heart disease. *J Thorac Cardiovasc Surg* 2000; **120**: 73–80.
- 2 Cheung PY, Chui N, Joffe AR, et al. Postoperative lactate concentrations predict the outcome of infants aged 6 weeks or less after intracardiac surgery: a cohort follow-up to 18 months. *J Thorac Cardiovasc Surg* 2005; **130**: 837–843.
- 3 Hack A, Busch V, Gempel K, et al. Subcutaneous microdialysis for children – safe biochemical tissue monitoring based on a minimal traumatizing no touch insertion technique. *Eur J Med Res* 2005; **10**: 419–425.

### O-61

#### Exogenous surfactant in children with hypoxaemic pulmonary disease and cyanotic cardiopathy: case report

C. Bellucci, T. dela Torre, F. Belloli, A. Ballotta, H. Kandil, F. Bettini, H.E.B. El Baghdady, G. Butera, R. Abella, A. Frigiola

Department of Cardiac Surgery, Cardiothoracic Intensive Care, Policlinico San Donato, San Donato Milese, Milan, Italy

In preterm infants surfactant deficiency is the major cause of hypoxaemic respiratory failure. The insufficiency of surfactant can complicate the clinical progress of infants with cyanotic congenital cardiopathy and diminished pulmonary flow.

**Case Report:** A 35 week preterm newborn was mechanically ventilated since birth due to tachypnoea, cyanosis and hypoxaemia. A diagnosis of respiratory distress was determined by clinical presentation and the chest radiograph. The diagnosis of tetralogy of Fallot was confirmed by echocardiography. Surgery was indicated because of hypoxaemia refractory to treatment. Before a modified Blalock-Taussig shunt procedure, we started therapy with exogenous surfactant (Curosurf 2 doses, 4 mL kg<sup>-1</sup> dosi<sup>-1</sup>).

After 24 hours with exogenous surfactant therapy, the clinical condition improved and the infant underwent successful palliative surgery at 10 days of life.

**Conclusion:** We believe that initial surfactant therapy, by improving the clinical condition, is a successful approach, mainly for this age group having

malformations that combine severe hypoxaemia of pulmonary and cardiac aetiology. It achieves haemodynamic stabilization and avoids undue urgent intervention with the risk of exposing children under 10 days to the physiopathological alterations of the extracorporeal circulation.

### O-62

#### Thyroid hormone levels in paediatric cardiac surgery: evaluation with respect to patients' and surgical characteristics

E.A. Akpek, H. Mutlu, A. Donmez, F. Demirsoy, S. Aslamaci

Baskent University Department of Anesthesiology, Ankara, Turkey

**Introduction:** Thyroid hormone secretion is greatly suppressed in children with critical illness and after major surgery. Recent studies in children who received triiodothyronine (T3) after paediatric cardiac surgery showed significant improvement in cardiac function. The aim of this study was to assess thyroid function in children undergoing cardiac surgery and to investigate the correlation of hormone levels with patients' and surgical characteristics, as well as haemodynamic status.

**Method:** After Ethics Committee approval, 77 children with congenital heart disease who were scheduled for cardiac surgery in Baskent University Hospital were included in this prospective observational study. Blood samples were obtained at baseline (t1), at the end of operation (t2), and at 48 hour post-surgery (t3) to measure levels of total T3, total T4 and TSH. Hormone levels were compared with four subgroups: age (infant vs. child), weight (<10 kg vs. >10 kg), presence or absence of cyanosis and administration of CPB (yes or no). Other data included perioperative haemodynamics, inotropic requirements, duration of mechanical ventilation, length of ICU and hospital stay.

**Results:** Patients included 50 (65%) male, 34 (44.2%) infants and 32 (41.6%) cyanotics. Mean age was  $2.2 \pm 1.9$  years with 45 (58.4%) of children less than 10 kg. Seven (9%) of the cases were done without CPB. Four patients had low total T3 levels at baseline, 11 had low values at 48 hour post-surgery. Two patients had low T4 levels, one at baseline and the other at 48 hour post-surgery. Total T3 levels decreased over time in all subgroups when compared to baseline values, except in non-CPB patients. However, mean values were within normal range in all subgroups, except for infants ( $0.67 \pm 0.29$  ng/mL in infants vs.  $0.82 \pm 0.31$  ng/mL in children) at 48 hour post-surgery. Patients with a low T3 level at 48 hour post-surgery had a significantly lower blood pressure in the ICU ( $P < 0.05$ ). However, inotropic requirements, duration of mechanical ventilation, length of ICU and hospital stay were not correlated with thyroid hormone levels.

**Conclusion:** These findings reveal that thyroid hormone levels after congenital heart surgery decrease when compared to baseline. The infant age group had total T3 levels below the normal range. However, this study does not exclude the effect of prophylactic T3 treatment on haemodynamics and/or inotropic requirements.

#### References:

- 1 Bettendorf M, Schmidt K, Grulich-Henn J, et al. Tri-iodothyronine treatment in children after cardiac surgery: a double-blind, randomised, placebo-controlled study. *Lancet* 2000; **356**(9229): 529–534.
- 2 Chowdhury D, Ojamaa K, Parnell VA, et al. A prospective randomized clinical study of thyroid hormone treatment after operations for complex congenital heart disease. *J Thorac Cardiovasc Surg* 2001; **122**(5): 1023–1025.

### O-63

#### Natriuretic peptide levels correlate strongly with cardiac index and global ejection fraction following paediatric cardiac surgery

T. Breuer<sup>1</sup>, A. Székely<sup>2</sup>, E. Sági<sup>2</sup>, E. Székely<sup>2</sup>, B. Héthársi<sup>2</sup>, L. Seres<sup>3</sup>, J. Leppaluoto<sup>4</sup>, A. Szatmári<sup>5</sup>

<sup>1</sup>School of Ph.D. Studies, Semmelweis University, Budapest, Hungary;

<sup>2</sup>Department of Paediatric Anaesthesia and Intensive Care; <sup>3</sup>Department of Cardiac Research; <sup>4</sup>Department of Physiology, University of Oulu, Oulu, Finland and <sup>5</sup>Department of Paediatric Cardiology, Gottsegen Hungarian Institute of Cardiology, Budapest, Hungary

**Introduction:** Atrial (ANP) and brain natriuretic peptides (BNP) and the N-terminal fragments of their prohormones (NT-proANP, NT-proBNP) have been used to diagnose heart failure, to assess disease gravity and also for prognostic purposes. Recently pulse contour cardiac output analysis and transpulmonary thermodilution have achieved an important role in early recognition of cardiac failure in paediatric cardiac patients [1].

**Method:** After approval of the institutional review board and parents' informed consent we investigated the clinical data of 11 children following open-heart cardiac surgery. We measured the level of NT-proANP, NT-proBNP preoperatively, postoperatively and 12, 24, 48 and 72 hours after arrival at the intensive care unit. The haemodynamic status was assessed by pulse contour cardiac output analysis and transpulmonary thermodilution at the same time points. For statistical analysis, Spearman correlation analysis was applied.

**Results:** We found strong correlation between NT-proANP, NT-proBNP levels and cardiac index (CI), stroke volume index (SVI) and global ejection fraction (GEF).

	CI		SVI		GEF	
	r	p	r	p	r	p
NT-proANP	-0.52	<b>0.005</b>	-0.40	0.054	-0.50	<b>0.013</b>
NT-proBNP	-0.48	<b>0.012</b>	-0.72	<b>&lt;0.001</b>	-0.49	<b>0.016</b>

**Conclusions:** Our data suggest that natriuretic peptide levels have a good correlation with haemodynamic parameters and therefore they can be used to monitor the haemodynamic status following paediatric cardiac surgery.

**Reference:**

- 1 Della Rocca G, Costa MG. Volumetric monitoring: principles of application. *Minerva Anestesiologica* 2005; 71: 303–306. Review.

## Risk Factors and Outcome

### O-64

#### Neural network model for mortality

R. Martinez Escobar, M. Ferrante, G. Tasca, E. Conti, G. Finamore, B. Amari

Fondazione Poliambulanza, Brescia, Italy

**Introduction:** Logistic regression (LR), a method commonly used for mortality prediction in cardiac surgery [1], has some limitations. Artificial neural networks (ANNs) are non-parametric methods that have been proposed as an alternative [2]. We compared the performance of two models created with these approaches, using preoperative risk factors, to predict mortality after cardiac surgery.

**Method:** We used data of 3288 consecutive, >18-year patients undergoing cardiac surgery admitted to our cardiac intensive care unit from October 1998 to August 2005. We constructed a LR model and an ANN model on a set (development set) of 2537 patients (October 1998–December 2003) and validated both models by using a set (validation set) of 751 patients (January 2004 – August 2005). Multivariate analysis was used to identify independent preoperative variables associated with death. We developed both models by means of the same preoperative variables, then we assessed the performance of the models by evaluating their calibration and discrimination on the development set and validation set.

**Results:** Six preoperative variables were included in the models: age, serum creatinine, heart failure, surgery of the thoracic aorta, emergency and rescue operation. The neural network was a 3-layer multilayer perceptron, with 4 nodes in the hidden layer. Calibration, assessed by the Hosmer-Lemeshow test, was good in the LR model (development set:  $P = 0.8$ ; validation set:  $P = 0.8$ ) but not in the ANN model (development set  $P < 0.001$ ; validation set:  $P < 0.001$ ). Discrimination, assessed by the area under the receiver operating characteristic curve (ROC area), was good in the two models in the development set: 0.84 in the LR model (95% confidence interval: 0.786–0.9) and 0.83 in the ANN model (95% confidence interval: 0.775–0.893). In the validation set the ROC area was 0.9 in the LR model (95% confidence interval: 0.837–0.894), and 0.92 in the ANN model (95% confidence interval: 0.861–0.976).

**Discussion:** In this study the performance of the logistic regression model was superior to the neural network model in terms of calibration, but discrimination was similar in both models. Neural networks could be an alternative to logistic regression to predict mortality after cardiac surgery.

**References:**

- 1 Shahian DM, Blackstone EH, Edwards FH, et al. Cardiac surgery risk models: a position article. *Ann Thorac Surg* 2004; 78: 1868–1877.
- 2 Tu JV. Advantages and disadvantages of using artificial neural networks versus logistic regression for predicting medical outcomes. *J Clin Epidemiol* 1996; 49: 1225–1231. Review.

### O-65

#### Quality of life and predictors of long-term survival after cardiac surgery

E. Bignami, G. Landoni, G. Crescenzi, G. Giardina, F. Boroli, O. Fochi, G. Aletti, A. Zangrillo

Department of Cardiothoracic and Vascular Anesthesia, IRCCS San Raffaele Hospital, Vita-Salute University of Milano; Department of Mathematics, University of Milano, Milano, Italy

**Introduction:** Cardiac surgery is still associated with non-negligible mortality and complications. We assessed long-term (3 years) survival and quality of life of 267 patients who underwent conventional heart surgery from April to June 2002.

**Method:** Consecutive patients were interviewed by phone calls. Through a structured (Medical Outcomes Study Short-Form) questionnaire [1] we investigated general health, functional status, activities of daily living and perception of life. We also asked if the patient needed re-admission in hospital.

**Results:** Only 8 patients died (3.0%), 7 of them from cardiac complications and 1 for cancer; Thirty-six patients (13.5%) had hospital admission for atrial fibrillation or other arrhythmias (9.3%), myocardial infarction (0.3%), heart failure (1.9%), percutaneous stenting (2.2%) and other causes (1.9%). None needed cardiac surgical re-intervention, 21 patients (7.9%) were recovered for non-cardiac-causes and 15 patients were lost to follow up (5.6%). No limitation in function activities of daily living was reported by most patients (94%), 92% perceived their general health as being excellent, very good or good and none considered it insufficient; 80% were NYHA I, 17% NYHA II, 3% NYHA III and none NYHA IV. The univariate analysis of 20 perioperative data indicated that only 5 factors were associated with postoperative death (table 1).

**Table 1.**

Event	Dead	Survivors	P
Peak troponin I (ng/mL)	23 (13–44)	8 (5–13)	<0.001
CPK-MB (ng/mL)	95 (42–140)	35 (21–58)	=0.005
Myocardial infarction	3 (30%)	5 (1.9%)	=0.002
ICU stay (days)	4.5 (1–12)	1 (1–2)	=0.006
Hospital stay (days)	18 (11–30)	5 (4–7)	<0.001

The multivariate analysis indicated that peak cardiac troponin I (OR 1.1 per ng/mL 95% CI 1.04–1.16  $P < 0.001$ ) and length of postoperative hospital stay (OR 1.08 per day 95% CI 1.01–1.15  $P = 0.03$ ) were independently associated with death.

**Discussion:** This three years follow up shows a low (3%) long-term mortality with excellent quality of life in patients undergoing cardiac surgery. Peak cardiac troponin I release [2] and length of hospital stay were the only independent predictors of death.

**References:**

- 1 Stewart AL, Hays RD, Ware JE Jr. The MOS short-form general health survey. Reliability and validity in a patient population. *Med Care* 1988; 26: 724–735.
- 2 Lehrke S, Steen H, Sievers HH, et al. Cardiac troponin T for prediction of short- and long-term morbidity and mortality after elective open heart surgery. *Clin Chem* 2004; 50: 1560–1567.

### O-66

#### Great changes in patient profile and procedures invalidate the EuroSCORE

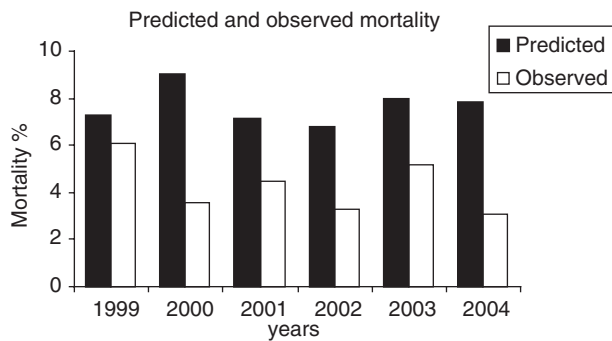
A.G. Lorentzen, E. Sloth, C.-J. Jakobsen

Department of Anaesthesia & Intensive Care, Aarhus University Hospital, Skejby Sygehus, Aarhus, Denmark

**Introduction:** Preoperative risk scores are essential for risk assessment, cost-benefit analysis and the study of therapy trends. Various score systems have been developed but although all are based on patient derived data, such as age, gender and co-morbidity, there are considerable differences in design and validity. One of the major risk assessment systems is the EuroSCORE [1, 2]. The purpose of our study was to evaluate the consistency of the EuroSCORE parameters in a large surgical population and to evaluate any changes in risk indices or results over time.

**Method:** Since January 1999, all adult cardiac surgery in Denmark has been reported to a central cardiac database. The West Danish Heart database is an internet based real time on-line system and contains: Referral, Risk-profile, EuroSCORE, Surgery, Anaesthesia, Intensive Care, Complications and

Discharge data. Initially, the Tuman and Parsonnet systems were used for risk assessment, but these have since been replaced by the EuroSCORE as the primary risk assessment tool. The database contains 5,571 procedures in the period to December 2004.



**Results:** From 1999 the EuroSCORE and predicted logistic mortality have slightly increased, while the observed mortality has decreased. The difference between predicted and observed mortality was insignificant in 1999, while in 2004 this difference was highly significant ( $P = 0.0001$ ). The average age has increased from 63.9 to 65.3 years and correcting the EuroSCORE for age changes, we found no significant change in the total EuroSCORE. The predominant change in age is a significantly greater number of patients older than 74 ( $P = 0.0001$ ). Other changes in this period are a great increase in procedures other than CABG (valve- and double procedures from 27.2% to 49.7%), a significant fall in patients with unstable angina and a small increase in patients coming for re-operation.

**Discussion:** The overall contribution of age to the EuroSCORE was 34.7%. Furthermore, the changes in procedure types and unstable angina contributed by 14.0% and 5.7% respectively. Altogether they count for a more than 50% change in the composition of the EuroSCORE since 1999. These changes are also reflected in great variations in the odds ratio of the individual parameters. Assuming that this is the "normal" finding in Cardiac Centres, the significant changes indicate that the EuroSCORE may no longer be valid and thus an update of the score system may be needed. This could be done by establishing a database system that permits regular upgrades, similar to the Danish Heart Registry ([www.dhreg.dk](http://www.dhreg.dk)).

#### References:

- 1 Roques F, Nashef SA, Michel P, et al. Risk factors and outcome in European cardiac surgery: analysis of the Euro-SCORE multinational database of 19 030 patients. *Eur J Cardiothorac Surg* 1999; **15**: 816–822.
- 2 Roques F, Michel P, Goldstone AR, et al. The logistic EuroSCORE. *Eur Heart J* 2003; **24**: 882–883.

## O-67

### A cardiac recovery unit increases quality of postoperative treatment and decreases intubation time and time spent in ICU

B.H. Nielsen, L. Folkersen, E. Sloth, C.-J. Jakobsen

Department of Anaesthesia & Intensive Care, Aarhus University Hospital, Skejby Sygehus, Aarhus, Denmark

**Introduction:** In many institutions cardiac surgical patients are cared for in Intensive Care Units (ICU). These can either be dedicated cardiothoracic units or part of a general ICU. Having previously overseen cardiac surgical patients in a general ICU setting, in 2003 we established a specialized cardiac recovery unit, with dedicated nursing staff and the presence of a specialist in cardiac anaesthesia 24 hours a day. At the same time the nursing staff were given a wider range of standard protocols for medication and the unit name was changed from ICU to Cardiac Recovery. Our aim in this study was to evaluate the effect on the quality of postoperative care.

**Method:** Since 1999, all adult cardiac surgery in Denmark has been reported to a central cardiac database. The system is an internet based real time on-line system and contains, among others, sections for risk-profile, anaesthesia, intensive care and complications. All data in this study is derived from our database containing 5,571 procedures in the period to December 2004.

**Results:** During this period there have been some changes in patient profile and procedure types, and the overall EuroSCORE for the period has increased

slightly from 5.38 to 5.64. The average intubation time has decreased from 22.3 to 11.4 hours and the mean ICU stay from 51.6 to 35.9 hours. The number of patients staying less than 18 hours has significantly increased ( $P < 0.0001$ ) and the number of patients staying more than 96 hours has significantly decreased ( $P = 0.0182$ ). In the same period, the number of patients ventilated for less than 6 hours after surgery has increased from 40.7% to 59.5% ( $P < 0.0001$ ). The use of vasodilators and pacemakers has significantly increased, while the use of inotropes has significantly decreased.

	1999	2000	2001	2002	2003	2004
A						
B	45.18%	36.36%	41.42%	55.98%	57.46%	55.38%
C	15.05%	12.24%	9.15%	10.14%	11.13%	12.79%
Pacemaker	18.92%	22.06%	26.77%	28.05%	27.81%	36.76%
IABP	4.97%	5.15%	3.16%	3.52%	3.44%	2.16%
No inotropes	59.25%	67.90%	69.83%	70.61%	72.71%	75.23%
Dopamine	13.66%	9.47%	6.92%	7.09%	6.46%	3.42%
D	14.72%	13.28%	14.05%	15.72%	12.08%	11.87%
E	12.30%	9.33%	9.13%	9.13%	6.55%	9.45%

A = Postoperative treatment; B = Vasodilatation drugs; C = Anti-arrhythmic drugs; D = Low dose inotropes; E = medium/high dose inotropes

**Discussion:** The increased use of vasodilators and pacemakers can easily be explained by a more than 100% increase in the number of procedures including valve replacement. The fall in use of inotropes may be partly explained by the lower proportion of CABG patients, although this is unclear due to the increase in number of double procedures and the slightly higher EuroSCORE. The huge decrease in ICU and ventilation time is partly due to an agreed policy in the department. Nevertheless, when the changes in patient profile are taken into account, this fall is greater than expected. We conclude that the use of a dedicated Cardiac Recovery unit, staffed by specialist nurses and with a specialist anaesthesiologist present around the clock, is the major reason for the improved quality and the lower costs associated with shorter observation and treatment time.

## O-68

### Three-year survival after major post-cardiac operative complications

O.V. Hein, C. Spies

Department of Anesthesiology and Intensive Care, Berlin, Germany

**Introduction:** After cardiac surgery, major morbidities known to be primary contributors to perioperative mortality are cardiac failure, respiratory failure, renal failure, and the need for mediastinal exploration. The first aim of this study was to compare the long-term survival in cardiac surgery patients with and without the occurrence of major morbidities. The second aim was to estimate the incidence and risk factors for the four major morbidities in a cardiac surgery patient population.

**Methods:** The Institutional Review Board approved the study and waived the need for individual consent. We included 2683 consecutive cardiac surgery patients cared for in a uniform fashion in a cardiothoracic intensive care unit at a university hospital. Clinical judgement as well as pre-, intra-, and postoperative risk factors leading to adverse outcome as defined in previous studies [1–4] were assessed as risk factors for the four major morbidities and mortality. Kaplan-Meier estimates for 3-year long-term survival were determined. Survival curves for the occurrence and non-occurrence of major morbidities were compared using the Log-Rank test. Univariate analyses were performed to identify risk factors associated with major morbidity and mortality. Mann-Whitney-U test was used for continuous variables and the  $\chi^2$  test for categorical and qualitative variables. Risk factors with  $P < 0.05$  on univariate analysis were entered in the multivariate analysis. Multivariate logistic stepwise regression was performed using a backward likelihood ratio technique. The odds ratio, 95% confidence interval (CI), and  $P$  values were calculated for each risk factor. The predictive performance of the risk model was assessed via the area under the receiver operating characteristics curve (AUC). The Hosmer-Lemeshow goodness-of-fit test was performed to evaluate how well the model was calibrated  $P < 0.05$  was considered to be significant.

**Results:** Perioperative mortality was significantly increased by the occurrence of major morbidity. In hospital mortality was 0.7% in the absence of major morbidity and 72% when all major morbidities occurred. 3-year mortality for the entire study population was 15%. For patients with morbidities, 3-year long-term survival was significantly decreased compared to patients without these morbidities. Various independent perioperative risk factors were found for perioperative major morbidity and mortality. Increasing age was an independent risk factor for mortality. An emergency operation was an independent risk factor for heart failure, respiratory failure, and MOF. Low

preoperative EF was an independent risk factor for heart failure and hospital mortality. High preoperative creatinine was a risk factor for ARF-D and MOF. Longer surgery duration was an independent risk factor for mediastinal exploration. Longer CPB duration was a risk factor for IABP, IABP/VAD and MOF. High APACHE II score on admission was an independent risk factor for all major morbidities with the exception of respiratory failure. Mild heart failure, i.e., high dose catecholamine therapy, was an independent risk factor for virtually all major morbidities. Respiratory failure was a risk factor for heart and renal failure, mediastinal exploration and ICU mortality. ARF-D was a risk factor for respiratory failure and mortality. IABP was a risk factor for VAD, mediastinal exploration and in hospital mortality. Mediastinal exploration during index hospitalization was a risk factor for heart failure, respiratory failure, MOF, and mortality. The predictive performance of the risk models assessed with AUC and calibration of the risk models assessed with Hosmer-Lemeshow goodness-of-fit test were good.

**Conclusions:** This study showed increased ICU-, hospital- and long-term mortality in the patients with major morbidities. In order to reduce worse

outcome, patients at risk have to be identified through risk assessment with previously determined independent risk factors as done in this study. However, not only measures to identify and reduce the risk of major morbidities and successful acute treatment are necessary to improve outcome. In addition, longer term follow-up and management of morbidities are necessary to possibly add to improvement in long-term survival.

#### References:

- Shroyer AL, Coombs LP, Peterson ED, et al. The Society of Thoracic Surgeons: 30-day operative mortality and morbidity risk models. *Ann Thorac Surg* 2003; **75**: 1856–1864.
- O'Brien MM, Shroyer AL, Moritz TE, et al. Relationship between processes of care and coronary bypass operative mortality and morbidity. *Med Care* 2004; **42**: 59–70.
- Rady MY, Ryan T. Perioperative predictors of extubation failure and the effect on clinical outcome after cardiac surgery. *Crit Care Med* 1999; **27**: 340–347.
- Ostermann ME, Taube D, Morgan CJ, Evans TW. Acute renal failure following cardiopulmonary bypass: a changing picture. *Intensive Care Med* 2000; **26**: 565–571.

## Thoracic and Vascular Anaesthesia

### O-69

#### Comparison between three different doses of intrathecal morphine in cardiac surgery

S. Casalino, E. Stelian, E. Novelli, F. Mangia, C. Sozio, C. Alessi, G. Lanzillo, M. Diena

Department of Anaesthesia, Department of Cardiac Surgery, Department of Biostatistics, Clinica San Gaudenzio, Novara, Italy

**Introduction:** Intrathecal morphine (ITM) has been used to decrease post-operative pain in patients undergoing abdominal surgery. Several studies report the use of ITM in cardiac surgery. There are still controversies about optimal dose, those which have been reported ranging between 5 and 30 mcg kg<sup>-1</sup> [1]. The goal of this study was to establish which dosage is associated with good pain control without prolonged mechanical ventilation or increased incidence of adverse effects.

**Method:** 60 adult patients scheduled for elective cardiac surgery have been prospectively evaluated. Exclusion criteria were: severe respiratory dysfunction (FEV<sub>1</sub> < 1 L), left ventricular ejection fraction < 35%, serum creatinine > 200 µmol L<sup>-1</sup>. Patients were randomly assigned (20 patients per group) to one of the following doses of intrathecal opioids: (A) morphine 7 mcg kg<sup>-1</sup> of ideal Body Weight (BW) + 50 mcg of fentanyl; (B) morphine 14 mcg kg<sup>-1</sup> of ideal BW + 50 mcg of fentanyl; (C) morphine 28 mcg kg<sup>-1</sup> of ideal BW + 50 mcg of fentanyl. Anaesthesia was accomplished with propofol 4 mg kg<sup>-1</sup> h<sup>-1</sup>, fentanyl 10–20 mcg kg<sup>-1</sup> and pancuronium.

**Measurements:** Duration of postoperative mechanical ventilation and levels of PaCO<sub>2</sub> and PaO<sub>2</sub>/FiO<sub>2</sub> (P/F) as gas exchange indicator were recorded. Pain was evaluated using visual analogue score (VAS) (ranging from 0 to 10). All these parameters were recorded 4, 12 and 24 hours after surgery. Prince Henry pain scale score (PHS) (ranging from 0 to 4) was recorded 24 hours after surgery to evaluate feasibility and cooperation to respiratory physiotherapy. Incidence of neurological events, nausea/vomiting, pruritus have been monitored.

**Results:** Demographic data, left ventricular ejection fraction, type of surgical procedures, cardiopulmonary bypass duration, aortic cross-clamping time, use of inotropes, incidence of nausea were similar. Neither neurological events nor respiratory depression have been encountered.

	Group A			Group B			Group C		
	4h	12h	24h	4h	12h	24h	4h	12h	24h
VAS	0.29	0.2	0.1	0.25	0.21	0.29	0.14	0.29	0.29
PCO <sub>2</sub>	5.6	5.3	5.3	6.1	5.5	5.3	5.7	5.3	5.2
P/F	409	361	393	348	341	342	353	334	348
PHS	0.5	0.58	0.71						
T.M.V	258 ± 110 min			284 ± 147 min			333 ± 183 min		

PCO<sub>2</sub> – kPa; T.M.V. = Time of Mechanical Ventilation

**Discussion:** These results show no significant statistical differences among the three groups. With increasing dose of ITM, mechanical ventilation was prolonged, even if statistical significance was not reached ( $P = 0.338$ ) due to the small number of patients. Low doses ITM (7 mcg kg<sup>-1</sup>) provide post-operative analgesia as effective as high doses ITM (28 mcg kg<sup>-1</sup>) without the need for prolonged ventilation.

#### Reference:

- Falucco O. Central neuraxial analgesia in cardiac surgery *Mt Sinai J Med* 2002; **69**: 45–50. Review.

### O-70

#### Diagnostic pitfalls of traumatic rupture of the thoracic aorta: case report

L. Mantovani, M. Mazzoni, G.L. Canu, S. Minuscoli, R. Ceriani, M. Setti, F. Bortone

Department of Anesthesia and Intensive Care, Humanitas-Gavazzeni, Bergamo, Italy

There are diagnostic difficulties associated with traumatic rupture of the descending thoracic aorta [1].

**Case Report:** A 53-yr-old, previously healthy male, victim of blunt chest trauma, was admitted to the Intensive Care Unit (ICU) of a tertiary care referral centre, having developed acute heart failure and a descending thoracic aortic tear.

On ICU admission the patient was alert, haemodynamically stable with a slight sinus tachycardia, and oxygen saturation 99% with FiO<sub>2</sub> 0.4. A chest CT scan showed a minimal periaortic effusion in the descending thoracic aorta in the isthmus area without any sign of a direct lesion of the aortic wall. At the same time, transthoracic echocardiography (TTE) showed the presence of minimal apical heart hypokinesia without any pericardial effusion or direct aortic lesion. Troponin I level was 12.3 ng/mL. On the first day, troponin I was 54.0 ng/mL, Hb and Ht were decreasing (10.8 g/dL and 30.2%). At CT scan, the presence of an aortic tear or wall haematoma was excluded and a little “notch” at the level of the isthmus was visualized. A transoesophageal echocardiogram (TOE) showed a wide akinetic zone involving the cardiac apex, 2/3 anterior wall and septum. In addition, there was evidence of thickening of the descending thoracic aorta wall at the isthmus described as compatible with haematoma ranging from 3 to 6 mm thickness. At ECG there was elevation of the ST segment from V2 to V6. Therapy with platelet aggregation inhibitors was instituted. Based on risk/benefit analysis no coronary angiography was done. On the second day, TOE showed worsening of the cardiac kinesis with an extension of the akinesis to the whole anterior wall. The lesion at the descending aortic level was increased with a maximum thickness of 13 mm without any sign of intimal tear or flap. Chest CT scan showed the presence of notches referred as recent partial post-traumatic aortic wall lesions. During the evening acute heart failure developed, and mechanical ventilation and an epinephrine infusion were started. Troponin I serum levels were highly increased (161.21 ng/mL). Next day, an endoprostheses was placed in the descending thoracic aorta. On the 10th day, the patient was discharged from ICU. The TTE showed an aneurysm of the apical anterior left ventricular wall, akinesis and dilatation of apex and anterior wall and a LVEF of about 25–30%. Four months later, the patient was operated on for left ventricular aneurysmectomy and bypass of the left anterior descending artery, uneventfully.

**Conclusion:** This case reports that late after chest blunt trauma, an aortic tear may evolve together with extension of myocardial infarction. After prior exclusion of aortic rupture, diagnostic tests must be repeated and the diagnosis actively sought, as suggested by close monitoring of clinical status and a high index of suspicion. Where available, a non invasive coronary study would be recommended.

#### Reference:

- Gleason TG, Bavaria JE. Trauma to great vessels. In: Cohn LH, Edmunds LH Jr. eds. *Cardiac Surgery in the Adult*. McGraw Hill, 2003; 1229–1250.



**O-71****Interventional lung assist (ILA) during neck wound repair after tracheal surgery: case report**I. Rovira<sup>1</sup>, G. Fita<sup>1</sup>, A. Alcón<sup>1</sup>, P. Matute<sup>1</sup>, M. Iglesias<sup>2</sup>, P. Macchiarini<sup>2</sup><sup>1</sup>Anaesthesia and <sup>2</sup>Thoracic Surgery Departments, Hospital Clínic, University of Barcelona, Spain

Tracheal re-intubation after recent tracheal surgery increases the risk of tracheal complications. Interventional lung assist (ILA) is a system that enables extrapulmonary passive ventilation [1]. We present a case of intraoperative use of ILA during anaesthesia for cervical wound repair after tracheal surgery.

**Case Report:** A 16-year-old boy with tracheal stenosis, secondary to endotracheal intubation and tracheostomy for severe head injury, was transferred to our hospital for tracheal surgery. Tracheal resection using "apnoeic oxygenation" during tracheal anastomoses was successfully performed. A week later, he suffered acute rupture of the innominate artery and emergency surgery with a vascular homograft and oesophagoplasty were needed. After 15 days in ICU and 10 days in intermediate care unit he was scheduled for repair of the open neck wound. A proseal laryngeal mask was inserted under remifentanyl and propofol anaesthesia and spontaneous breathing was maintained. The left femoral artery was cannulated for pulse contour cardiac output (PiCCO) monitoring and the interventional lung assist (ILA) device was inserted in the right femoral vessels. Apnoea was induced by increasing the anaesthesia level and surgery was performed in apnoeic conditions using ILA with an oxygen flow of 6 or 10 L min<sup>-1</sup>. Apnoea and surgery times were 30 and 90 minutes respectively. Measurements were performed before ILA use, at 15 minutes (6 L min<sup>-1</sup> flow) and 30 minutes (10 L min<sup>-1</sup> flow) of apnoea plus ILA and after ILA. Haemodynamics and gas exchange are shown in the table:

	PLM (FiO <sub>2</sub> 0.8)	ILA (6 L min <sup>-1</sup> )	ILA (10 L min <sup>-1</sup> )	PLM (FiO <sub>2</sub> 0.6)
HR (beats min <sup>-1</sup> )	106	113	122	110
SBP (mmHg)	120	118	140	145
dPmx (mmHg sec <sup>-1</sup> )	730	840	1550	1600
CI (L min <sup>-1</sup> m <sup>-2</sup> )	2.9	5.6	5.3	4.7
SVRI (dyn s cm <sup>-5</sup> m <sup>-2</sup> )	2370	1052	1491	1370
PaO <sub>2</sub> (kPa)	37.6	14.8	10.3	30.0
PaCO <sub>2</sub> (kPa)	5.3	4.9	4.3	4.5

HR: heart rate, SBP: systolic blood pressure, dPmx: left ventricle contractility, CI: cardiac index, SVRI: systemic vascular resistance index, PLM: Proseal laryngeal mask, ILA: interventional lung assist.

**Discussion:** In this case the use of ILA provided a good extracorporeal carbon dioxide removal during the apnoeic phase of surgery. Oxygenation was also maintained at safe levels avoiding endotracheal intubation and mechanical ventilation. Systemic vascular resistances were reduced with ILA, cardiac index increased and contractility improved. To our knowledge this is the first intraoperative use of ILA or pumpless extracorporeal lung assist system.

**Reference:**

- Mateis G. New technologies for respiratory assist. *Perfusion* 2003; **18**: 245–251. Review.

**O-72****Videothoroscopic sympathectomy in the treatment of refractory angina pectoris**

M.D. Dobias, M.S. Stritesky, R.D. Demes

General Hospital, Charles University, 1st Faculty of Medicine, Prague, Czech Republic

**Introduction:** Refractory angina pectoris is defined as severe disabling angina in spite of optimal medical therapy and where percutaneous coronary intervention (PCI) or coronary artery bypass surgery (CABG) is not feasible. Videothoroscopic sympathectomy (VTSY) seems to be one of the possible alternative methods in the treatment of refractory angina.

**Method:** 15 males aged from 52 to 84 years (mean 64 years) with angina pectoris class IV according to CCS classification, refractory to a conventional therapy, underwent VTSY between 1998–2005 at our institution. VTSY was performed under combined anaesthesia with selective single lung ventilation. The use of capno-pleural overpressure immediately influences haemodynamics and can only be carried out safely with continual monitoring and prompt correction by an experienced anaesthesiologist. A pneumothorax is produced in the operated hemithorax and only the contralateral lung is being ventilated. Bilateral gangliectomy Th2–Th4 was performed in 12 patients and in 3 patients only unilateral. Transection of interganglion connections was achieved in two patients because of anatomical conditions. To verify the effect of sympathectomy we have introduced a method of myocardial scintigraphy using metaiodine-benzylguanid (I-123 MIBG).

**Results:** Early results: Average hospital stay was 4.9 days (4–10 days), with no deaths occurring in our group.

Six-month results: Pain decreased on average from level 10 to 3.9 according to the visual analogue scale (interval 2–10). The preoperative angina class dropped from class IV to a postoperative average of 2.2 (interval 1–4). The extent of sympathectomy was strongly correlated with the regression of angina. A decrease in pain did not occur in one patient with severe chronic back pain who additively used a combination of painkillers. Reflex truncal hyperhidrosis, considered a possible side-effect of thoracic sympathectomy, was referred by one of our patients.

**Discussion:** VTSY was performed in 15 patients with refractory angina pectoris with very good early and six months follow-up results. VTSY was associated with reduction in angina symptoms and improved quality of life. For further validation of these results larger studies and follow-up are required.

**References:**

- Mannheimer C, Camici P, Chester MR, et al. The problem of chronic refractory angina; report from the ESC Joint Study Group on the Treatment of Refractory Angina. *Eur Heart J* 2002; **23**(5): 355–370. Review.
- Kim MC, Kini A, Sharma SK. Refractory angina pectoris: mechanism and therapeutic options. *J Am Coll Cardiol* 2002; **39**(6): 923–934. Review.

**Free Poster Sessions****Cardiac Anaesthesia/Drugs****P-73****The analgesic effect of fentanyl, thiopental, magnesium and lidocaine on propofol-induced injection pain in cardiac patients: a comparative study**

I. Oztekin, M. Kurt, S.D. Oztekin, A. Aygun, G. Abay, G. Camur, B. Cinar, S. Canik

Department of Anaesthesiology and Reanimation, Siyami Ersek Thoracic and Cardiovascular Surgery Center; Istanbul University FN School of Nursing; Department of Cardiovascular Surgery, Siyami Ersek Thoracic and Cardiovascular Surgery Center, Istanbul, Turkey

**Introduction:** Propofol is well known for its association with pain on injection. A number of techniques have been tried for minimizing propofol-induced pain

with variable results [1,2]. We compared the efficacy of fentanyl, thiopental; magnesium and lidocaine for the prevention of propofol-induced pain.

**Method:** Two hundred and fifty ASA III adults, undergoing elective cardiac surgery were randomly assigned into 5 groups of 50 each. Group I (F) received fentanyl (150 µg), Group II (T) received thiopental (0.5 mg/Kg), Group III (M) received magnesium sulphate (1 gm), Group IV (L) received lidocaine 2% (40 mg) and Group V (NS) received normal saline, all in a volume of 2 mL and accompanied by venous occlusion for one minute. Induction with propofol 1.5 mg/Kg was accomplished following the release of venous occlusion. Pain was assessed on both Visual Analogue Scale (VAS) (0–10 points) and a four-point scale (4PS) (0: no pain, 1: mild pain, 2: moderate pain, and 3: severe pain) at the time of pre-treatment and propofol injection. The values of invasive arterial blood pressure, heart rate and pulse oximeter were recorded when pain was assessed as compared with the beginning. Results were analysed by Chi-squared test. A *P* value of <0.05 was considered as significant.

**Results:**

		F n: 50	T n: 50	M n: 50	L n: 50	NS n: 50
VAS-1	Painless	n: 27	n: 21	n: 15	n: 50*	n: 48*
	Max. point	3 (n: 6)	3 (n: 7)	4 (n: 8)	0	2 (n: 2)
VAS-2	Painless	n: 5	n: 5	n: 14#	n: 16#	n: 4
	Max. point	6 (n: 13)	3 (n: 8)	4 (n: 7)	4 (n: 11)	6 (n: 9)
4PS-1	Painless	n: 27	n: 24	n: 15	n: 50*	n: 48*
	Max. point	1 (n: 9)	1 (n: 10)	1 (n: 11)	0	1 (n: 2)
4PS-2	Painless	n: 5	n: 11	n: 17#	n: 17#	n: 4
	Max. point	2 (n: 18)	1 (n: 13)	1 (n: 13)	1 (n: 13)	3 (n: 17)

VAS-1, 4PS-1 during pre-treatment. VAS-2, 4PS-2 = propofol-induced injection pain. Max. point = maximum point of pain. n = number of patients. \* $P < 0.001$ . # $P < 0.001$ . Mean arterial blood pressure value was significantly different between Gp F and Gp M ( $P = 0.03$ ).

**Discussion:** IV magnesium and lidocaine pre-treatment were equally effective in attenuating propofol-induced pain. However, magnesium pre-treatment itself causes pain. Lidocaine is the best choice in the use of pre-treatment for attenuating pain associated with IV propofol in our study.

**References:**

- Agarwal A, Dhiraj S, Raza M, et al. Vein pretreatment with magnesium sulfate to prevent pain on injection of propofol is not justified. *Can J Anaesth* 2004; **51**: 130–133.
- Roehm KD, Piper SN, Maleck WH, et al. Prevention of propofol-induced injection pain by remifentanyl: a placebo-controlled comparison with lidocaine. *Anaesthesia* 2003; **58**: 165–170.

**P-74****Perioperative outcome in oral-treated and insulin-treated diabetic patients following coronary artery surgery**

P. Knapik, E. Urbanska, M. Knapik, M. Herdyska, J. Foremny, M. Zembala  
*Silesian Centre for Heart Diseases, Zabrze, Poland*

**Introduction:** Diabetic patients have poorer short-term outcome after coronary artery surgery [1]. When oral anti-diabetic agents can no longer achieve glycaemic control, treatment with insulin is the next therapeutic option. The aim of this study was to compare postoperative complications and 30-day mortality in the oral-treated and insulin-treated diabetic patients following coronary artery surgery.

**Method:** Among 638 consecutive diabetic patients who underwent elective, first-time coronary artery surgery over a 3 years period, 311 (48.7%) were oral-treated and 327 (51.3%) were insulin-treated. Patients with diet-controlled diabetes as well as those in a critical preoperative condition were excluded. Perioperative complications and 30-day mortality were compared. The *t*-test and two-tailed Fisher test were used.  $P < 0.05$  was considered significant.

**Results:** Mean age of oral-treated and insulin-treated patients was similar ( $63.3 \pm 8.5$  yr vs.  $63.2 \pm 7.1$  yr,  $P = 0.87$ ). 124 oral-treated patients (39.9%) and 116 insulin-treated patients (35.5%) underwent off-pump surgery ( $P = 0.25$ ). Isolated and cumulative number of patients with the most common perioperative complications are shown below.

Perioperative complications	Oral-treated (n = 311)	Insulin-treated (n = 327)	<i>P</i>
Ventilation > 24 h	14 (4.5%)	27 (8.3%)	0.053
Stroke	3 (1.0%)	7 (2.1%)	0.23
Renal replacement	5 (1.6%)	9 (2.8%)	0.32
Infection	1 (0.3%)	10 (3.1%)	<b>0.008</b>
Perioperative MI	13 (4.2%)	15 (4.6%)	0.80
Norepinephrine	14 (4.5%)	19 (5.8%)	0.46
IABP	18 (5.8%)	22 (6.7%)	0.62
Low cardiac output	22 (7.1%)	30 (9.2%)	0.33
ICU stay > 5 days	12 (3.9%)	14 (4.3%)	0.79
Complications (all)	27 (8.7%)	65 (19.9%)	<b>&lt;0.0001</b>
Death	7 (2.3%)	9 (2.8%)	0.69

**Conclusion:** Insulin-treated diabetic patients present similar mortality but more perioperative complications in comparison to oral-treated patients following elective coronary artery surgery.

**Reference:**

- Carson JL, Scholz PM, Chen AY, et al. Diabetes mellitus increases short-term mortality and morbidity in patients undergoing coronary artery bypass graft surgery. *J Am Coll Cardiol* 2002; **40**: 418–423.

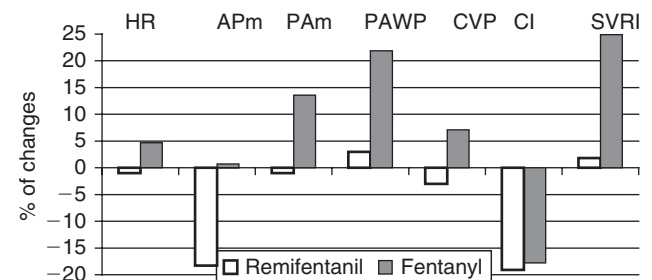
**P-75****Remifentanyl and fentanyl during induction of anaesthesia for coronary artery surgery**

P. Knapik, E. Urbanska, M. Knapik, M. Herdyska, J. Foremny, M. Zembala  
*Silesian Centre for Heart Diseases, Zabrze, Poland*

**Introduction:** Remifentanyl and fentanyl are both used in cardiac anaesthesia [1]. The aim of this study was to compare a standardized anaesthetic induction combined with either remifentanyl infusion or a bolus dose of fentanyl.

**Method:** Patients were randomly allocated into group R ( $n = 30$ ) and group F ( $n = 24$ ). During induction, patients in group R received remifentanyl infusion  $0.5 \mu\text{g kg}^{-1} \text{min}^{-1}$ , while group F received a bolus dose of  $5 \mu\text{g/kg}$  fentanyl. After initiation of remifentanyl infusion or the injection of fentanyl,  $0.2 \text{ mg/kg}$  etomidate was given, followed by the injection of  $0.1 \text{ mg/kg}$  pancuronium and the administration of 1% isoflurane. Heart rate (HR), mean arterial pressure (APm), mean pulmonary pressure (PAm), pulmonary artery wedge pressure (PAWP), central venous pressure (CVP) and cardiac index (CI) were measured while systemic and pulmonary vascular resistance indices (SVRI and PVRI) were calculated. All measurements were performed before induction and after tracheal intubation. The *t*-test for repeated measurements was used.  $P < 0.05$  was considered significant.

**Results:** CI decreased in both groups, HR and APm decreased only in R group, while SVRI increased only in F group. HR, APm and SVRI after induction were significantly higher in F group (see figure).



**Conclusion:** Remifentanyl is more potent than fentanyl in blunting a cardiovascular response to tracheal intubation.

**Reference:**

- Howie MB, Cheng D, Newman MF, et al. A randomized double-blinded multicenter comparison of remifentanyl versus fentanyl when combined with isoflurane/propofol for early extubation in coronary artery bypass graft surgery. *Anesth Analg* 2001; **92**: 1084–1093.

**P-76****Perioperative hyperglycaemia following on-pump and off-pump coronary surgery in non-diabetic patients**

P. Knapik, E. Urbanska, E. Kuciewicz, A. Golda, A. Krawczuk, A. Farnas  
*Silesian Centre for Heart Diseases, Zabrze, Poland*

**Introduction:** Glycaemia may be difficult to control after cardiac operations [1]. Hyperglycaemia is known to increase the risk for complications after coronary artery surgery [2]. The aim of this study was to establish whether eliminating cardiopulmonary bypass has an impact on postoperative glycaemia control in non-diabetic patients.

**Method:** 844 consecutive adults patients underwent first-time coronary revascularization over an 11 months period. 585 patients (69%) were not diabetic preoperatively. Blood glucose levels were registered every 2 hours in the first postoperative day. Mean and standard deviation of glucose (for all measurements), peak glucose and range of glucose levels (for all patients) and overall insulin consumption (for patients who received insulin) were compared between groups. Descriptive statistics, *t*-test, two-tailed Fisher test, Mann-Whitney test<sup>MW</sup> and ANOVA were used.  $P < 0.05$  was considered significant.

**Results:** All the tested variables (excluding only glycaemia range) were higher in CABG group (see table).

	CABG (n = 412)	OPCAB (n = 173)
Mean glucose (mmol/L)	$8.4 \pm 1.9^*$	$8.0 \pm 1.5$
Peak glucose (mmol/L)	$10.6 \pm 1.9^{***}$	$9.8 \pm 1.5$
Glycaemia range (mmol/L)	$4.5 \pm 2.3$	$3.7 \pm 1.6$
Insulin usage	197 (48%)**	62 (36%)
Insulin consumption <sup>MW</sup> (U)	$16 (2-251)^*$	$12 (4-70)$

\* $P < 0.05$  \*\* $P < 0.01$  \*\*\* $P < 0.001$

**Conclusion:** Non-diabetic CABG patients present higher glycaemia and require more insulin than OPCAB patients in the early postoperative period.

**References:**

- McAlister FA, Man J, Bistriz L, et al. Diabetes and coronary artery bypass surgery: an examination of perioperative glycaemic control and outcomes. *Diabetes Care* 2003; **26**: 1518–1524.

- 2 Estrada CA, Young JA, Nifong LW, et al. Outcomes and perioperative hyperglycemia in patients with or without diabetes mellitus undergoing coronary artery bypass grafting. *Ann Thorac Surg* 2003; **75**: 1392–1399.

## P-77

### Hyperglycaemia worsens neurocognitive function after implantation of an internal cardioverter/defibrillator (ICD)

M. Weigl, A. Moritz, I. Schmatzer, B. Birkenberg, B. Mora, M. Dworschak  
Division of Cardiothoracic and Vascular Anaesthesia and Intensive Care, University Hospital, Vienna, Austria

**Introduction:** Hyperglycaemia has a negative impact on neurologic outcome after cerebral ischaemia [1]. ICD implantation requires repetitive brief induction of ventricular fibrillation with global hypoperfusion [2]. We evaluated whether diabetes mellitus (DM) also affects neurocognitive function after these iatrogenically induced cardiac arrests.

**Method:** We investigated 25 patients (18 without DM and 7 with DM) scheduled for elective ICD insertion in monitored anaesthesia care. Immediately prior to induction of each ventricular fibrillation 0.1 mg/kg etomidate was administered as the sole anaesthetic. The Digit Span forward (DSTf) and backward test (DSTb) as well as the Mini Mental State Exam (MMSE) were performed pre- and three days postoperatively. The maximum scores that can be obtained in these tests are 60, 50 and 30 points, respectively. These tests have already been used in the postoperative setting after cardiac surgery [3].

**Results:** On average, two shocks were applied per patient without group differences. Preoperative blood glucose was  $5.6 \pm 0.7$  vs.  $8.5 \pm 2.5$  mmol/L ( $P = 0.008$ ,  $t$ -test) in No DM and DM patients, respectively. Neurocognitive test results (median with 25 and 75 percentiles) are given below:

	Preop No DM	Postop No DM	Preop DM	Postop DM
DSTf	41 (31/49)	42 (38/47)	41 (35/48)	38 (31/44)
DSTb*	28 (24/32)	31 (26/39)	23 (20/29)	24 (21/34)
MMSE	29 (29/30)	29 (29/30)	29 (27/30)	30 (28/30)

\* =  $P < 0.05$  (One Way Repeated Measures ANOVA)

**Conclusion:** As these tests were repeated after three days a positive learning curve could be expected in all of these patients. However, only patients without DM showed slight improvements in the DSTf and DSTb tests postoperatively. MMSE results were in the normal range throughout in both groups. Therefore, elevated blood glucose levels before induction of brief periods of ventricular fibrillation seem to be associated with impaired neurocognitive function immediately after surgery.

#### References:

- 1 Sieber FE, Martin LJ, Brown PR, et al. Diabetic chronic hyperglycemia and neurologic outcome following global ischemia in dogs. *J Cereb Blood Flow Metabol* 1996; **16**: 1230–1235.
- 2 Dworschak M, Franz M, Czerny M, et al. Release of neuron-specific enolase and S100 after implantation of cardioverters/defibrillators. *Crit Care Med* 2003; **31**: 2085–2089.
- 3 Wimmer-Greinecker G, Matheis G, Brieden M, et al. Neuropsychological changes after cardiopulmonary bypass for coronary artery bypass grafting. *Thorac Cardiovasc Surg* 1998; **46**: 207–212.

## P-78

### Terlipressin induces a direct vasoconstriction of the coronary artery in rats

F. Ryckwaert, P. Colson, B. Murat, G. Guillon  
IGF, Montpellier, France

**Introduction:** Terlipressin has been proposed as an alternative treatment for hypotension after general anaesthesia [1]. Arginine-vasopressin (AVP) is the endogenous human hormone while terlipressin is a prodrug converted through endopeptidases action into lysine-VP (LVP). Little is known about the coronary vasopressor effect of AVP, LVP and terlipressin. The study was aimed at assessing their respective role on coronary flow using a Langendorff heart preparation modified with an accurate Doppler measurement system.

**Method:** Adult male Wistar rats were anaesthetized with intraperitoneal pentobarbital. The hearts were excised, arrested in ice-cooled Krebs–Henseleit buffer, and perfused retrogradely through the aorta using a non-recirculating Langendorff apparatus. pH was 7.4 when equilibrated with carbon dioxide at 37°C. Perfusion pressure was set at 100 cm H<sub>2</sub>O and kept constant. The hearts underwent a baseline period of 5 minutes; then VP analogues were added to the Krebs perfusion solution. The following data were recorded: heart rate, end-diastolic pressure, peak-systolic pressure (Psp, mmHg), maximum positive and minimum negative pressure derivatives (dp/dt max and dp/dt min, respectively, mmHg/sec), coronary flow (CF, mL/min).

**Results:** Terlipressin acts as a vasoconstrictor, an effect sustained even in the presence of endopeptidase inhibitors. It is 500 fold less powerful than LVP and 1500 less than AVP (figure). Aside from the vascular effect, there is a proportional impairment of systolic function observed with the 3 compounds as proved by decreases in Psp and dp/dt<sub>max</sub>. No significant changes were found for diastolic function except at highest concentrations.

**Discussion:** The results suggest that even a small terlipressin IV bolus, as recommended in clinical practice, may induce direct coronary constriction. Besides, a small terlipressin degradation of less than 1%, may provide LVP concentration enough to induce sustained coronary constriction and left ventricular function impairment.

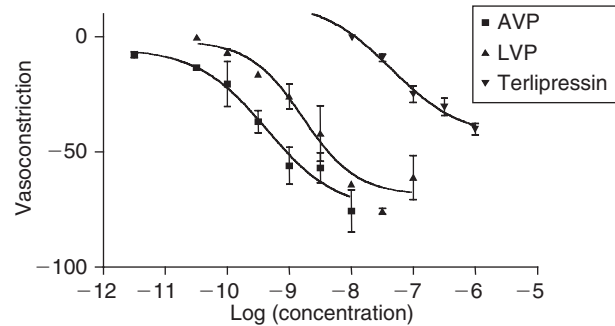


Figure. % changes in coronary flow

#### Reference:

- 1 Eyraud D, Brabant S, Nathalie D, et al. Treatment of intraoperative refractory hypotension with terlipressin in patients chronically treated with an antagonist of the renin-angiotensin system. *Anesth Analg* 1999; **88**: 980–984.

## P-79

### Comparison of different insulin protocols in post-cardiac surgery patients: multicentre European study

J. Blaha, R. Hovorka, J. Kremen, J.J. Cordingley, S. Squire, J. Plank, M. Ellmerer, J. Kunstyr, T. Kotulak, M. Stritesky, M. Haluzik  
Department of Anesthesiology and Intensive Medicine, 1st Faculty of Medicine, Charles University, Prague, Czech Republic; Clin. School of Medicine, University of Cambridge, Cambridge, United Kingdom; 3rd Department of Internal Medicine, 1st Faculty of Medicine, Charles University, Prague, Czech Republic; Royal Brompton Hospital, London, United Kingdom; Medical University Hospital Graz, Graz, Austria

**Introduction:** Increased blood glucose (BG) levels frequently occur in critically ill patients both with and without diabetes. After the Leuven study [1] demonstrated markedly reduced mortality in critically ill patients treated with intensive insulin therapy, numerous protocols have been developed and tested to implement tight glycaemic control in ICU patients. Most of these protocols are dependent on proper training and experience of the ICU staff and even intuitive decisions. Here we have investigated the use of a fully automated model predictive controller (MPC) algorithm implemented on a bedside laptop computer to advise on insulin infusion rate and we compared its effectiveness with different insulin protocols used for glycaemic control in four European cardiovascular centres – Charles University General Hospital, Prague (CUP), Medizinische Universität, Graz (MUG), Royal Brompton Hospital, London (RBH) and Katholieke Universiteit, Leuven (KUL).

**Method:** 20 post-cardiac surgery patients with BG level higher than 6.7 mmol/L on admission to ICU in each participating centre were included into the randomized controlled trial and were investigated up to 48 hours. Half of the patients were treated accordingly to a respective standard protocol for insulin therapy, and half of the patients by automated MPC algorithm. The target BG range for all protocols was between 4.4 and 6.1 mmol/L. In all patients hourly BG and arterial blood gas analysis were performed.

**Results:** The algorithms clearly show the differences in the effectiveness of BG control in different clinical centres over Europe. With the same target range for glycaemia levels, mean BG in 24 hours period in MPC was  $6.75 \pm 1.93$ , in CUP  $6.78 \pm 0.85$ , in MUG  $8.30 \pm 1.18$ , and in RBH  $6.60 \pm 0.68$  mmol/L. Compared to all tested respective routine protocols, BG control by MPC algorithm resulted in a significantly higher percentage of glycaemia levels within the target range ( $55.6 \pm 1.5$  vs. CUP:  $39.1 \pm 5.4\%$  vs. RBH:  $37.5 \pm 9.3$  vs. MUG:  $4.9 \pm 2.6\%$  of time monitored,  $P < 0.01$ ).

**Discussion:** First, all evaluated insulin protocols were safe with respect to hypoglycaemia. Secondly, continuous insulin infusion is a necessary prerequisite to achieve satisfactory BG control in ICU patients both with and without

diabetes. In contrast, implementation of iv. insulin boluses in addition to continuous insulin infusion did not bring additional advantage over a protocol with continuous insulin infusion only. Similarly, both absolute glucose value based approach and relative glucose change approach were comparably effective in BG management in this study. Thirdly, our data suggest

that the use of MPC algorithm allows better control of BG in ICU patients than routine paper-based protocol.

#### Reference:

- 1 van den Bergh G, Wouters P, Weekers F, et al: Intensive insulin therapy in the critically ill patients. *N Engl J Med* 2001; **345**: 1269–1367.

## Intensive Care Medicine

### P-80

#### Percutaneous dilational tracheostomy in cardiovascular patients

H. Kandil, A. Ballotta, F. Belloli, F. Bettini, T. Della Torre, C. Bellucci

Department of Cardiac ICU – Policlinico S. Donato (Milan), Italy

**Introduction:** Respiratory failure is a frequent complication of cardiovascular surgery, particularly when associated with postoperative cardiac failure [1–3]. The need for long-term mechanical ventilation, either due to respiratory or cardiac failure, prolongs Intensive Care Unit (ICU) stay and may induce further damages to lung function, mainly by way of infection. There is a wide consensus in believing that these patients may benefit from a tracheostomy, that seems a safe and cost-effective procedure in this population. However, different techniques, indications, timing of the procedure and side effects are reported in the literature. Our 5 years experience is presented in this work.

**Method:** Observational study on 174 percutaneous dilational tracheostomies (PDT) that have been performed in our post-cardiovascular surgery ICU from 2000 to 2005. 53 PDT have been done according to the Ciaglia progressive dilators technique, 5 with the Percutwist, and 116 with the Blue Rhino system. All the procedures have been performed in the ICU, under fiberoptic bronchoscopic guidance.

**Results:** 1.3% of the cardiovascular surgical population was treated with PDT during the postoperative course. 11 patients were cardiac surgery patients, and 11 thoracic vascular surgery patients. 68% were older than 70 years. The median timing for the procedure was 13 days after the operation; the median duration of tracheostomy ventilation was 24 days. Peri-procedure complications included 3 cases of minor bleeding, 2 late tracheal stenoses, 1 case of cannula dislocation in the Ciaglia progressive dilators group and only 1 case of minor bleeding in the Blue Rhino group.

**Conclusions:** Due to the easy execution, the low incidence of complications, and safe and effective management, percutaneous dilational tracheostomy guided by fiberoptic bronchoscopy is feasible and effective for cardiovascular surgery patients who require long-term mechanical ventilation. PDT performed with adequate timing and techniques may play a role in the respiratory weaning of patients suffering from post-cardiovascular surgery respiratory failure, needing prolonged mechanical ventilation.

#### References:

- 1 Bacchetta MD, Girardi LN, Southard EJ, et al. Comparison of open versus bedside percutaneous dilational tracheostomy in the cardiothoracic surgical patient: outcomes and financial analysis. *Ann Thorac Surg* 2005; **79**: 1879–1885.
- 2 Wagner F, Nasser R, Laucke U, et al. Percutaneous dilational tracheostomy: results and long-term outcome of critically ill patients following cardiac surgery. *Thorac Cardiovasc Surg* 1998; **46**: 352–356.
- 3 Hubner N, Rees W, Seufert K, et al. Percutaneous dilational tracheostomy done early after cardiac surgery—outcome and incidence of mediastinitis. *Thorac Cardiovasc Surg* 1998; **46**: 89–92.

### P-81

#### BiPAP ventilator as an early extubation technique in fast track cardiac surgery

N. Yapici, A. Kilic, Y. Bicer, T. Coruh, Z. Aykac

Siyami Ersek Thoracic and Cardiovascular Surgery Center, Anaesthesiology and Reanimation Clinic, Istanbul, Turkey

**Introduction:** With new advances in surgical and anaesthetic techniques, the goal is to have patients extubated within 4 to 6 hours after coronary artery bypass surgery (CABG). The usefulness of non-invasive ventilation (NIV) has been assessed with regard to weaning and extubation, to reduce the duration of mechanical ventilation. BiPAP is also safe and effective when used in intubated, mechanically ventilated patients [1]. We aimed in this study to investigate the effects of BiPAP S/T (Spontaneous/Timed mode), on extubation time, haemodynamics and blood gases after CABG.

**Method:** After ethics committee approval and informed consent, 60 patients undergoing elective CABG, were divided into two groups as SIMV-CPAP (Group I) and SIMV-BiPAP (Group II). In both group on arrival in the intensive care unit, the patients were managed with a Servo 900 mechanical

ventilator: The initial setting was in the synchronized intermittent mandatory ventilation mode with FiO<sub>2</sub> of 1.0. When spontaneous breathing reappeared, the ventilator settings were changed in group I, to continuous positive airway pressure mode. In group II, patients were connected from the endotracheal tube to the BiPAP ventilator with ST mode. In group I, patients were weaned from the ventilator in a CPAP mode by reducing the level of PS to 5 cm H<sub>2</sub>O as tolerated. In group II, if they achieved extubation criteria, patients were extubated and the BiPAP therapy was continued with a full-face mask. Measurements were taken at predetermined time intervals. Statistical analysis was made with Student's *t*-test.

**Results:** There were no statistical difference between groups regarding haemodynamics and blood gases although extubation times differed.

#### Table.

	Extubation time (h)	Re-intubation	ICU stay (h)
SIMV-CPAP	7.9 ± 2.13*	–	22 ± 3
SIMV-BiPAP	3.83 ± 1.20	–	20 ± 7

\**p* > 0.05

**Discussion:** After CABG, respiratory management is crucial because of the hazardous effects of bypass. It has been shown that BiPAP S/T is safe and effective also in augmenting invasive ventilatory support. Takami has reported that BiPAP allows better alveolar recruitment during both inhalation and exhalation, thereby improving lung mechanics [2]. In our study we observed that the extubation time was shorter in the BiPAP group. This is the result of BiPAP allowing unrestricted and independent spontaneous breathing during every phase of the respiratory cycle. Based on these findings, we concluded that the BiPAP ventilator can be used as a safe and effective device for early extubation in fast track cardiac surgery.

#### References:

- 1 Patel RG, Petrini MF. Respiratory muscle performance, pulmonary mechanics, and gas exchange between the BiPAP S/T-D system and the Servo Ventilator 900C with bilevel positive airway pressure ventilation following gradual pressure support weaning. *Chest* 1998; **114**:1390–1396.
- 2 Takami Y, Ina H. Beneficial effects of bilevel positive airway pressure after surgery under cardiopulmonary bypass. *Cardiovascular and Thoracic Surgery* 2003; **2**: 156–159.

### P-82

#### Follow-up at one year of percutaneous dilational tracheostomy in cardiac surgery patients

H. Zahedi, G. Panduri, G. Mancinelli, F. Giuliotti, S. Rocchi, C. Münch

Ospedali Riuniti Ancona, Italy

**Introduction:** Percutaneous dilational tracheostomy (PDT) is a routine intervention in modern ICUs. Surprisingly little is known about differences in long term outcomes and complications among the different available techniques [1]. The present study investigated specific outcomes of the Percutwist PDT in a post cardiac surgery patient population.

**Method:** We performed Percutwist PDT's in twenty patients (15M/5F, mean age 71 ± 10 years) during a study period from 2003–2004. Informed consent was obtained from all patients (or next of kin). Fiberoptic bronchoscopy was provided during all interventions. Intervention times, respiratory and haemodynamic parameters, blood losses and early (within 48 hours) and late complications were recorded. Patients discharged from the hospital were interviewed for follow-up at 3, 6 and 12 months. Data were expressed as mean values ± standard deviation (SD); variables were compared by two-tailed Student's *t*-test. *P* < 0.01 was considered statistically significant.

**Results:** Procedure time was 20 ± 6 minutes, respiratory and haemodynamic parameters remained stable throughout the procedure. We observed 5 cases of immediate bleeding but no blood transfusions were required. One patient had to be switched to surgical tracheostomy and two patients to a different percutaneous technique (early complications 25%). Late complications included 1 tracheobronchial fistula, 1 tracheal stenosis and 1 case of sialorrhoea (late complications 15%). After 1 year 3 patients were alive, two of them at home and 1 patient still in the hospital with his tracheostomy but with spontaneous breathing. ICU length of stay was 65 ± 34 days, mean

SAPS II was  $39 \pm 16$ , observed hospital mortality was 60%, observed overall mortality at 1 year was 85% (4F/13M). The patient with the tracheo-bronchial fistula died after 2 months without being discharged from the ICU (procedure related mortality 5%).

**Discussion:** Overall mortality in this patient group was high and only 15% of patients survived after 1 year of hospital discharge. Percutaneous dilational tracheostomy with the PercuTwist technique is simple but significant procedure-related morbidity and mortality occurred (early complications in 20% of procedures, late complications in 15% of patients, procedure related mortality 5%). Larger trials are needed to investigate PercuTwist PDT's patient safety.

#### Reference:

- 1 Francois B, Clavel M, Desachy A, et al. Complications of tracheostomy performed in the ICU. subthyroid tracheostomy vs. surgical cricothyroidotomy. *Chest* 2003; **123**: 151–158.

## P-83

### Percutaneous dilational tracheostomy: a comparison between Fantoni and PercuTwist techniques

H. Zahedi, G. Mancinelli, E. Rigo, L. Zanin, S. Comi, F. Allegrezza, F. Gasparri, C. Münch

*Ospedali Riuniti, Ancona, Italy*

**Introduction:** Different techniques of percutaneous dilational tracheostomy (PDT) have become popular in the intensive care setting [1]. Until today no final consensus about a preferable technique exists. We investigated differences between the Fantoni and the PercuTwist technique in a post cardiac surgery ICU.

**Method:** Thirty patients (19M/11F) were enrolled in the study period from 2004–2005. Informed consent was obtained from all patients (or from the next of kin). 15 patients (8M/7F, mean age  $76 \pm 8.4$ ) were scheduled for Fantoni PDT and 15 patients (11M/4F, mean age  $71 \pm 4.4$ ) for PercuTwist PDT in the ICU, exclusion criteria being prior tracheostomy, major coagulation disorders, purulent airway secretions and active airway bleeding. All patients were fasted for at least 6 hours prior to intervention and anaesthesia. Muscle relaxation and analgesia were provided in a standardized manner to all patients. Flexible (PercuTwist) or rigid (Fantoni) bronchoscopy was provided in all patients. The endotracheal tube was substituted by a laryngeal mask airway (LMA) in all PercuTwist procedures. Intervention times, respiratory and haemodynamic parameters, blood losses and early (within 48 hours) and late complications were recorded. Data were expressed as mean values  $\pm$  standard deviation (SD), variables were compared by two-tailed Student's *t*-test.  $P < 0.01$  was considered statistically significant.

**Results:** Procedure duration was similar in both groups and respiratory and haemodynamic parameters remained equally stable. Blood losses were significantly different between groups (3 cases of intra-procedural haemorrhage in the PercuTwist group,  $P < 0.01$ ; one PercuTwist procedure had to be switched to a surgical tracheostomy). In four cases of the Fantoni group minor difficulties in final positioning of the tracheal cannula were observed (26.7%,  $P < 0.01$ ). Late complications included in the PercuTwist group were 1 tracheal stenosis and 1 case of refractory sialorrhoea (incidence of late complications 13.3%,  $P < 0.01$ ). No other major complications and no procedural related deaths were observed.

**Discussion:** Both techniques may offer specific advantages in certain patient groups [2]. In our study the incidence of procedural bleeding and of late complications were higher in the PercuTwist group, minor procedure difficulties were more frequent in the Fantoni group. We conclude that the Fantoni PDT offers a better risk protection against tracheal wall damage than the PercuTwist PDT.

#### References:

- 1 Francois B, Clavel M, Desachy A, et al. Complications of tracheostomy performed in the ICU. subthyroid tracheostomy vs surgical cricothyroidotomy. *Chest* 2003; **123**: 151–158.
- 2 Trotter ST, Hazard PB, Sakabu SA, et al. Posterior tracheal wall perforation during percutaneous dilational tracheostomy. an investigation into its mechanism and prevention. *Chest* 1999; **115**: 1383–1389.

## P-84

### N-terminal-pro-brain natriuretic peptide predicts left ventricular dysfunction after coronary artery surgery

L.A. Krichevskij, I.E. Kharlamova, I.A. Kozlov

*Institute of Transplantology and Artificial Organs, Moscow, Russia*

**Introduction:** Myocardial dysfunction is an important cause of mortality and morbidity after coronary artery bypass grafting (CABG). We hypothesized that cardiac failure may be predicted by N-terminal-pro-brain natriuretic peptide (NT pro-BNP).

**Method:** After informed consent, 38 patients (pts) scheduled for CABG surgery with cardiopulmonary bypass (CPB) were prospectively included. NT pro-BNP was measured by electrochemiluminescence assay. Twenty four pts (group 1) had NT pro-BNP less than 600 pg/mL, fourteen pts (group 2), more than 600 pg/mL. Transoesophageal echocardiography and thermomodulation right ventricular volumetric monitoring were used for evaluation of cardiac function at the end of surgery. Statistical analysis was performed using parametric tests.  $P < 0.05$  was considered statistically significant. Data are given as mean  $\pm$  standard deviation.

**Results:** Groups 1 and 2 were similar ( $P > 0.05$ ) for left ventricular ejection fraction before surgery ( $56 \pm 12$  and  $49 \pm 15\%$ ), CPB time ( $134 \pm 54$  and  $149 \pm 52$  min), aorta cross-clamping time ( $84 \pm 37$  and  $81 \pm 31$  min). Systolic left ventricular function (LVF) at the end of surgery was better in group 1 (table). Diastolic LVF (Ve/Va) and others parameters were similar. There were no difference of dosage of dopamine and dobutamine ( $3.6 \pm 1.2$  and  $4 \pm 2 \mu\text{g kg}^{-1} \text{min}^{-1}$ ).

Parameters	Group 1	Group 2	P
CI ( $\text{L min}^{-1} \text{m}^{-2}$ )	$3.4 \pm 0.9$	$3.5 \pm 0.9$	0.57
PAWP (mmHg)	$7.7 \pm 2.5$	$11 \pm 3$	0.009
LVEF (%)	$49 \pm 11$	$31 \pm 9.8$	0.0008
Ve/Va	$1.3 \pm 0.4$	$1.1 \pm 0.7$	0.71
RAP (mmHg)	$5.6 \pm 2.3$	$5.9 \pm 3$	0.61
RVEF (%)	$34.4 \pm 8$	$28.4 \pm 11$	0.15

CI – cardiac index, HR – heart rate, PAWP – pulmonary artery wedge pressure, LVEF – left ventricular ejection fraction, Ve – peak early transmitral flow, Va – peak atrial transmitral flow, RAP – right atrial pressure, RVEF – right ventricular ejection fraction.

**Discussion:** NT pro-BNP is a significant marker of heart failure [1]. This study shows a potential use of NT pro-BNP as a predictor for left ventricular dysfunction following CABG.

#### Reference:

- 1 McDonagh TA, Holmer S, Raymond I, et al. NT-proBNP and the diagnosis of heart failure: a pooled analysis of three European epidemiological studies. *European J Heart Failure* 2004; **6**: 269–275.

## P-85

### Acute renal failure after mitral valve surgery

G. Landoni, A. Roberti, G. Marino, M. Fichera, F. Boroli, M. Crivellari, T. Bove, A. Zangrillo

*Department of Cardiovascular Anaesthesia and Intensive Care, Università Vita-Salute di Milano, IRCCS San Raffaele, Milano, Italy*

**Introduction:** Acute renal failure (ARF) is a serious complication following cardiac operations performed with cardiopulmonary bypass and carries a high mortality rate [1, 2]. The aim of this study was to define the incidence, predictors and mortality related to ARF after different types of mitral valve (MV) surgery.

**Method:** We studied 1276 consecutive adult patients who underwent isolated mitral valve surgery. After Ethical Committee approval, all patients gave written informed consent. Postoperative acute renal failure was defined as a 100% increase in serum creatinine from baseline levels. Perioperative variables measured were age, sex, basic pathology, preoperative renal impairment defined as creatinine  $>124 \mu\text{mol/L}$ , ventricular dysfunction, preoperative neurological event, chronic obstructive pulmonary disease, diabetes, type of surgery, use of intra-aortic balloon pump, cardiopulmonary bypass duration, redo or emergency surgery, haemorrhage, blood transfusions, surgical revisions and development of low-output syndrome. We used a multivariate stepwise logistic regression to assess the independent correlates of acute renal failure and investigate the effect of possible confounders.

**Results:** Acute renal failure developed in 32 (2.5%) patients. Hospital death occurred in 23/1276 (1.8%) patients: those who developed ARF had a 46.9% (15/32) incidence of death versus 0.6% (8/1244) in the patients who did not develop ARF. The crude incidence of acute renal failure for mitral valve replacement and mitral valve repair was 8% (25/312) and 0.7% (7/964) respectively ( $P < 0.001$ ). At multivariate analysis, the variables independently associated with acute renal failure were age, diabetes, preoperative renal impairment, mitral valve replacement, emergency operation, re-operation for bleeding and low-output syndrome.

**Discussion:** This study confirms the high mortality of postoperative acute renal failure in cardiac surgery and shows that mitral valve replacement is an independent risk factor for this complication.

#### References:

- 1 Kellum JA, Angus DC. Patients are dying of acute renal failure. *Critical Care Medicine* 2002; **30**(9): 2156–2157.
- 2 Bove T, Calabro MG, Landoni G, et al. The incidence and risk of acute renal failure after cardiac surgery. *J Cardiothorac Vasc Anesth* 2004; **18**(4): 442–445.

**P-86****Postoperative complications in cardiac surgery patients with preoperative dialysis-dependent chronic renal failure**

P. Siondalski, L.K. Keita, P. Mrozinski, V. Musial-Swiatkiewicz, J. Rogowski, R. Lango

Department of Cardiac Surgery, Department of Anaesthesiology, Medical University of Gdansk, Poland

**Introduction:** Cardiac surgery patients with dialysis-dependent renal failure are at high risk of postoperative complications and death. The aim of the present study was to assess the rate of postoperative complications in patients with end-stage renal disease undergoing heart surgery.

**Method:** We retrospectively analysed the outcome of all patients with dialysis-dependent renal failure operated on at our department from January 1994 to June 2005. Sixty one patients (44 men and 17 women, mean age:  $55.0 \pm 12.3$  years) were included in the study. The perioperative renal replacement therapy consisted of haemodialysis (HD) in 47 patients (77%) or peritoneal dialysis (PD) in 14 patients (23%) until the day before operation and ultrafiltration during the cardiopulmonary bypass (CPB). Before 1998 preoperative renal replacement therapy was continued throughout the perioperative treatment. From 1998 to 2005 patients treated with chronic HD who were scheduled for operation on CPB, were put on PD one month before the operation. HD or PD was resumed from the second postoperative day. 15 patients were submitted to on-pump coronary artery bypass grafting (CABG), 29 patients to off-pump CABG, 13 patients to valve replacement, 3

patients to CABG with valve replacement, and one to the Bentall procedure. Chi-squared test was used for statistical analysis.

**Results:** Eight patients (13.1%) died in the entire group. One patient died out of 14 treated with PD (7.1%). Seven patients died out of 47 treated with HD (14.9%). We observed the following postoperative complications: heart failure requiring intra-aortic balloon pumping in 5 patients (8.2%), sepsis in 4 patients (6.6%), postoperative bleeding in 6 patients (9.8%), prolonged respiratory support in 5 patients (8.2%) and wound infection in 9 patients (14.8%). Only one patient (3.4%) died out of 29 who underwent off-pump CABG. Four patients (27%) died out of 15 submitted to on-pump CABG. Mortality rate was significantly lower in patients undergoing off-pump in comparison to on-pump CABG ( $P = 0.045$ ).

**Discussion:** In-hospital mortality observed in the present study, which is similar to previous reports from other centres, remains very high in comparison with patients without end-stage renal disease [1]. Our results indicate that both HD and PD might not be an optimal postoperative renal replacement therapies in patients operated on with the use of CPB. A higher mortality rate in patients undergoing on-pump in comparison to off-pump CABG indicates that CPB renders patients at higher risk of complications and death during post-operative HD and PD. Further studies involving post-operative veno-venous haemofiltration are required in order to find an optimal perioperative renal replacement therapy in chronically dialysed patients.

**Reference:**

- 1 Horst M, Mehlhorn U, Hoerstrup SP, et al. Cardiac surgery in patients with end stage renal disease: 10 year experience. *Ann Thorac Surg* 2000; **69**: 96–101.

**Miscellaneous****P-87****Postoperative hospital stay of cardiac surgical patients following early discharge from ICU**

C. Ferrari, C. Savi, L. Civardi, A. Piacentini, A.M. Condemni

Cardioanaesthesia, "L. Sacco" Hospital, Milan, Italy

**Introduction:** Cardiac surgery is associated with a large expenditure of healthcare resources. Identifying factors that affect hospitalization after cardiac surgery could improve healthcare management and costs [1].

**Method:** Retrospective analysis of 1488 patients (pts) who underwent cardiac surgery between January 1998 and June 2005, and were discharged from our ICU on the first day after surgery. Statistical analysis was performed with SPSS Software 13.0. Data are expressed as mean  $\pm$  standard deviation (SD), T-Test and one-way ANOVA were used to compare means, univariate analysis to detect predictors of post surgery in hospital stay.  $P < 0.05$  was considered statistically significant.

**Results:** 1488 pts, all discharged from the ICU the first day after surgery, mean age  $63 \pm 12$  yr, 71% males, 67% coronary artery by-pass grafting (CABG), 28% valve procedures (VP) and 5% CABG + VP with a mean postoperative in-hospital stay of  $7.75 \pm 2.7$  days. Predictors of longer postoperative hospitalization (PH) are shown in Table 1.

**Table 1.** Univariate associations with postoperative hospitalization

Continuous variables	Mean $\pm$ SD	Pearson coefficient	P (correlation-T statistic)
Mechanical ventilation (h)	$8.9 \pm 3.63$	0.1121	<0.0001
Surgical time (min)	$248.2 \pm 56.5$	0.0965	<0.0002
Categorical variables	N	PH days Mean $\pm$ SD	P (ANOVA)
Chronic renal failure	Yes 83	$8.5 \pm 4.2$	<0.0066
	No 1405	$7.7 \pm 2.6$	
Arteriopathy	Yes 320	$8.1 \pm 4.1$	<0.0094
	No 1168	$7.66 \pm 2.2$	

**Table 2.** Stepwise multiple regression analysis, PH as dependent variable

Regression model	R square	Adjusted R square	R Square change	F change	Sig. F change
MV	0.013	0.012	0.013	18.963	0.0001
MV+AR	0.018	0.016	0.005	7.605	0.006
MV+AR+ST	0.022	0.020	0.005	7.266	0.007
MV+AR+ST+CRF	0.025	0.023	0.003	4.656	0.031

**Discussion:** Prolonged PH could affect resources management (i.e. free beds) in planning surgical activity. Even in early ICU discharged pts, not only pre-existing conditions (e.g. chronic renal failure, arteriopathy) could affect postoperative in-hospital stay. Early weaning from mechanical ventilation and faster surgical procedures may result in shorter hospitalization after ICU care, allowing better surgical planning.

**Reference:**

- 1 Nickerson NJ, Murphy SF, Davila-Roman VG, et al. Obstacles to early discharge after cardiac surgery. *Am J Manag Care* 1999; **5**: 29–34.

**P-88****Hypovolaemia-induced vasodilatation during angiotensin AT<sub>1</sub> receptor blockade: role of the AT<sub>2</sub> receptor in piglets**

P. Colson, F. Ryckwaert, G. Guillon

IGF, Montpellier, France

**Introduction:** AT<sub>1</sub> receptor antagonists may interfere with the haemodynamic determinants of blood pressure either directly or indirectly through the stimulation of AT<sub>2</sub> receptor provided angiotensin II is available to interact with them. However, there is only indirect evidence of AT<sub>2</sub> receptor stimulation during renin-dependent state (hypovolaemia) with AT<sub>1</sub> antagonist [1,2]. The study was aimed at assessing the counteracting effect of AT<sub>2</sub> receptor during AT<sub>1</sub> receptor blockade.

**Method:** Experiments were performed on female farm-bred piglets (15–20 kg). The study was approved by the animal care and use committee of our institution. Pigs were randomly assigned to receive placebo ( $n = 6$ ), valsartan ( $3 \text{ mg kg}^{-1}$ ) an AT<sub>1</sub> receptor antagonist (a-AT<sub>1</sub> group;  $n = 6$ ), or valsartan and PD 123319, ( $3 \text{ mg kg}^{-1}$ ), an AT<sub>2</sub> receptor antagonist (a-AT<sub>1-2</sub> group;  $n = 6$ ) after anaesthesia (end tidal isoflurane concentration at 0.8–1 MAC) and before hypovolaemia by 20% of the total estimated blood volume. Measurements consisted of heart rate, mean arterial pressure (MAP), PCWP, cardiac output (CO) and systemic vascular resistance (SVR) at baseline, 30 minutes after injection and after bleeding. Overall effects were evaluated by ANOVA for repeated measures then further comparisons were made using paired Student's *t*-test (within group) and unpaired Student's *t*-test (between groups) when appropriate.

**Results:** Baseline values were similar between groups and injection of treatments had no significant effect. Thirty minutes after bleeding, MAP decreased significantly and similarly in the 3 groups (25–30%). The placebo group had a significant decrease in CO ( $28.7 \pm 15.9\%$ ) without significant change in SVR ( $+5.5 \pm 15.3\%$ ). In the a-AT<sub>1</sub> group, SVR decreased significantly ( $-17.6 \pm 6.0\%$ ,  $P = 0.006$  vs. placebo group) with a moderate change in CO

( $-13.9 \pm 9.7\%$ ). Addition of the AT<sub>2</sub> antagonist to the AT<sub>1</sub> antagonist (a-AT<sub>1-2</sub> group) did not abolish the lowering of SVR ( $-14.5 \pm 17.2\%$ ).

**Discussion:** The results suggest that AT<sub>2</sub> receptor has only a small if any contribution to the vasodilatation observed in the AT<sub>1</sub>-blockade group. Valsartan-induced vasodilatation could be the result of a more complex and combined action of AT<sub>2</sub>, ang(1-7) and AT<sub>4</sub> receptors [3].

#### References:

- Ryckwaert F, Colson P, Andre E, et al. Haemodynamic effects of an angiotensin-converting enzyme inhibitor and angiotensin receptor antagonist during hypovolaemia in the anaesthetized pig. *Br J Anaesth* 2002; **89**: 599-604.
- Aneman A, Svensson M, Broome M, et al. Specific angiotensin II receptor blockade improves intestinal perfusion during graded hypovolemia in pigs. *Crit Care Med* 2000; **28**: 818-823.
- de Gasparo M, Catt KJ, Inagami T, et al. International union of pharmacology. XXIII. The angiotensin II receptors. *Pharmacol Rev* 2000; **52**: 415-472. Review.

## P-89

### Cardiac surgery in HIV patients: clinical outcome

M. Munari, A. Delle Fave, C. Savi, L. Villa, C. Ferrari, F. Cislaghi, A.M. Condemni

*Cardioanaesthesia, "L. Sacco" Hospital, Milan, Italy*

**Introduction:** Recent studies suggest the direct role of Human Immunodeficiency Virus (HIV) as the cause of cardiomyopathies, endocarditis and heart vessel disease. At the same time the improvement in prognosis relating to new therapies has dramatically changed the natural history of HIV infection and increased the number of patients (pts) who need cardiac surgery [1].

**Method:** A retrospective study of 17 consecutive pts operated from January 2000 to September 2005 was conducted to evaluate postoperative complications and in-hospital outcome in pts who acquired infection only through sexual transmission, excluding drug abusers. No opportunistic infection or tumour developed since the initial HIV diagnosis (6 months-15 years); median pre operative CD4 count was  $406 \pm 230 \text{ mm}^3$  (160-800). Routine antibiotic prophylaxis was started at induction of anaesthesia and continued for 48 h. Antiretroviral therapies were suspended on the day of surgery until the second post operative day. Universal infection precautions protocol was followed at all times.

**Results:** Mean age was 57 years (38-74). 15 of 17 pts were male. 12 pts underwent multiple coronary artery bypass grafting (CABG) with  $3.08 \pm 1 \text{ graft/pts}$ . 2 of 12 CABG were performed off-pump. 5 pts underwent valvular or a concomitant procedure: 1 aortic valve replacement, 1 mitral valve repair, 1 mitral valve replacement (MVR), 1 MVR + CABG and 1 aortic valve repair with ascending aorta replacement. Aortic cross clamping and cardiopulmonary bypass times were  $76.02 \pm 43.5$  and  $103.9 \pm 45$  minutes. All except one pt were discharged from ICU in  $2.1 \pm 0.5$  days and from hospital in  $7.5 \pm 2$  post operative days. Mean ventilation time was 11 hours (5-21). One patient had post operative complications due to low cardiac output syndrome with multiorgan failure. He was discharged from ICU and hospital respectively on the 22nd and 30th post operative days. 7 of 17 pts were transfused. Pre and postoperative CD4 count were not significantly different. No pt died, developed sepsis, wound infection, sternal dehiscence or needed ICU readmission. No needle stick injuries occurred.

**Conclusions:** In recent years there was an increase in non-drug related HIV pts requiring cardiac surgery. No expected complications due to immunologic depression after cardiopulmonary bypass or blood transfusion occurred in our pts, which proves that pts who are asymptomatic and treated with anti-retroviral therapy show low morbidity following cardiac surgery with a favourable outcome.

#### Reference:

- Gregory D, Trachiotis, E. Pendleton A, et al. Cardiac surgery in patient infected with the Human Immunodeficiency Virus. *Ann. Thorac. Surg* 2003; **76**: 1114-1118.

## P-90

### Which patients are most likely to develop postoperative arterial hypertension following coronary artery surgery?

P. Knapik, E. Kuczewicz, E. Urbanska, B. Czech, A. Golda, M. Oliwa  
*Silesian Centre for Heart Diseases, Zabrze, Poland*

**Introduction:** It has been confirmed that isolated systolic hypertension is associated with an adverse outcome following coronary surgery [1]. Perioperative arterial hypertension (PAH) may represent a real problem in the postoperative period. The aim of this study was to establish which patients are most likely to develop significant postoperative arterial hypertension following coronary artery surgery.

**Method:** The postoperative period of 825 consecutive adults patients who underwent elective, first-time coronary revascularization over the 11 months

period was analysed in a search for patients with a systolic blood pressure  $> 180 \text{ mmHg}$ . Such values had to be found in at least one measurement in the first 24 hours after the arrival in the postoperative ICU, despite routine analgesia and sedation. Patients entered either the PAH group or no-PAH group. Arterial hypertension, tobacco smoking, renal failure, vascular disease, diabetes, previous MI, left main stem CAD ejection fraction before coronary surgery and the use of cardiopulmonary bypass were analysed. Logistic regression analysis was performed and  $p < 0.05$  was considered significant.

**Results:** 69 patients (8.4%) were found to develop significant PAH. Only two factors (namely previous myocardial infarction (MI) and the presence of diabetes) were found to be significant in the logistic regression analysis (see table below).

Preoperative variables	Significance (p value)	Odds ratio	Confidence interval (-95%, +95%)	
No previous MI	0.007	0.50	0.30	0.83
Diabetes	0.0005	2.45	1.48	4.04

Among 330 patients without previous MI, 38 patients (11.5%) developed PAH, while for 495 patients with previous MI, this applied only to 31 patients (6.3%) ( $p = 0.007$ ). LVEF for patients who developed PAH was  $51.4\% \pm 10.0$  and  $49.7 \pm 10.6$  for patients in the no-PAH group ( $p = 0.22$ ). Among 585 patients without diabetes, 36 patients (6.2%) had PAH, while for 240 patients with diabetes, this applied to as many as 33 patients (13.8%) ( $p = 0.0005$ ).

**Conclusion:** Patients who develop PAH following coronary artery surgery are less likely to have had a previous MI and are more likely to be diabetic.

#### Reference:

- Aronson S, Boisvert D, Lapp W. Isolated systolic hypertension is associated with adverse outcomes from coronary artery bypass grafting surgery. *Anesth Analg* 2002; **94**: 1079-1084.

## P-91

### Central venous catheters coated with chlorhexidine and silver sulfadiazine: our experience on a cardio-surgical population

G. Marino, G. Landoni, T. Bove, A. Zangrillo  
*Ospedale San Raffaele, Milano, Italy*

**Introduction:** Central venous catheters (CVC) represent a fundamental part of the management of critically ill patients, but there can be serious infection complicating their use. Catheter-related bloodstream infections (CRBSIs) are the most frequent. The incidence of CRBSIs is variable and may be due to type of catheter, patient-related and other factors [1]. There is evidence that the use of catheters impregnated with antiseptic chlorhexidine and silver sulfadiazine (CH-SS) can reduce the rate of catheter colonization (CC) and CRBSIs [2].

**Method:** We studied 7132 adult patients who underwent cardiac surgery. From 1/1/1999 to 30/6/2001 we used a triple-lumen standard non-coated CVC; from 30/6/2002 to 31/12/2004 we used a triple-lumen CH-SS-coated CVC. Maximal antiseptic barrier precautions were used during catheter insertion. The culture of the catheter tip was carried out when there were signs of local or systemic infection (semi-quantitative technique). At the same time, three peripheral blood cultures were carried out. We diagnosed CRBSIs according to CDC criteria. We analysed our data retrospectively. Values of  $P < 0.05$  were considered statistically significant. Statistical analysis was performed using EPI-Info (CDC, Atlanta, Ga.).

**Results:** We found 97 (2.7%) catheter colonizations in the standard non-coated group, and 62 (1.7%) in the CH-SS coated group ( $P < 0.005$ ). As regards CRBSIs, we had 17 (0.5%) events in the standard non-coated group, and 7 (0.2%) in the CH-SS coated group ( $P = 0.06$ ). Gram-positive bacteria caused 58 (59.7%) catheter colonizations in the standard group, and 41 (67.2%) in the CH-SS group ( $P = 0.1$ ); Gram-negative bacteria caused 24 (24.7%) CC in the standard group and 10 (16.3%) in the CH-SS group ( $P = 0.02$ ); finally, yeast caused 15 (15.4%) CC in the standard group and 10 (16.3%) in the CH-SS group ( $P = 0.4$ ).

**Discussion:** Our experience with central venous catheters coated with CH-SS showed a reduction of colonization by Gram-negative bacteria and no decrease in the same field by Gram-positive bacteria and yeast. There was a lower rate of colonization with a significant difference between standard and coated catheters. On the contrary, we did not find a significant difference regarding the rate of CRBSIs in the two groups, although the rate of the coated-group was lower. Perhaps, the low event number in the standard group did not permit significant statistical results.

**References:**

- Centers for Disease Control and Prevention: Guidelines for the prevention of intravascular catheter-related infections. *MMWR Recomm Rep* 2002; **51**: 1–29.
- Maki DG, Stolz SM, Wheeler S, et al. Prevention of central venous catheter-related infection by use of an antiseptic impregnated catheter. A randomized, controlled trial. *Ann Intern Med* 1997; **127**: 257–266.

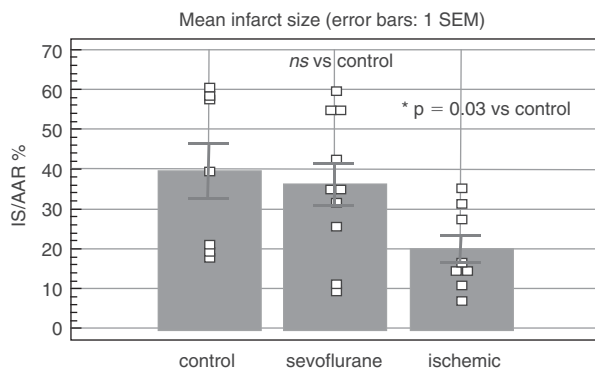
**P-92****Ischaemic preconditioning, but not sevoflurane, reduces myocardial infarct size in an experimental porcine closed-chest ischaemia-reperfusion model**

J.R. Larsen, E. Sloth, S. Aagaard, J.M. Hasenkam  
Aarhus University Hospital, Skejby, Aarhus, Denmark

**Introduction:** The endogenous cellular protection mechanism of *preconditioning* has chiefly been investigated in animals with collateral coronary flow. In this study, preconditioning with either ischaemia or sevoflurane was examined in a porcine experimental model featuring no or little collateral coronary flow.

**Method:** Randomized, controlled, animal experimental trial.  $N = 25$  20 kg pigs were subjected to 40 min ischaemia of the distal LAD-region under pentobarbital anaesthesia, followed by 2.5 h reperfusion, risk area (AAR)-staining, euthanasia and infarct-staining (IS) by the tetrazolium method. Prior to ischaemia pigs were randomized to  $2 \times 5$  min pre-ischaemia ( $n = 8$ ), or  $2 \times 5$  min 4% inhaled sevoflurane ( $n = 10$ ), and  $n = 7$  pigs acted as controls IS/AAR was compared between groups. Ventricular contractile performance was monitored using tissue Doppler echocardiography (peak systolic velocity) in the basal interventricular septum.

**Results and Discussion:** Preliminary results ( $n = 25$ ) are depicted. IS/AAR is reduced by 50% by ischaemia, but unchanged by sevoflurane. The porcine coronary anatomy may account for this, and because of its similarity to human coronary anatomy be implicated in negligible clinical results from sevoflurane preconditioning upon necrosis.



**Conclusion:** Histopathological and ventricular functional changes were observed following pharmacological intervention with inhaled sevoflurane in an *in vivo* experimental porcine ischaemia-reperfusion model. The changes were smaller than expected, possibly explained by no coronary collaterals in this model.

**P-93****Serum electrolyte concentration changes and their prognostic value for atrial fibrillation following coronary artery bypass grafting surgery**

M. Svagzdiene, E. Sirvinskas, R. Benetis  
Institute for Biomedical Research, Kaunas Medical University, Kaunas, Lithuania

**Introduction:** Postoperative atrial fibrillation (AF) after cardiac surgery is a rather common (17–33%) and unresolved problem [1]. Electrolyte balance disorders after cardiac surgery are not widely investigated, but results of some studies suggest that they may play an important role in the development of postoperative arrhythmias [2,3]. The aim of the study was to compare serum electrolyte concentrations in patients with and without AF following myocardial revascularization and to estimate the prognostic value of the changes.

**Method:** After approval of Biomedical Ethics Committee and signed informed consent form, the data of 82 male patients who underwent coronary artery bypass grafting (CABG) with cardiopulmonary bypass, were analysed. Patients were divided into two groups: Group I ( $n = 22$ ) were patients with AF after surgery and Group II ( $n = 60$ ) were patients without AF after surgery. Serum electrolytes were measured before the surgery, after arrival at ICU and on the next morning after the surgery.

**Results:** Before the surgery serum electrolyte levels did not differ between groups. After arrival at ICU serum chloride was significantly higher in group I than in the group II: 111.91 (4.48) vs. 105.17 (5.73) mmol/L ( $P < 0.001$ ); and serum phosphate level was significantly lower in group I than in group II: 0.98 (0.15) vs. 1.09 (0.19) mmol/L,  $P = 0.013$ . On the next morning ionized serum calcium level was lower in the group I than in the group II: 0.97 (0.06) vs. 1.00 (0.05) mmol/L,  $P = 0.021$ . Serum phosphate level remained significantly lower in group I than in group II: 0.81 (0.16) vs. 0.99 (0.20) mmol/L,  $P < 0.001$ . Binary logistic regression showed that serum potassium ( $P = 0.01$ ), ionized calcium ( $P = 0.023$ ), chloride ( $P = 0.003$ ) and phosphate ( $P = 0.005$ ) concentration immediately after the surgery may be used for prediction (72.7%) of atrial fibrillation after myocardial revascularization.

**Discussion:** Serum electrolyte concentrations play an important role in the development of atrial fibrillation. Serum potassium, ionized calcium, chloride and phosphate level immediately after surgery may be used for prediction of atrial fibrillation after myocardial revascularization.

**References:**

- Shingu Y, Aoki H, Oba J, et al. Atrial fibrillation after isolated coronary bypass surgery. *Kyobu Geka* 2005; **58** (9): 807–811. Japanese.
- Polderman KH, Girbes AR. Severe electrolyte disorders following cardiac surgery: a prospective controlled observational study. *Crit Care* 2004; **8**: R459–R466.
- Cohen J, Kogan A, Sahar G, et al. Hypophosphatemia following open heart surgery: incidence and consequences. *Eur J Cardiothorac Surg* 2004; **26** (2): 306–310.

## Poster Sessions

### Haemostasis/Cardiac Anaesthesia

**P-94****Purified antithrombin supplementation in coronary revascularization operations**

M. Ranucci, G. Soro, D. Conti, A. Cazzaniga, M. Rossi  
Policlinico S. Donato (Milan), Catholic University (Rome)

**Introduction:** During cardiac operations, the circulating levels of antithrombin (AT) are reduced [1]. Patients reaching the operating theatre with preoperative low levels of AT are more likely to be heparin-resistant [2,3]. Purified antithrombin concentrates or human recombinant antithrombin have been proposed for treating heparin resistance in cardiac operations with cardiopulmonary bypass, and exert a beneficial effect in terms of haemostatic system activation control. However, little information is available with respect to antithrombin

supplementation and clinical outcome in selected categories of patients. The aim of this study was to evaluate clinical outcome data in patients intraoperatively treated with purified antithrombin compared to a control population.

**Method:** 89 patients forming the AT-treated group received purified antithrombin to correct preoperatively low values of antithrombin activity or to treat heparin resistance. The Control group was retrospectively created with a propensity score analysis. After verifying the homogeneity of the two groups, various outcome variables were compared between groups.

**Results:** Patients in the AT-treated group had a shorter Intensive Care Unit ( $2.6 \pm 3$  vs.  $3 \pm 2.7$  days) and Hospital ( $7.5 \pm 3.5$  vs.  $8.6 \pm 4.5$  days) stay, and a lower rate (relative risk 0.1, 95% confidence interval 0.01–0.81) of severe postoperative morbid events. Conversely, they demonstrated a significant, albeit clinically irrelevant, more pronounced postoperative bleeding tendency.



**Discussion:** AT supplementation in patients at risk for inadequate thrombin suppression during the operation reduces postoperative complications and shortens the recovery time. However, a careful monitoring of the heparin requirements is recommended in order to avoid undesired excessive postoperative bleeding.

**References:**

- 1 Hashimoto K, Yamagishi M, Sasaki T, et al. Heparin and antithrombin III levels during cardiopulmonary bypass: correlation with subclinical plasma coagulation. *Ann Thorac Surg* 1994; **58**: 799–805.
- 2 Ranucci M, Cazzaniga A, Soro G, et al. The antithrombin III-saving effect of reduced systemic heparinization and heparin-coated circuits. *J Cardiothorac Vasc Anesth* 2002; **16**: 316–320.
- 3 Ranucci M, Ditta A, Boncilli A, et al. Determinants of antithrombin consumption in cardiac operations requiring cardiopulmonary bypass. *Perfusion*. 2004; **19**: 47–52.

## P-95

### Effects of preoperative antiplatelet therapy on postoperative bleeding using thromboelastography in off-pump coronary artery bypass grafting

H.J. Kwak, J.Y. Kim, W.S. Jung, Y.W. Hong, Y.L. Kwak

*Gachon Medical School, Gil Medical Center, Incheon, South Korea*

**Introduction:** The preoperative use of clopidogrel and aspirin significantly increases postoperative bleeding in on-pump coronary bypass patients. In a retrospective study, postoperative bleeding associated with preoperative clopidogrel administration was reported to be attenuated in off-pump coronary artery bypass grafting (OPCAB) possibly because cardiopulmonary bypass, which significantly disturbs coagulation system, is avoided. This prospective study is designed to determine the effect of aspirin and clopidogrel therapy on postoperative bleeding and coagulation profile using thromboelastography (TEG) in OPCAB.

**Method:** After obtaining IRB approval and informed consent, 77 patients undergoing OPCAB were divided into three groups according to their medication history: those on aspirin and clopidogrel within 2 days of surgery (group 1, n = 20), those on both within 3 to 7 days before surgery (group 2, n = 20) and those on neither more than 7 days before surgery (control group, n = 20). The routine coagulation profiles and TEG were measured before induction (baseline value) and 24 hours after surgery in intensive care unit. The transfusion requirement and chest tube output were recorded at the first 24 hours after surgery.

**Results:** Postoperative haemoglobin and platelet count were significantly decreased in all groups. Preoperative R time of group 1 and 2 was significantly longer than that of the control group. Postoperative maximum amplitude of group 1 and 2 was significantly less than that of control group. However, there were no significant differences in transfusion requirements and postoperative bleeding among the groups.

**Discussion:** The continuation of aspirin and clopidogrel up to 2 to 7 days before surgery did not increase postoperative bleeding and transfusion requirements in spite of negative effect on coagulation system measured by TEG. Considering the negative effect of hypercoagulation on myocardial outcome as well as thrombotic complications, continuing aspirin and clopidogrel can be beneficial without increasing the risk of postoperative bleeding in patients undergoing OPCAB.

**References:**

- 1 Leong JY, Baker RA, Shah PJ, et al. Clopidogrel and bleeding after coronary artery bypass graft surgery. *Ann Thorac Surg* 2005; **80**: 928–933.
- 2 Woo YJ, Grand T, Valettas N. Off-pump coronary artery bypass grafting attenuates postoperative bleeding associated with preoperative clopidogrel administration. *Heart Surg Forum* 2003; **6**: 282–285.

## P-96

### Levosimendan pre-treatment shows anti-ischæmic effects during regional myocardial ischaemia in an open chest pig model

C. Metzsch, L. Algotsson

*Department of Cardiothoracic Anaesthesia and Intensive Care, Lund University Hospital, Lund, Sweden*

**Introduction:** Levosimendan has shown promising clinical effects on cardiac failure complicating acute coronary syndromes, and in experiments in dogs levosimendan has reduced infarct size after coronary artery occlusion [1] probably by activation of the mitochondrial ATP-sensitive potassium channels. However, the myocardial metabolic effects have been insufficiently investigated.

**Method:** In anaesthetized pigs, a marginal branch of the circumflex artery was occluded for 30 minutes and then reperfused. The myocardial metabolism in ischaemic and control tissue was investigated with microdialysis concomitantly with coronary flow and global circulation. Levosimendan pre-treatment (Group 1) started 30 minutes before ischaemia was compared to levosimendan started 10 minutes after coronary occlusion (Group 2). Between groups differences during the experiment were tested with a two-way repeated measurements ANOVA.

**Results:** During the ischaemic period cardiac output (CO) and contractility ( $dp/dt_{max}$ ) were higher in the pre-treated group, and systemic vascular resistance (SVR) was lower. The differences disappeared during reperfusion. During ischaemia and reperfusion microdialysate glucose was lower in the pre-treated group, and lactate and lactate/pyruvate ratio (LPR) were higher.

Presented as percent of baseline, (median[range]), haemodynamic values during ischaemia were (Group 1; Group 2): CO = (114[100–133]; 93[86–123]),  $dp/dt_{max}$  = (117[83–157]; 99[81–106]), SVR = (85[81–90]; 105[96–122]). The myocardial metabolite levels at the end of ischaemia were: glucose = (88[35–178]; 48[3–65]), lactate = (339[168–677]; 823[292–1109]), LPR = (267[78–3684]; 1455[399–3634]). At reperfusion the levels were: glucose = (119[60–180]; 66[36–104]), lactate = (343[160–710]; 733[251–1113]), LPR = (141[70–1286]; 533[103–703]). No differences were found for heart rate, arterial pressure, pulmonary arterial pressure, coronary artery flow, and myocardial glycerol levels.

**Discussion:** The haemodynamic effects are in concordance with previous studies and reviews on the effects of levosimendan. The effects on the myocardium indicate a reduced ischaemic metabolic response. In conclusion, levosimendan pre-treatment showed metabolic anti-ischæmic actions and better preserved global circulation during myocardial ischaemia and reperfusion.

**Reference:**

- 1 Kersten JR, Montgomery MW, Pagel PS, et al. Levosimendan, a new positive inotropic drug, decreases myocardial infarct size via activation of KATP channels. *Anesth Analg* 2000; **90**: 5–11.

## P-97

### Clopidogrel and OPCAB surgery in HIT: case report

C. Beverini, M.R. Marino, S. Gregu, S. Salis, G. Merli, L. Salvi

*Centro Cardiologico Fondazione Monzino IRCCS, Milano, Italy*

One of the most morbid complications of heparin therapy is Heparin-Induced Thrombocytopenia (HIT). HIT is an immunologically mediated syndrome that can lead to life-threatening thromboembolic complications [1]. Since heparin is routinely used during coronary artery bypass grafting surgery (CABG), an alternative anticoagulant should be considered in patients with a history of HIT.

**Case report:** A patient affected by unstable angina with a history of HIT was to undergo urgent cardiac surgery. The patient developed in the past a severe thrombocytopenia ( $6 \times 10^9 L^{-1}$ ) after an angioplasty procedure. At that time no test was done to verify the presence of anti-H-PF4 antibodies, nor did we, since HIT antibodies are transient. The urgency of the surgery did not allow any further evaluation of the patient. He underwent off-pump coronary surgery (OPCAB) using only an anti-aggregation protocol: clopidogrel 450 mg plus acetylsalicylic acid 900 mg the night before surgery and the same dosage just before surgery. Twenty-four hours after surgery salicylate 900 mg was repeated followed by salicylate 300 mg plus ticlopidine 150 mg every day until hospital discharge. The patient was discharged from the hospital 10 days after the surgery without any impairment. Coronary computerized tomography (TC) at six months after surgery documented good patency of the grafts.

**Conclusions:** Hirudin is suggested as an acceptable solution in case of HIT [2]. It is a potent direct thrombin inhibitor, with no effects on platelets. Other alternative strategies are haemodilution, antibodies directed to GPIIb/IIIa receptors (abciximab) or the use of a GPIIb/IIIa inhibitor (tirofiban) [3]. Clopidogrel is a non-competitive antagonist of platelet adenosine diphosphate receptor and a potent inhibitor of platelet aggregation, widely used in interventional cardiology. Usually clopidogrel is stopped a few days before surgery. A loading dose of clopidogrel plus aspirin, associated with an OPCAB procedure and haemodilution, could be a safe solution for patients undergoing emergency CABG surgery with a history of HIT.

**References:**

- 1 Warkentin TE, Greinacher A. Heparin-induced thrombocytopenia and cardiac surgery. *Ann Thorac Surg* 2003; **76**: 2121–2131. Review.
- 2 Carr CS, Rayner A, Ponte J, et al. Off-pump coronary artery bypass grafting in a heparin-induced thrombocytopenia type II patient using hirudin. *Ann Thorac Surg* 2005; **79**: 696–698.
- 3 Von Segesser, Mueller X, Marty B, et al. Alternatives to unfractionated heparin for anticoagulation in cardiopulmonary bypass. *Perfusion* 2001; **16**: 411–416. Review.

**P-98****Off-pump versus on-pump coronary artery surgery: a search for fibrinolysis by the method of rotation thromboelastography**

M. Jares, T. Vanek, F. Bednar, M. Maly, Z. Straka

Department of Cardiac Surgery, study group MSM0021620817, 3rd Medical School of Charles University, Prague, Czech Republic; Department of Biostatistics and Informatics, National Institute of Public Health, Prague, Czech Republic

**Introduction:** Effect of fibrinolytic inhibitors on the decrease in perioperative bleeding in off-pump coronary surgery has been reported [1]. However, information concerning the activation of coagulation and fibrinolytic pathways during off-pump and on-pump cardiac surgery procedures is still limited [2]. The aim of this prospective, randomized study was to compare rotation thromboelastography (roTEG) results and D-dimer levels in off-pump vs. on-pump coronary surgery to search for the activation of fibrinolysis.

**Method:** 20 patients scheduled for coronary bypass grafting were assessed (off-pump group A, n = 10; on-pump group B, n = 10). Blood samples for roTEG examination were taken preoperatively (t0), 15 minutes after sternotomy (t1), on the completion of peripheral bypass anastomoses (t2), and at the end of procedures (t3). The time points for D-dimer levels analyses were before operation, at the end of procedures, and 24 hours later.

**Results:** For roTEG parameters at all times the distinctiveness of t2 from the other times was confirmed ( $P < 0.001$ ). A certain degree of roTEG signs of fibrinolysis was noticed at time t2 in both groups and in group B these marks were quite widely, but non-significantly expressed ( $P$ -values for inter-group differences for Lysis on Set Time at 60 min., and 150 min. were  $P = 0.190$ , and  $P = 0.122$ , respectively). Completely expressed roTEG signs of hyperfibrinolysis were observed in 2 patients from group B (Lysis on Set Time at 60 min. 0% and 19%, at 150 min. 0% and 0%, respectively). In group B also the highest geometric means of D-dimers (1326.0 [943.5; 1863.6] ng mL<sup>-1</sup>) and a dramatic inter-group difference ( $P < 0.001$ ) were observed at the end of surgery. 24 hours later the significantly elevated D-dimer levels in both groups (A: 1070.0 [723.5; 1582.6] vs. B: 1093.3 [732.0; 1632.9] ng mL<sup>-1</sup>) were equalized ( $P = 0.932$ ).

**Discussion:** Our roTEG results display a slightly greater activation of fibrinolysis during the course of cardiopulmonary bypass, compared to off-pump cardiac surgery. In the on-pump group the highest mean value of D-dimers was already detected at the end of surgery, while in the off-pump group the maximum values were reached only on post-operative day 1.

**References:**

- 1 Vanek T, Jares M, Fajt R, et al. Fibrinolytic inhibitors in off-pump coronary surgery: a prospective, randomized, double-blind TAP study (tranexamic acid, aprotinin, placebo). *Eur J Cardiothorac Surg* 2005; **28**: 563–568.
- 2 Casati V, Gerli C, Franco A, et al. Activation of coagulation and fibrinolysis during coronary surgery: on-pump versus off-pump techniques. *Anesthesiology* 2001; **95**: 1103–1109.

**P-99****Evidence for preconditioning by levosimendan in coronary artery bypass grafting**

V. De Santis, A. Craus, D. Vitale, L. Tritapepe

Department of Anesthesiology and Intensive Care, University of Rome "La Sapienza", Rome, Italy

**Introduction:** The calcium sensitizer levosimendan has been shown to protect against myocardial ischaemia and reperfusion injury in animal models. The present study investigated whether these effects were clinically relevant and would protect the myocardium during coronary artery bypass grafting (CABG).

**Method:** Twenty-four patients with stable angina scheduled for elective CABG surgery were equally randomized into control and levosimendan (Levo) groups. In the Levo group, 24 µg/kg levosimendan was infused intravenously over a 10 minute period just prior to placing the patient on cardiopulmonary bypass. A time-matched placebo infusion was given to control patients. Perioperative haemodynamic variables, concentrations of cardiac troponin I over the 48 h post-operative period, and clinical outcomes were assessed.

**Results:** There were no adverse effects related to levosimendan. Post-operative troponin I concentrations in the Levo group were significantly lower than control ( $P < 0.05$ ). Levo-treated patients had significantly higher cardiac indices (CI) ( $P < 0.05$ ), spent less time receiving mechanical ventilation ( $9.8 \pm 2.6$  vs.  $11.2 \pm 2.5$  h) and had shorter intensive care and postoperative hospital length of stays ( $27.3 \pm 7.5$  vs.  $33.6 \pm 10$  h, and  $11.5 \pm 2$  vs.  $13 \pm 2$  days, respectively).

**Conclusion:** Patients receiving levosimendan during cardiopulmonary bypass surgery showed improved outcomes and evidence of less myocardial damage.

**P-100****Effect of sildenafil on pulmonary haemodynamics in patients with valvular heart disease**

J.Y. Kim, Y.W. Hong, J.K. Shim, W.K. Lee, S.H. Choi, Y.L. Kwak

Gachon Medical School Gil Hospital, Incheon; Yonsei University College of Medicine, Seoul; Kwandong University College of Medicine, Kyungkido, South Korea

**Introduction:** Pulmonary arterial hypertension (PAH) is thought to be associated with relative deficiencies in vasodilators such as nitric oxide. Phosphodiesterase type 5 (PDE5) is abundant in the pulmonary vasculature and by inhibiting PDE5, sildenafil was reported to reduce PAH [1]. However, the effect of sildenafil on secondary PAH has rarely been studied. This study was designed to evaluate the effect of oral sildenafil on secondary PAH in patients with valvular heart disease.

**Method:** After obtaining IRB approval and informed consent, 38 patients with PAH (mean pulmonary artery pressure (PAP) > 30 mmHg) undergoing valve replacement surgery were randomly allocated to control (n = 20) and sildenafil group (n = 18). After pulmonary artery catheter insertion, patients were medicated with placebo or sildenafil (50 mg). Anaesthesia was induced 10 min later. Haemodynamic variables were measured before medication (T0), 10 (T1 baseline), 20 (T2) and 50 min (T3) after induction.

**Results:** There were no differences in haemodynamic variables before and after induction of anaesthesia (T0 vs. T1). Systolic and mean PAP significantly decreased at T2 when compared to those at T1 in the sildenafil group. In the control group, pulmonary vascular resistance index (PVRI) and right ventricular end diastolic volume index (RVEDVI) increased significantly and cardiac index (CI) decreased significantly at T3 when compared to those at T1. The differences in other haemodynamic variables were not statistically significant

		T0	T1 (baseline)	T2	T3
CI	C	3.1 ± 0.9	3.3 ± 0.8	3.0 ± 0.8	2.8 ± 0.6*
(L/min/m <sup>2</sup> )	S	3.7 ± 1.0	3.2 ± 0.8	3.2 ± 0.6	2.9 ± 0.6
mPAP	C	42 ± 12	31 ± 7	32 ± 7	34 ± 12
(mmHg)	S	40 ± 8	34 ± 8	29 ± 6*	33 ± 8
PVRI	C	370 ± 157	235 ± 88	267 ± 127	315 ± 133*
	S	338 ± 138	263 ± 161	206 ± 132	235 ± 112
RVEDVI	C	151 ± 38	156 ± 5.3	174 ± 67	192 ± 70*
(mL/m <sup>2</sup> )	S	172 ± 46	198 ± 83	186 ± 80	194 ± 69

C = control; S = sildenafil. Data are expressed as mean ± SD. PVRI: pulmonary vascular resistance index (dyn scm<sup>-2</sup>). RVEDVI: right ventricular end diastolic volume index \* $P < 0.05$  compared values at T1.

**Conclusions:** Sildenafil, which has an onset of 30 min and a peak effect in 60 min, reduced PAP 30 min after medication. It prevented an increase in PVRI and RVEDVI that occurred in the control group. Therefore, sildenafil is a promising agent to be used in patients with secondary PAH.

**Reference:**

- 1 Lee AJ, Chiao TB, Tsang MP. Sildenafil for pulmonary hypertension. *Ann Pharmacother* 2005; **39**: 869–884.

**P-101****An audit of bedside thromboelastography to detect heparin rebound following cardiac bypass surgery**

M.W. Harper, P. Robbins

Derriford Hospital, Plymouth Hospitals NHS Trust, Plymouth, United Kingdom

**Introduction:** Heparin rebound, the reappearance of anticoagulant activity after adequate neutralization with protamine, can lead to excessive postoperative bleeding after cardiac surgery [1]. Studies have demonstrated that heparin activity can persist up to 6 hours after apparent protamine neutralization. It has been suggested that this is due to the release of protein bound heparin [1], which dissociates after the *in vivo* elimination of protamine which has a half life around 7.4 min [2]. We aimed to determine the incidence of detectable heparin rebound on our unit by auditing the routine plain vs. heparinase thromboelastographs carried out in postoperative cardiac bypass patients on the Cardiac Intensive Care Unit (CICU).

**Method:** Thirty four consecutive patients undergoing elective cardiac bypass surgery were studied in a prospective audit of bedside TEGs performed on the CICU within 2 hours postoperatively. Heparin and protamine given intraoperatively was recorded as was the use of aprotinin, diclofenac, and preoperative anticoagulants. We examined the incidence of bleeding, consumption of blood products and incidence of re-sternotomy in relation to the differences between plain and heparinase TEG studies.

**Results:** Of the 34 patients studied 7 had significantly different reaction ( $t$ ) times between plain and heparinase samples (difference greater than 5 minutes). This group accounted for both of the re-sternotomies which occurred within the cohort, experienced greater blood loss and consumed more blood products per capita (mean 2 units per capita) than the remaining 27 patients (mean 0.5 units per capita).

**Conclusion:** Our results have demonstrated that bedside plain and heparinase TEGs represent a rapid and valuable investigation in predicting bleeding complications at an early stage in the immediate postoperative period, which may elucidate a coagulopathy easily reversed by further protamine either by empirical bolus or infusion [3].

#### References:

- 1 Teoh KH, Young E, Bradley CA, Hirish J. Heparin binding proteins. Contribution to heparin rebound after cardiopulmonary bypass. *Circulation* 1993 Nov; **88**(5 Pt 2): 11420-11425.
- 2 Butterworth J, Lin YA, Priellip R, et al. The pharmacokinetics and cardiovascular effects of a single intravenous dose of protamine in normal volunteers. *Anesthesia Analgesia* 2002; **94**(3): 514-522.
- 3 Teoh KH, Young E, Blackall MH, et al. Can extra protamine eliminate heparin rebound following cardiopulmonary bypass surgery? *J Thorac Cardiovasc Surg* 2004; **128**(2): 211-219.

## P-102

### An audit of current post operative thrombo-prophylaxis following cardiac surgery

M.W. Harper, T. Nokes, P.M. Robbins

*Derriford Hospital, Plymouth Hospitals NHS Trust, Plymouth, United Kingdom*

**Introduction:** Venous thromboembolism (VTE) is a common and often occult complication after major surgery despite specific prophylaxis recommendations [1]. Little has been published concerning the frequency of deep vein thrombosis (DVT) and pulmonary embolism (PE) following coronary artery bypass graft (CABG) surgery and there are no specific UK published guidelines to direct prophylaxis in this patient group. Some recent work has suggested that the incidence of asymptomatic DVT immediately following cardiac surgery may be as high as 15% [2]. The aim of this audit was to ascertain the proportion of patients in this large tertiary centre, given formal thromboprophylaxis in the immediate post operative period following cardiac surgery.

**Method:** 81 patients (>24 hours post bypass surgery) were selected at random over three weeks. Information regarding type of operation, duration of in-patient stay, presence of and documentation of thromboembolic risk factors, mobility, contraindications for thromboprophylaxis and anticoagulants prescribed were recorded for each patient.

**Results:** Of the 81 patients studied, 7 had contraindications to thromboprophylaxis and were excluded from further analysis. Of the 74 remaining patients, 20% had documented, formal thromboembolic risk assessment, 45% were fully immobile and the remainder (55%), were mobile to chair. The majority (64%) were receiving no prophylaxis except for aspirin, 25% were receiving appropriate anticoagulation and a further population of 11% were receiving anticoagulation but were sub-therapeutic.

**Conclusion:** There is wide local variation in the application of thromboprophylaxis in the post-operative care of bypass surgery patients. The overwhelming majority receive nothing. Very few are even formally risk assessed, yet frequently present with more than one risk factor for post operative VTEs. Even for those in which oral anticoagulants are commenced, there is considerable lag time before attaining therapeutic INR, possibly at the most significant time for thrombotic complications. Heparin bridging was rarely used to cover the theoretical period of a hypercoagulable state associated with initiating oral anticoagulation. These results clearly demonstrate the need for formal thromboprophylaxis guidelines and increased awareness, to provide a consistent strategy following bypass surgery.

#### References:

- 1 Sixth ACCP Consensus Conference on Anti-thrombotic Therapy. *Chest* 2001; **119** (Suppl), 1s-370s.
- 2 Ambrosetti M, Salerno M, Zambelli M, et al. Deep vein thrombosis among patients entering cardiac rehabilitation after coronary artery bypass surgery. *Chest* 2004; **125**: 191-196.

## P-103

### The effects of mannitol on cardiopulmonary functions in patients undergoing off-pump coronary artery bypass surgery

J.K. Shim<sup>1</sup>, S.H. Choi<sup>1</sup>, H.K. Shinn<sup>3</sup>, Y.W. Hong<sup>1,2</sup>, Y.L. Kwak<sup>1,2</sup>

*Department of <sup>1</sup>Anesthesiology and Pain Medicine and <sup>2</sup>Anesthesia and Pain Medicine Research Institute, Yonsei University College of Medicine, Seoul; <sup>3</sup>Department of Anesthesiology and Pain Medicine, College of Medicine, Inha University, Incheon*

**Introduction:** Compared to on-pump surgery, off-pump coronary artery bypass surgery (OPCAB) is associated with a greater reduction in postoperative respiratory compliance with a larger amount of fluid administration required to maintain stable haemodynamics during manipulation of the heart [1]. Also, transient interruption of coronary flow is necessary during grafting. Mannitol is an osmotic diuretic with free radical scavenging properties. The authors evaluated the effects of mannitol on cardiopulmonary functions in patients undergoing OPCAB.

**Method:** After IRB approval, 23 patients were randomly allocated to receive either 20% mannitol 0.5 mg · kg<sup>-1</sup> (n = 12) or normal saline 2.5 mL · kg<sup>-1</sup> (n = 11, control) intravenously, immediately after harvesting of the internal mammary artery. Haemodynamic and pulmonary variables were measured 10 min after induction of anaesthesia (T1) and immediately after the surgery (T2) with an inspired oxygen fraction of 0.6. Biochemical variables including serum creatine kinase MB (CKMB) level were measured 24 h before and after the surgery. Intraoperative fluid balance, duration of surgery and the time to extubation were recorded. Statistical analysis was done with  $t$ -test and  $P < 0.05$  was considered significant.

**Results:** The values of PaO<sub>2</sub> and CKMB are shown in the table. Changes in lung compliance were insignificant. Haemodynamic and biochemical variables, and intraoperative fluid intake were similar between the groups, despite greater urine output in the mannitol group (2.8 ± 1.1 mL · kg<sup>-1</sup> · hr<sup>-1</sup> vs. 1.8 ± 0.8 mL · kg<sup>-1</sup> · hr<sup>-1</sup>,  $P = 0.035$ ). Time to extubation was not significantly different.

**Table.** Within and between group comparisons of PaO<sub>2</sub> and CKMB

	Group	T1	T2
PaO <sub>2</sub> (kPa)	Control	33.8 ± 7.0	25.3 ± 8.9*
	Mannitol	29.3 ± 5.8	30.4 ± 5.0*
CKMB (ng·ml <sup>-1</sup> )	Control	2.2 ± 0.8	11.8 ± 7.9*
	Mannitol	1.7 ± 0.4	6.7 ± 3.0*

Data are mean ± SD. \* $P < 0.05$  compared to values at T1;  $P < 0.05$  between group comparisons.

**Discussion:** Intravenous infusion of mannitol yielded beneficial effects on cardiopulmonary functions in terms of PaO<sub>2</sub> and CKMB without increasing fluid requirement or adverse haemodynamic effects. Although without statistical significance, a trend toward faster extubation time in the mannitol group could be observed (8.6 ± 3.5 h vs. 13.1 ± 6.3 h,  $P = 0.58$ ). Its potential role in preserving pulmonary function and reducing the extent of myocardial injury during OPCAB could be observed in this preliminary study and further study with a larger number of patients is warranted.

#### Reference:

- 1 Staton GW, Williams WH, Mahoney EM, et al. Pulmonary outcomes of off-pump vs. on-pump coronary artery bypass surgery in a randomized trial. *Chest* 2005; **127**: 892-901.

## P-104

### Should we consider presurgical erythropoietin treatment risk free? Case report

M. Basora, G. Fita, P. Matute, C. Roux, J.L. Pomar, C. Gomar

*Hospital Clinic, Barcelona, Spain*

Cardiac surgery in Jehovah's Witness patients remains a challenge in the presence of low blood volume and anaemia.

**Case Report:** We report a case of a 57-year-old female Jehovah's Witness suffering from severe mitral valve stenosis with severe pulmonary hypertension and massive tricuspid insufficiency (NYHA III/IV). She was scheduled for valve replacement and refused all blood derivatives. The patient showed atrial fibrillation and was receiving warfarin treatment. In order to improve the Hb (12 g dL<sup>-1</sup>), the patient was treated with two doses of 200 mg of iv. iron and 40,000 IU of sc. recombinant human erythropoietin (rHuEPO) weekly and a third dose, two days after the second. A week after the last dose, the patient suffered a sudden loss of strength on the left side of the body, with left facial paralysis and deviation of the gaze to the right. The cranial CAT didn't show alterations. At this time her Hb was 12.4 g dL<sup>-1</sup>, the platelet number was 362,000, with INR 3.0 and normal blood pressure. Three hours later the symptoms disappeared, and with a diagnosis of transient ischaemic attack (TIA), the patient was discharged from the emergency room. Three weeks later the patient was operated on for mitral replacement and tricuspid annuloplasty with a preoperative Hb 13.9 g dL<sup>-1</sup>. No blood derivatives were used.

**Discussion:** It was suspected that treatment with rHuEPO played a role in the episode of TIA due to a possible increase in platelet aggregation. The patient had never had a TIA before and had been correctly coagulated with warfarin. Apart from correcting the Hb, rHuEPO improves both platelet-subendothelium interaction and has a direct beneficial effect on platelet aggregation, which appears soon after initiation of the treatment and occurs

before the Hb rise can be observed [1]. Although very few clinical thrombotic events have been reported in the large studies that led to rHuEPO registration for use in the perioperative period, none of these studies [2] used the diagnostic method, i.e. venography, echo-Doppler, to detect deep vein thrombosis. The initial increase in platelet aggregation produces a thrombotic risk, and this risk may increase with the progressive Hb rise in the following days. We should consider that rHuEPO is not free of risks, even with a presurgical indication and define more accurately the exclusion criteria for this drug.

#### References:

- 1 Tassies D, Reverter JC, Cases A, et al. Effect of recombinant human erythropoietin treatment on circulating reticulated platelets in uremic patients: association with early improvement in platelet function. *Am J Hematol* 1998; **59**: 105–109.
- 2 de Andrade JR, Frei D, Guilfoyle M. Integrated analysis of thrombotic/vascular event occurrence in epoetin alfa-treated patients undergoing major, elective orthopedic surgery. *Orthopedics* 1999; **22**: s113–s118.

## P-105

### Comparison of dexmedetomidine or midazolam on haemodynamics and mixed venous oxygen saturation in patients undergoing coronary artery bypass grafting (CABG)

N. Ozkan, N. Sahin, H.K. Kabukcu, G. Celikbilek, T.T. Aydogdu

Department of Anaesthesiology and Reanimation, Akdeniz University Medical Faculty, Antalya, Turkey

**Introduction:** The alpha-2 receptors are located on blood vessels, where they mediate vasoconstriction, and on sympathetic terminals, where they inhibit norepinephrine release. The alpha-2 receptors are also located within the central nervous system, and their activation leads to sedation, a reduction of tonic levels of sympathetic outflow, and augmentation of cardiac vagal activity. Dexmedetomidine is a novel lipophilic alpha-methylol derivative with a high affinity for alpha-2 receptors [1]. In our study we aimed to compare the effects of dexmedetomidine with those of midazolam on the haemodynamics and mixed venous oxygen tension (PvO<sub>2</sub>) of patients undergoing CABG.

**Method:** Forty patients planned for CABG were assigned into two groups with twenty patients each. After the infusion of dexmedetomidine (0.2–0.4 µg kg<sup>-1</sup> h<sup>-1</sup>), following a loading dose of 1 µg kg<sup>-1</sup> hr<sup>-1</sup> (Group D) and the infusion of midazolam (0.05–0.07 mg kg<sup>-1</sup> hr<sup>-1</sup>) (Group M), fentanyl (20–30 µg kg<sup>-1</sup>) and cisatracurium (0.15 mg kg<sup>-1</sup>) were administered intravenously for intubation in both groups. Haemodynamic measurements, PvO<sub>2</sub> and SpO<sub>2</sub> were recorded preoperatively, at tenth minute of infusion, intubation, incision, arrival in intensive care unit (ICU), 1, 2, 4, 24 h, before extubation and then at 1, 2, 4, 24 h after extubation. For statistical analysis we used Mann-Whitney, Friedman and Wilcoxon tests. *P* < 0.05 values were accepted as significant.

**Results:** Demographic data and cross-clamp times were similar between the two groups. In Group M, the changes in each value of systolic, mean, diastolic arterial pressures were parallel for each patient in the group and were lower than Group D at tenth minute of infusion, after intubation, at incision, before bypass and at arrival in ICU (*P* < 0.05). Oxygen consumption was similar between the two groups.

**Table 1:** Comparison of PvO<sub>2</sub>, CaO<sub>2</sub>, Do<sub>2</sub> between groups

	Gp	Preop.	Intub.	Post op	ICU 1 hr	Pre extub	Post extub
PvO <sub>2</sub> (kPa)	D	6.2 ± 0.5	6.2 ± 0.5	5.6 ± 0.8	5.4 ± 0.8*	5.4 ± 0.6*	5.2 ± 0.8*
	M	6.9 ± 1.1*	7.8 ± 0.7*	6.6 ± 0.8*	5.0 ± 0.5	5.1 ± 0.3	5.1 ± 0.3
CaO <sub>2</sub>	D	1774.	1610	980	1312	1287	1357*
	M	1758	1687	974	1238	1179	1192
DO <sub>2</sub>	D	89335	76760	49616	65619	66475	66786
	M	80721	74572	64432*	64614	64170	68310

\**P* < 0.05

**Conclusion:** Dexmedetomidine blunted the sympathetic response caused by surgical stimulus so it was dependable for use intraoperatively and it was useful for sedation and analgesia postoperatively. It had beneficial effects on haemodynamic stability and oxygen profile in patients undergoing CABG.

#### Reference:

- 1 Belleville JP, Ward DS, Bloor BC, et al. Effects of intravenous dexmedetomidine in humans. *Anesthesiology* 1992; **77**: 1125–1133.

## Echocardiography/Intensive Care Medicine

## P-106

### Apical ballooning syndrome due to pheochromocytoma treated with mechanical ventricular support: case report

A. Camata, V. Salandin, B. Persi, E. Toniolo, P. Zanatta, T. Collavo

Treviso Regional Hospital, Cardioanaesthesia, Treviso, Italy

A patient was admitted to the ICU of the Heart Surgery Division for left ventricle support. The final diagnosis was severe acute dilated cardiomyopathy due to pheochromocytoma.

**Case Report:** A 42 years old woman was admitted to the Intensive Care Unit (ICU) for cardiogenic shock, respiratory insufficiency, anuria, abdominal pain, hyperglycaemia (>33 mmol/L). Tracheal intubation was performed and cannulation of a central vein for inotropic support. The radial artery was cannulated to monitor the arterial pressure. Diuretics and insulin were administered. A transoesophageal echocardiography (TOE) detected severe global myocardial depression of systolic function and cardiac dilatation (ejection fraction < 15%).

A 17 g Fr cannula was positioned percutaneously in the right femoral artery and a 21 g Fr cannula in the right femoral vein. We decided to use the Levitronix<sup>®</sup> Centrimag, a Medtronic Carmeda<sup>®</sup> circuit and a Jostra Quadrox<sup>®</sup> Bioline oxygenator to perform cardiopulmonary bypass (CPB). The cardiac index (CI) was maintained at 2.5 L min<sup>-1</sup> m<sup>-2</sup> to obtain a mean arterial pressure of 80–100 mmHg. Two hours later the blood gas analysis values were within a normal range and diuresis was restored. A low dose of dobutamine (3–8 µg kg<sup>-1</sup> min<sup>-1</sup>) was infused to avoid ventricular dilatation. The activated clotting time (ACT) was kept at 180–200 sec. Mechanical ventilation was reduced (tidal volume 400 mL, respiratory rate 15/min, PEEP 5 mmHg, 0.21 inspired oxygenation fraction). The patient was sedated (midazolam 0.03 µg kg<sup>-1</sup> min<sup>-1</sup>). A TOE and a chest X-ray were performed daily. Cardiac and pulmonary functions progressively improved. There were neither haemolytic nor haemorrhagic complications. On the fifth day from admission to ICU a continuous TOE was performed during progressive weaning (30 min) from CPB until complete stop. TOE was continuously performed for 60 min

after weaning. After 60 min the cannulae were removed and protamine was administered. Dobutamine (5–8 µg kg<sup>-1</sup> min<sup>-1</sup>) was used as inotropic support. Sedation was interrupted and spontaneous ventilation started some days later. The patient was discharged from ICU without complications 17 days after admission to the hospital. TOE performed 1 month later showed EF 57% and non-dilated cardiac chambers. Two months later the patient underwent surgery for the removal of the pheochromocytoma.

**Conclusions:** Although rarely encountered, apical ballooning syndrome must be considered by cardiologist and emergency department physicians. Its prompt and aggressive treatment with pharmacological support or mechanical circulatory support is indicated because complete recovery may be anticipated in these patients.

#### Reference:

- 1 William G. Recognition of the apical ballooning syndrome in the USA. *Circulation* 2005; **111**: 388–90.

## P-107

### Epicardial intraoperative echocardiography for mitral valve repair in a patient with dextrocardia: case report

A. Camata, V. Salandin, P. Zanatta, S. Meneghetti, L. Menato, Mg. Maggiolini

Treviso Regional Hospital, Cardiac Anaesthesia, Treviso, Italy

Transoesophageal Echocardiography (TOE) is the most effective method to assess the feasibility and quality of mitral valve repair in cardiac surgery. However, when the insertion of a TOE probe is contraindicated or impossible, epicardial intra-operative echocardiography (EIE) may be the most convenient alternative [1].

**Case Report:** A 38 years old man affected by several cardiac and facial malformations, underwent surgery for mitral valve repair. Nasal intubation was performed with bronchoscopy but TOE probe introduction was impossible. There was dextroversion of the heart in situs solitus. Two superior venae

cavae and partial pericardial agenesis were present. In this case EIE was mandatory to assess the feasibility of mitral valve repair. The probe was positioned through the long axis of the heart, to reproduce a type of parasternal long axis view [1] and a perpendicular short axis view at the mitral valve level. EIE was performed before and after cardiopulmonary bypass (CPBP).

Since the heart was rotated with the apex to the right, in the supine position the left ventricle was above and next to the ultrasound source on the screen. For the same reason the posterior mitral valve leaflet was next to the probe. It was possible to measure the mitral annular size and to assess the degree and mechanism of the mitral regurgitation (both leaflets prolapsed, without flail and annular dilatation). An annular prosthetic ring and two artificial pairs of chordae were implanted. After CPB the ring and the chordae were clearly visualized and residual mitral regurgitation was excluded. Any other complication related to mitral repair, like systolic anterior motion, could then be excluded.

**Discussion:** In this case several malformations were combined. The EIE, yet using "off-axis" views, enabled us to guide surgical repair of the mitral valve and to evaluate the quality of the procedure after CPB. This diagnostic support to surgical indications was especially valuable in a case where the anatomic heart malformation created unusual difficulties for the standard surgical approach.

#### Reference:

- 1 Eitzschig HK, Kallmeyer IJ, Mihaljevic T, et al. A practical approach to a comprehensive epicardial and epiaortic echocardiographic examination. *J Cardiothorac Vasc Anesth* 2003; 17: 422–429.

## P-108

### Acute increase in left ventricular afterload by mitral valve repair does not affect "Tei index"

A. Ouattara, N. Mabrouk, P. Leger, H. Benhaoua, T. Barbry, P. Coriat

Department of Anaesthesia and Critical Care, Institute of Cardiology, Pitié-Salpêtrière Hospital, Paris, France

**Introduction:** Perioperative systolic function is currently assessed by transoesophageal echocardiographic fractional area change (FAC). However, its afterload-dependency [1] may be responsible for an overestimation of systolic function in patients presenting with mitral regurgitation. The Tei index, a new parameter of global ventricular function [2], seems to be less sensitive to changes in left ventricular (LV) loading conditions [3]. The aim of this study was to compare the impact of acute increase in LV afterload on Tei index and FAC in patients undergoing mitral valve repair.

**Method:** After approval by our local ethical committee, 25 patients undergoing mitral valve repair were prospectively studied. A transoesophageal echocardiography (TOE) was performed after sternotomy and was repeated after weaning from cardiopulmonary bypass just before inotropic drugs were given. For each TOE examination, the mitral inflow velocity curve, the left ventricular end-diastolic and end-systolic areas and the aortic blood flow velocity were recorded on an optical disk for later off-line analysis, during a brief period of apnoea. The FAC was defined as end-diastolic area minus end-systolic area divided by end-diastolic area. The Tei index was defined as the sum of isovolumetric relaxation and contraction times divided by ejection time. All echocardiographic measurements were made by anaesthesiologists with experience and board certification in TOE. FAC and Tei index were compared before and after mitral valve repair by using a paired Student's *t* test.

**Results:** Two patients having uninterpretable views were excluded from statistical analysis. After mitral valve repair, the FAC significantly decreased ( $53 \pm 9\%$  versus  $42 \pm 10\%$ ,  $P < 0.05$ ) while Tei index was not significantly modified ( $0.46 \pm 0.16$  versus  $0.47 \pm 0.17$ , NS). Moreover, a significant linear relationship between preoperative Tei index ( $Tei_{preop}$ ) and postoperative FAC ( $FAC_{post}$ ) was found:  $FAC_{post} = 61 - 41 \times Tei_{preop}$  ( $Rho = -0.65$ ,  $P < 0.001$ ).

**Discussion:** Tei index is not affected by an acute increase in afterload provoked by the correction of mitral regurgitation. Our finding strongly suggests an afterload independency of Tei index. By predicting postoperative FAC, preoperative Tei value affords an opportunity to anticipate a difficult weaning from the cardiopulmonary bypass when severe systolic dysfunction is identified.

#### References:

- 1 Robotham JL, Takata M, Berman M, et al. Ejection fraction revisited. *Anesthesiology* 1991; 74: 172–183. Review.
- 2 Tei C. New non-invasive index for combined systolic and diastolic ventricular function. *J Cardiol* 1995; 26: 135–136.
- 3 Lutz JT, Giebler R, Peters J. The 'Tei-index' is preload dependent and can be measured by transoesophageal echocardiography during mechanical ventilation. *Eur J Anaesthesiol* 2003; 20: 872–877.

## P-109

### Neurophysiological evaluation in comatose patients after cardiovascular surgery: case report

P. Zanatta, E. Bosco, A. Camata, T. Collavo, E. Toniolo, V. Salandin, C. Valfrè

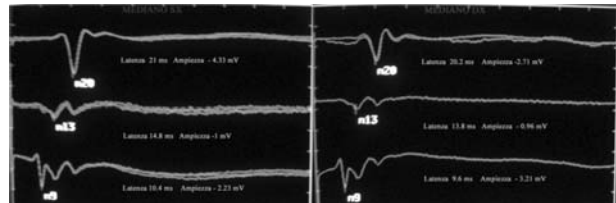
Department of Anesthesiology, Regional hospital of Treviso, Italy

Haemodynamic instability and neurological impairment are common conditions in patients in the postoperative cardiovascular intensive care unit. This report focuses on the possibility of using somatosensory evoked potentials (SEP) to better assess the neurological evaluation after cardiac surgery.

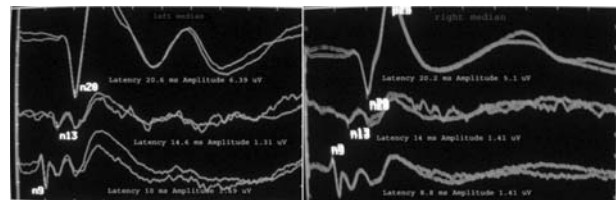
**Case Report:** A comatose patient, submitted two days earlier for an emergency repair of an aortic arch dissection, was daily monitored with bilateral SEP from median nerve stimulation. During the surgical procedure the patient suffered from a systemic circulatory arrest period of 25 min. at 26°C because of sudden aortic rupture. Brain protection was achieved either with antegrade cerebral perfusion through the innominate trunk only and with a thiopental sodium injection.

On the second postoperative day the patient was still comatose, with a Glasgow Coma Score of 2. He was not submitted to a cerebral CT scan because of severe haemodynamic instability.

The somatosensory evoked potentials were bilaterally present, with a normal latency without the middle latency components. The left SEP had a lower amplitude.



On the third postoperative day the Glasgow Coma Score (GCS) was 6 (E1, Vt, M4). The SEP had a higher amplitude and the middle cortical latency components appeared. The blood exams revealed thiopental substrates.



On the fourth postoperative day the patient woke up without neurological deficits.

**Discussion:** Neurophysiological examination with evoked potentials provide valuable information regarding the functional status of a specific nervous pathway. The daily SEP analysis provide useful information about the restoration of the brain function and patient consciousness.

#### Reference:

- 1 Robinson LR, Micklesen PJ, Tirschwell DL, et al. Predictive value of somatosensory evoked potentials for awakening from coma. *Crit Care Med*. 2003; 31(3): 960–967.

## P-110

### Effect of EMLA cream on chest tube removal pain

D. Karakaya, S.I. Baris, A. Mehel

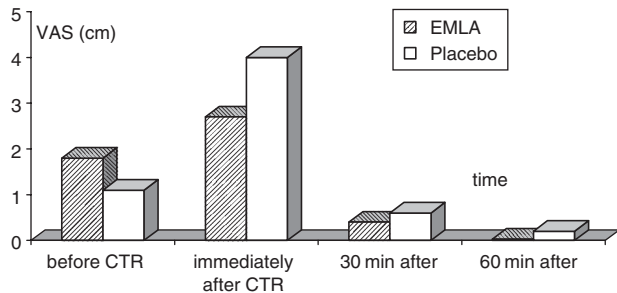
Ondokuz Mayıs University, Samsun, Turkey

**Introduction:** Chest drain removal (CTR) is a painful procedure for most patients. Different drugs and methods are used during CTR in children and adults. A eutectic mixture of local anaesthetics (EMLA) has been shown to reduce chest tube removal (CTR) pain in children [1]. The aim of this study was to evaluate the effect of EMLA during CTR in adult patients after cardiothoracic surgery in a placebo controlled manner.

**Method:** After Ethical Committee Approval and informed patient consent, 55 patients who had undergone cardiac surgery were randomly allocated to receive 5g per chest tube EMLA cream (EMLA®; Astra Pharmaceuticals, Wayne, PA) ( $n = 31$ ) or placebo ( $n = 24$ ) cutaneously 2 h before CTR. One mg midazolam was given intravenously to all patients 5 min before CTR. Pain and anxiety was evaluated by a physician blinded to the treatment group before, immediately after, 30 and 60 min after each CTR using a 10 cm

visual analog score (VAS). Heart rate and blood pressure were also recorded.

**Results:** Demographic data were similar between groups. In the placebo group, VAS scores were significantly higher at the time of first CTR than immediately before or 30 and 60min after ( $P < 0.05$ ). VAS scores were significantly lower in the EMLA group immediately after the first CTR than the placebo group ( $2.7 \pm 0.4$  vs.  $4.0 \pm 0.4$ ) ( $P < 0.05$ ), (Figure 1). However, there was no difference in VAS scores between groups during second CTR at any time. Anxiety was also similar in both groups. Blood pressure and HR were significantly higher in both groups only immediately after CTR ( $P < 0.05$ ), but were not significant between groups.



**Figure 1.** VAS scores of the first chest tube removal.

\* $P < 0.05$  vs. placebo group

**Discussion:** We conclude that EMLA cream application around the chest tube insertion site is an effective method for chest tube removal pain after cardiac surgery.

**Reference:**

- Rosen DA, Morris JL, Rosen KR, et al. Analgesia for pediatric thoracostomy tube removal. *Anesth Analg* 2000; **90**: 1025–1028.

## P-111

### Long-term outcome in cardiac surgical patients needing prolonged intensive care treatment

M. Mazzone, R. De Maria, C. Solinas, G. Villa, A. Locati, F. Bortone  
*Department of Anesthesia and ICU, Humanitas-Gavazzeni, Bergamo, Italy*

**Introduction:** The European System for Cardiac Operative Risk Evaluation (EuroSCORE) is a model for prediction of in-hospital mortality, while the Sequential Organ Failure Assessment (SOFA) score is a system devised to quantify the severity of multiple organ dysfunction syndrome (MODS). These indices may also have a place in predicting event-free long term survival.

**Method:** Single-institution observational cohort study was carried out in 99 consecutive adult cardiac surgical patients with postoperative MODS, operated on between January 2000 and August 2002. Pre- and postoperative variables, EuroSCORE and SOFA score were correlated to long-term outcome. Information on deaths or events leading to hospital admission after the index discharge were obtained from the Regional Health Database; out-of-hospital deaths were identified through the National Death Index.

**Results:** Mean age was  $71 \pm 8$  years, 42% were female. Type of surgery was isolated CABG in 37%, valve surgery in 22%, surgery on the thoracic aorta in 7%, combined or other procedures in 33%. EuroSCORE averaged  $8.05 \pm 4.06$  (range 1–21). Postoperative ICU stay was  $10.6 \pm 8.5$  days; in-hospital 30-day mortality was 11.1% ( $n = 11$ ). During 136 person-years of follow-up (mean  $1.5 \pm 0.83$ ), 11 of 88 patients discharged died (12.5%), while the combined end-point of all-cause death or hospital admission for a cardiovascular event occurred in 42 patients (47.7%). By Cox multivariate analysis, the max SOFA (HR 1.99, 95% C.I. 1.19–3.35) and max cardiovascular score (HR 2.22, 95% C.I. 1.09–4.51) were the best independent predictors of all-cause mortality. Kaplan-Meier survival rates according to a max SOFA  $\leq 10$  and  $> 10$  were 88% and 64%, respectively ( $P = 0.0001$ , adjusted by max cardiovascular score). EuroSCORE (HR 1.47, 95% C.I. 1.03–2.09), max cardiovascular score (HR 1.67, 95% C.I. 1.15–2.43) and max liver score (HR 2.24, 95% C.I. 1.43–3.49) were independently associated with the combined end-point. Kaplan-Meier event-free survival rates, according to a max cardiovascular score  $< 3$  and  $\geq 3$ , were 60% and 20%, respectively ( $P = 0.0001$ , adjusted by EuroSCORE and max liver score). Of all deaths, 91% occurred in the initial 4 months after surgery, whereas cardiovascular events were more evenly distributed across the whole observation period.

**Conclusion:** High EuroSCORE and postoperative severity of MODS, cardiac failure and hepatic failure are associated with long-term mortality and cardiovascular events after cardiac operations. The use of preoperative and

postoperative predictive models of mortality may be suitable for comparative assessment of long-standing results in cardiac surgery. This finding has important implications for the discharge planning of these patients, who require close follow-up in the early post-discharge period.

**Reference:**

- Ceriani R, Mazzone M, Bortone F, et al. Application of the sequential organ failure assessment score to cardiac surgical patients. *Chest* 2003; **123**: 1229–1239.

## P-112

### Diagnosis of patent foramen ovale by transnasal transoesophageal echocardiography

G. Campolongo, P.A. Chiavari, P. Mollo, A. Placanica, L. Tritapepe  
*Department of the heart and large vessels "A. Reale"; Department of anaesthesiology, Rome, Italy*

**Introduction:** The aim of the study was to evaluate the feasibility and tolerability of transnasal, transoesophageal echocardiography examination and compare it with the standard transoesophageal technique.

**Method:** We studied 99 patients (58 females and 41 males) with an age range from 13 to 71 years: 68 patients (45 females and 23 males) with suspected PFO at transthoracic examination and 31 patients (13 females and 18 males) with a previous transient ischaemic attack (TIA) or a cryptogenic ictus. An Acuson/Siemens Sequoia C256 system connecting to a multiplane transoesophageal TE-V5M probe or to an intracardiac Acunav, 10F, monoplane, multi-frequency (5.5–10 MHz) probe has been used. ECG and  $O_2$ -saturation were monitored during all the procedures. Patients were studied double blinded by two operators. PFO diagnosis was made on the presence of right to left atrial shunt at colour-Doppler or during echocontrast infusion. The shunt has been classified on the basis of number of microbubbles in the left atrium during a Valsalva manoeuvre (mild = 3–9 microbubbles; moderate = 10–30 microbubbles; severe  $> 30$  microbubbles).

**Results:** Nasal introduction of the Acunav probe has been feasible in all patients (100%) using only a lubricant jelly. Neither local anaesthesia nor general sedation has been used. Transnasal examination showed a PFO in 33 patients (33%); the echocontrast infusion revealed a mild shunt in 5 patients (15.1%), a moderate shunt in 17 patients (51.5%) and severe shunt in 11 patients (33.4%). Oral introduction of transoesophageal TE-V5M probe was feasible in all patients (100%) using local anaesthesia; in 11 patients (11.1%) probe introduction required general sedation. No significant changes of cardiac rhythm or  $O_2$ -saturation have been shown during all the procedures ( $P = NS$ ). TOE confirmed transnasal results. No complications occurred during all the procedures. Moreover, the nasal approach has been better tolerated than the standard one.

**Conclusions:** Transnasal transoesophageal echocardiography seems feasible, safe and well tolerated. This study showed that transnasal and standard transoesophageal have the same accuracy for both PFO diagnosis and shunt quantification.

## P-113

### Staphylococcus spp isolates in a cardiac surgical intensive care unit

G. Landoni, A. Roberti, G. Marino, M. Fichera, F. Boroli, M. Crivellari, T. Bove, A. Zangrillo

*Department of Cardiovascular Anaesthesia and Intensive Care, Università Vita-Salute di Milano, IRCCS San Raffaele, Milano, Italy*

**Introduction:** Postoperative infections are among the most severe complications in cardiac surgical patients, prolonging hospitalization and increasing the cost of care. *Staphylococcus* species, and particularly *Staphylococcus aureus*, rank among the most commonly found pathogens in cardiac surgical patients [1]. The aim of this study was to describe the epidemiology of methicillin-resistant *Staphylococcus* isolates in a cardiac surgical Intensive Care Unit over a 5-year period and to determine the risk factors and outcome of this condition.

**Method:** During the period from January 1998 to July 2003 the clinical data of all adult patients who underwent cardiac surgery in a university hospital have been prospectively recorded in a database. If a persistent fever ( $> 38.5^\circ\text{C}$ ), sepsis, and/or significant chest x-ray findings were noted, samples were cultured from bronchial secretions, urine, and blood from 3 different blood sampling sites (2 from venipuncture and 1 from a central venous catheter), and specific bacteriologic tests were done because of clinical suspicion. Univariate and multivariate analysis identified the risk factors for the development of methicillin-resistance and in-hospital death. After approval of the Ethical Committee all patients gave written informed consent.

**Results:** Methicillin-resistant *Staphylococcus* species strains have been isolated in 118 of 6423 operated patients during the study period (7.6 cases

per 1000 days of Intensive Care Unit stay), with a constant prevalence rate throughout the years. Methicillin-resistant *Staphylococcus* species have been the most frequently isolated micro-organisms in our Intensive Care Unit. 75% of *St aureus* and 95% of coagulase-negative Staphylococci were methicillin-resistant. In-hospital mortality in MRS-positive patients was 50.0% (59/118) while it was 1.7% (108/6305) in non-MRS patients ( $P < 0.0001$ ). On multivariate analysis methicillin-resistant *Staphylococcus* species isolation was the single risk factor with the strongest association with in-hospital death (odds ratio, 8.5, 95% confidence interval 4.9–14.7). In our series there were no isolates of vancomycin-resistant species (*Enterococcus* species or *Staphylococcus* species).

**Discussion:** *Staphylococcus* species represent the most frequently isolated microorganisms in our Intensive Care Unit. In-hospital mortality in cardiac surgical patients is strongly correlated to the isolation of Methicillin-resistant *Staphylococcus*.

#### Reference:

- 1 Bolon MK, Morlote M, Weber SG, et al. Glycopeptides are no more effective than beta-lactam agents for prevention of surgical site infection after cardiac surgery: a meta-analysis. *Clini Infect Dis* 2004; **38**: 1357–1363.

## P-114

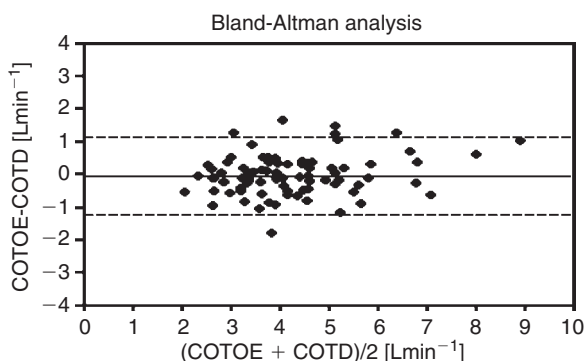
### Transoesophageal echocardiography accurately detects cardiac output variation: a prospective comparison with thermodilution in cardiac surgery

V. Parra, G. Fita, I. Rovira, E. Arcos, I. Bel, M. Sadurní, C. Paré, C. Gomar  
Hospital Clínico y Facultad de Medicina, Universidad de Chile, Santiago, Chile; Servicio de Anestesiología, Hospital Clinic; Servicio de Ecocardiografía, Hospital Clinic; Unidad de Epidemiología y Bioestadística, Hospital Clinic, Universidad de Barcelona, Barcelona, Spain

**Introduction:** Intraoperative Doppler ultrasound can be used to measure CO by transoesophageal echocardiography (TOE). Recently, its reliability has been questioned compared to the thermodilution (TD) technique (1). The purpose of this study was to compare intraoperative changes in CO measured by TOE (COTOE) and by TD (COTD) in cardiac surgery. We also assessed the agreement between the techniques.

**Method:** Forty-six cardiac surgical patients (34 male, 12 female, mean age  $63 \pm 14.6$  years) were prospectively included after approval by the ethics committee of the Institution. CO was assessed simultaneously and in a blind manner by TD, with 10 mL saline at  $12^\circ\text{C}$ , and by TOE in deep transgastric view with pulsed wave Doppler at the level of the left ventricular outflow tract (LVOT). Matched COTD and COTOE measurements were obtained in triplicate, at the end of expiration and at two times during surgery, pre and post cardiopulmonary bypass (CPB). Patients with significant tricuspid or aortic regurgitation, atrial fibrillation, cardiac shunts or LVOT obstruction were excluded.

**Results:** COTOE measurements were obtained in 39 patients (85%). In 4 patients, Doppler recordings could not be obtained adequately and 3 developed LVOT obstruction after CPB. Bland-Altman analysis revealed a bias of  $-0.01 \text{ Lmin}^{-1}$ , with narrow limits of agreement ( $-1.2$  to  $1.18 \text{ Lmin}^{-1}$ ) and 28.5% of error. TOE was accurate (84% sensitivity and 71% specificity,  $P < 0.01$  by ROC curves) for detecting more than 15% of change in COTD. There were no complications related to the study.



**Discussion:** The agreement between COTOE and COTD is clinically acceptable and TOE is a reliable tool to assess significant CO changes in a population of selected patients. However, these results cannot be generalized and, therefore, COTOE does not seem to be an alternative to TD in daily clinical practice.

#### Reference:

- 1 Bettex DA, Hinselman V, Hellermann JP, et al. Transoesophageal echocardiography is unreliable for cardiac output assessment after cardiac surgery compared with thermodilution. *Anaesthesia* 2004; **59**: 1184–1192.

## P-115

### Cardiac papillary fibroelastoma of the mitral valve: case report

D. Penzo, D. De Cosmo, A. Bossi

Umberto I° Hospital, Mestre-Venezia, Italy

Cardiac papillary fibroelastoma (CPF) is the second most common primary cardiac tumour and the most common valvular tumour of the heart. The location on the mitral valve does not occur frequently, with fewer than 50 cases being reported in the literature [1].

**Case Report:** A 54 year old female patient presented at our hospital with clinical signs of acute ischaemia of her left arm. A transthoracic echocardiogram (TTE) revealed a mobile excrescence on the mitral valve. This finding was confirmed by transoesophageal echocardiography (TOE) which showed that the cardiac mass measured  $14 \times 15 \text{ mm}$  on the midportion of the posterior mitral leaflet on the atrial side and it was attached to the endocardium by a small stalk. The echocardiographic characteristics, including location, size and appearance were consistent with CPF and the patient was scheduled for surgical removal of the lesion. It was excised and the mitral valve was preserved. Postoperative pathological examination of the cardiac mass confirmed the diagnosis of a papillary fibroelastoma.

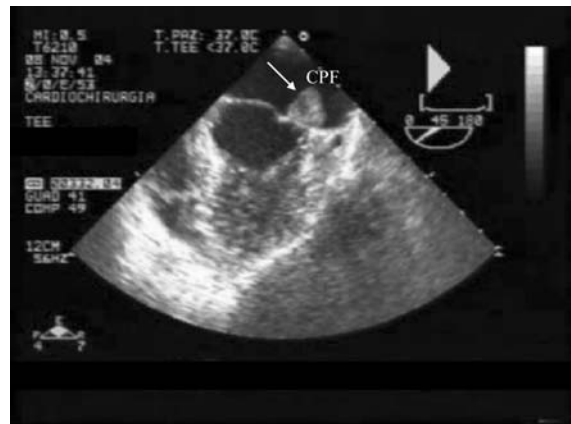


Figure 1: TOE show a mass (arrows) attached to the posterior leaflet of mitral valve.

**Discussion:** CPF is a rare cardiac neoplasm that originates mainly from the valvular endocardium. There have been rare reports of sudden death as a result of fibroelastoma, probably because of coronary occlusion or embolization. CPF may cause chest pain or myocardial infarction, neurovascular events (most currently) and rarely pulmonary emboli. Patients with events that may be embolic in nature and are not explained by other cardiovascular or neurological disease should undergo TTE and TOE if necessary to exclude cardiac sources of emboli, including CPF. Echocardiographically, they present as highly mobile excrescences, variable in size and number, with well-demarcated borders and homogeneous texture, typically located on one of the valves by a small stalk. The differential diagnosis should include other benign tumours, thrombi, degenerative valve tissue and vegetations.

In summary, this case underlines that echocardiography is a convenient and non-invasive diagnostic technique and should be the first choice of tests to search for CPFs.

#### Reference:

- 1 Remadi JP, Degandt A, Rakotoarivello Z. Cardiac papillary fibroelastoma of the mitral valve chordae. *Heart* 2004; **90**: 1397.

## P-116

### Comparison of manual and mechanical ventilation during transport of patients to the Intensive Care Unit after cardiac surgery

A. Canbulat, S. Goren, E.B. Mogol, F.N. Kaya

Department of Anaesthesiology and Intensive Care, Uludag University, School of Medicine, Bursa, Turkey

**Introduction:** Intra-hospital transport of critically ill patients is a very important procedure (1). The aim of this study was to compare the effects of mechanical and manual ventilation during transport to the intensive care unit (ICU), on haemodynamic parameters, arterial blood gases, transport time and transport complications in patients undergoing cardiac surgery.

**Method:** After obtaining ethical committee approval, 70 patients scheduled for coronary artery bypass and cardiac valve surgery, ASA grade II-IV, aged 20–79 were assigned randomly into two groups. Ventilation during the transport of the patients to the ICU was performed with manual ventilation (Group MAV; 100% O<sub>2</sub>, 6 L min<sup>-1</sup> with Mapleson-D system; n = 36,) or mechanical ventilation (Group MEV; 50% O<sub>2</sub>, volume controlled ventilation; n = 30). Measurements were recorded in 3 periods; operation room (OR), during transport (T) and in the ICU (ICU). Haemodynamic parameters (HR, SAP, DAP, CVP, PAP, PCWP, CO), systemic and pulmonary arterial blood gases (pH, Pco<sub>2</sub>, PO<sub>2</sub>, BE) and peripheral oxygen saturation (SpO<sub>2</sub>) values were recorded in OR and ICU periods. During the T period SAP, DAP, HR, SpO<sub>2</sub> values and transport times (TS) were recorded. Also mean arterial pressure (MAP), stroke volume index (SVI), systemic and pulmonary vascular resistance indices (SVRI, PVRI) were calculated. Observed complications (mechanical and medical) during T period were recorded. T-test, Pearson's chi-squared, Mann-Whitney U, and paired t-test were used for statistical analysis.

**Results:** The demographic data and preoperative properties of patients were similar in both groups. When we compared the two groups, transport times were found to be shorter in Group MV (3.8 ± 0.9 vs. 5.8 ± 1.6 min; P < 0.01). The alterations in HR, MAP, DAP, CVP, PAP, PCWP, PVRI, SVRI, SVI, CO, SpO<sub>2</sub> were similar in both groups, whereas the increase in SAP during T period was significantly higher in Group MEV compared with Group MAV (P < 0.05). Systemic arterial PO<sub>2</sub>, PCO<sub>2</sub> and pulmonary arterial pH, PO<sub>2</sub>, PCO<sub>2</sub> values were significantly lower in Group MV (P < 0.001, P < 0.01, P < 0.05, P < 0.01, P < 0.05). Complication rates recorded during the transport period were similar between the two groups.

**Discussion:** This study demonstrated that when a mechanical ventilator was used for the transport of patients to the ICU after cardiac surgery, transport duration shortened, blood gases could be kept at desired values, and less alteration in haemodynamic parameters but similar complications occurred. We concluded that the use of mechanical ventilation for the intrahospital transport of critical patients is a safer method compared with manual ventilation after cardiac surgery.

#### Reference:

- Waydhas C. Intra-hospital transport of critically ill patients. *Crit Care* 1999; 3: 83–89. Review.

## Miscellaneous

### P-118

#### Comparison of the effects of lidocaine applied by local injection or iontophoresis for analgesia during radial artery cannulation in open heart surgery

H. Kamalipour, S. Ahmadi, K. Kamali

*Shiraz University of Medical Sciences, Shiraz, Iran*

**Introduction:** Pain control associated with invasive procedures is a major challenge. Radial artery cannulation is an invasive, painful procedure. The standard method of providing analgesia for this technique is lidocaine infiltration in the skin and subcutaneous tissue. However, infiltration itself is painful. Iontophoresis is a novel technique that uses an electrical current to facilitate movement of ionized lidocaine into the skin and subcutaneous tissues, and provides analgesia. We compared the effect of lidocaine infiltration with lidocaine iontophoresis for pain relief during radial artery cannulation prior to induction of anaesthesia in patients undergoing open heart surgery.

**Method:** Sixty patients were enrolled in a prospective, randomized, single-blind controlled trial. Group 1 (n = 30) received iontophoresis using 4% lidocaine 4 mL for 10 min. Group 2 (n = 30) received local infiltration of 2% lidocaine 1 mL using a 25G needle. Pain scores were reported immediately after the first attempt at cannulation, using a 10-cm VAS. Difficulty of cannulation was also recorded.

**Results:** The data of 60 patients was analysed using Mann-Whitney, Chi-squared and t-tests.

The groups were similar in terms of age and sex. The VAS median (SD) pain score in the iontophoresis group and infiltration group were respectively 2.4 (1.4) and 4.5 (1.7). The VAS scores in the iontophoresis group were significantly lower (P = 0.000) than the infiltration group. The success rate for radial cannulation in the iontophoresis group was higher than in the infiltration group (24 vs. 17).

### P-117

#### Procalcitonin as a diagnostic marker of infection after ventricular assist devices implantation: comparison with C-reactive protein and serum amyloid

B.J. Gutowska, E. Sitkowska, P. Wolski

*Institute of Cardiology, Warsaw, Poland*

**Introduction:** Procalcitonin (PCT), C-reactive protein (CRP) and serum amyloid (SAA) are well known and widely accepted markers of infection. There is a high risk of infection after ventricular assist devices implantation (POLVAD-MEV, Zabrze, Poland) and it is important to diagnose it as soon as possible.

**Method:** A total of twenty two patients underwent ventricular assist devices implantation. Serum levels of PCT, CRP and SAA were measured preoperatively and each day after implantation (414 measurements). Infected patients were divided into three groups, depending on type of infection: nine patients with bacteraemia, three patients with mediastinitis and three patients with pneumonia. Seven patients were without infection. Area under the receiver operating characteristic (AUROC) curve, optimum predictive values, and optimum diagnostic cut off values were evaluated.

**Results:** PCT was the best infection marker for patients with pneumonia. For PCT measured two days before pneumonia diagnosis, the AUROC curve was 0.891 (P < 0.05) and 0.924 (P < 0.05) when pneumonia was diagnosed. Cut off values for PCT were 1.9 ng/mL and 2.0 ng/mL. AUROC for CRP was 0.697 at this same point with cut off value 123 mg/L; for SAA AUROC was below 0.50. For the group with mediastinitis, compared to CRP and SAA, PCT was the best marker as well, but the area under the ROC curve was lower at 0.656; with lower specificity and sensitivity and cut off value 1.2 ng/mL during the day of mediastinitis diagnosis. Two days before a diagnosis of mediastinitis, the positive predictive value was low for all three parameters. PCT serum level measured on the day of bacteraemia episode and the day after has the best AUROC curve: 0.86 and 0.884 with cut off 2.8 ng/mL (P < 0.05); for CRP and SAA it was below 0.6 (P = ns).

**Conclusion:** In patients with ventricular assist devices implantation who develop infection, PCT concentration is a better diagnostic marker than CRP and SAA. When PCT level is more than 2 ng/mL, it is necessary to intensify bacteriological investigations.

**Conclusions:** Lidocaine iontophoresis is a useful, painless alternative to lidocaine infiltration in providing dermal analgesia for radial artery cannulation.

### P-119

#### Surgical stress and its impact on hepatic metabolism and lipid peroxidation in cardiac patients

V.A. Nepomniashchikh, V.V. Lomivorotov, M.N. Deryagin, L.G. Kniazkova, M.A. Novikov

*Research Institute of Circulation Pathology, Novosibirsk, Novosibirsk Region, Russia*

**Introduction:** The aim was to study the impact of surgical intervention in patients with acquired heart diseases (AHD) and coronary artery disease (CAD) on the metabolism of antipyrine, which is considered to be the "gold standard" for evaluating the cytochromes of a P-450-dependent monooxygenase function of the liver (MFL) responsible for biotransformation of a majority of drugs.

**Method:** 45 patients were consistently studied before and after surgical intervention. Out of the total number 20 patients had AHD and 25, CAD. The activity of MFL was evaluated by measuring the value of antipyrine clearance (CLAP), while LPO was determined by the values of malonic dialdehyde (MDA), adjoint triens (AT), ceruloplasmin (CP) and catalase (CT). 14 patients had one valve replaced, 5 patients, 2 valves and 1 patient, 3 valves. All patients with CAD underwent myocardial revascularization.

**Results:** On admission CLAP was slow by 27% and the values of MDA, AT, CP and CT were higher than normal by 39, 35, 41 and 43% respectively. During the first day after operation CLAP in 38 patients tended to decrease by 46%, while the level of MDA, AT and CT was prone to increase by 24, 62 and 23% respectively as opposed to the initial period. On the 8–12th day after the operation the rate of microsomal oxidation in the liver considerably



increased, while the intensity of peroxidation processes was reduced. It was found that there was direct correlation dependence among CLAP, MDA, AT on the one hand and the length of extracorporeal circulation on the other hand ( $P < 0.05$ ). The degree of CLAP slow down was found to depend inversely on the temperature condition of perfusion ( $r = -0.37, P < 0.05$ ).

MFL activity in 7 patients tended to change in a reverse direction. During the first day CLAP increased by 78% and on the 8–12th day after operation it somewhat slowed down and exceeded the initial values by 64%. Under close examination it was established that all patients of this group were administered intraoperatively such doses of glucocorticoids that exceeded those offered to the first group by a factor of 5.

**Discussion:** Open-heart operations on patients with AHD and CAD result in a further slow down in microsomal oxidation in the liver and activity of LPO during the first day after surgical intervention. On the 8–12th day of the post-operative period the rate of hepatic metabolism considerably increased, while the intensity of LPO increased. Administering glucocorticoids causes stimulation of MFL, thus demonstrating high inducibility and possible correction of their activity. Changes in the rate of xenobiotic biotransformation in the liver require correction of the doses of drugs used for intensive care of cardiac patients.

#### Reference:

- 1 Carcillo JA, Doughty L, Kofos D, et al. Cytochrome P450 mediated-drug metabolism is reduced in children with sepsis-induced multiple organ failure. *Intensive Care Med* 2003; **29**: 980–984.

## P-120

### Somatosensory evoked potentials brain monitoring during CABG off-pump in a patient with multiple risk factors for stroke: case report

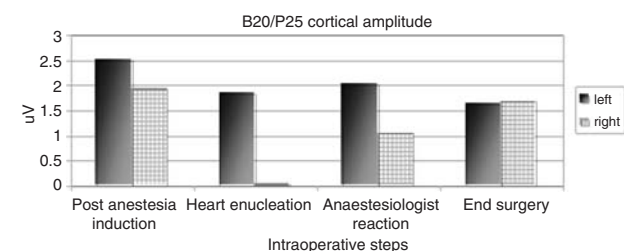
P. Zanatta, W. Tamari, C. Valfrè, E. Bosco, A. Camata, V. Salandini, G. Arnetoli

Anesthesia and Intensive Care Department, Regional Hospital of Treviso, Italy; Cardiac Surgery Unit, Regional Hospital of Treviso, Italy; Neuroscience Department, Careggi University Hospital of Florence, Italy

Early postoperative stroke is a serious adverse event after conventional CABG surgery. Although off pump procedures can reduce the neurological complication by avoiding CPB and aortic manipulation, the period of heart displacement necessary in mini-invasive CABG remains a factor of concern because of low cerebral perfusion. This report focuses on how to diagnose and overcome cerebral ischaemia in a high risk patient, as a result of haemodynamic instability during the off-pump procedure.

**Case report:** A patient with poorly controlled hypertension, diabetes mellitus, unstable angina, occluded internal right carotid and left vertebral arteries and a 50% stenosis of the left internal carotid artery, was intraoperatively monitored with continuous bilateral SEP from median nerve stimulation.

During heart displacement to perform the coronary anastomoses on the posterior and lateral walls, we assisted a low cardiac output without arterial pressure variation and concomitant disappearance of right SEP with anisocoric status (right > left). The right SEP reappeared after 10 minutes by increasing the blood pressure with norepinephrine, expanding volaemia with packed red cells and reducing brain metabolism by doubling MAC of isoflurane.



The patient did not develop perioperative neurological complications and was discharged home after the sixth day.

**Discussion:** During the off-pump CABG procedure, the low cardiac index produced by heart displacement predisposes patients with multiple risk factors to stroke, to a reduction of the cerebral blood flow and brain ischaemia.

#### Reference:

- 1 Ueno T, Ikeda K, Matsuyama S. Characteristic changes in cerebral perfusion during on-pump and off-pump coronary artery surgery. *Jpn J Thorac Cardiovasc Surg* 2005; **53**: 138–142.

## P-121

### Sildenafil used for weaning low dose inhaled NO in a 6-year-old child with pulmonary hypertension after VSD closure and mitral valve replacement: case report

P. Deutsch, M. Crisnic, M. Cocora, M. Gaspar, M. Deutsch, D. Nechifor, M. Sintean

Institute for Cardiovascular Disease, Timisoara, Romania

Use of inhaled nitric oxide for treatment of pulmonary hypertension after paediatric cardiac surgery is limited by its mode of delivery, high costs and the rebound sometime seen at weaning. Oral sildenafil is a phosphodiesterase type V inhibitor that can produce sustained pulmonary vasodilatation in patients with primary or secondary pulmonary hypertension. Some authors reported that sildenafil may potentiate pulmonary vasodilatation and ameliorate the deleterious effects of abrupt discontinuation of inhaled NO [1,2].

**Case report:** We describe our experience in a 6-year-old child, weight 15 kg, with congenital mitral stenosis, muscular ventricular septal defect (VSD) and severe pulmonary hypertension. At initial angiography, the shunt at VSD level was bidirectional but became left to right after oxygen administration. The total pulmonary resistance decreased to 384 dyn s cm<sup>-5</sup>. Under standard anaesthesia care and extracorporeal circulation (ECC), the mitral valve was replaced and the VSD was closed through the tricuspid valve. A patent foramen ovale (PFO) was left unclosed. A catheter was placed in the pulmonary artery for monitoring purposes and the ECC was discontinued using a continuous infusion of dobutamine 15 µg kg<sup>-1</sup> min<sup>-1</sup>, Dopamine 9 µg kg<sup>-1</sup> min<sup>-1</sup> and nitro-glycerine 1.5 µg kg<sup>-1</sup> min<sup>-1</sup>; the lungs were ventilated to achieve normocapnoea with 100% O<sub>2</sub> initially, then decreased to 60% and inhaled NO was administered at 40 ppm. Sedation was maintained with a continuous infusion of fentanyl. In the first two postoperative days NO was gradually decreased to 3 ppm. The pulmonary pressure remained around 30 mmHg and the cardiac output was considered adequate, as judged by the level of mixed venous blood saturation (70%). At three attempts to discontinue NO, the pulmonary artery pressure increased to 50–60 mmHg and the saturation of systemic arterial blood decreased to 75–80%; the systemic blood pressure remained unchanged and a right-to-left shunt was demonstrated by transthoracic echocardiography at PFO level. This pattern promptly reversed after reinstitution of NO at the same dose. Sildenafil was administered through a nasogastric tube at a dose of 6.25 mg, repeated every 12 hours. In the morning of the third postoperative day NO was discontinued without adverse effects and the trachea extubated after another 3 hours.

**Conclusions:** Rebound pulmonary hypertension can appear even after discontinuing inhaled NO at low doses and this adverse effect can be blunted by orally administered sildenafil.

#### References:

- 1 Atz AM, Wessel DL. Sildenafil ameliorates effects of inhaled nitric oxide withdrawal. *Anesthesiology* 1999; **91**: 307–310.
- 2 Atz AM, Lefler AK, Fairbrother DL, et al. Sildenafil augments the effect of inhaled nitric oxide for postoperative pulmonary hypertensive crisis. *J Thorac Cardiovasc Surg* 2002; **124**: 628–629.

## P-122

### Re-calibration of the subcutaneous glucose electrode improves its accuracy during cardiac surgery

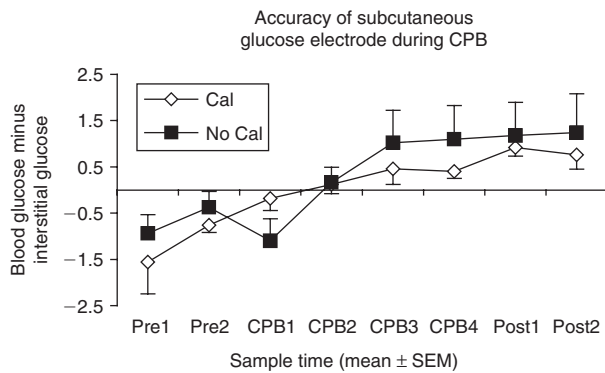
M.W. Harper, P. Moor, M.J. Jayarajah, M.J. Bennett

Derriford Hospital, Plymouth, UK

**Introduction:** During cardiac surgery, blood glucose (BG) levels are monitored with a blood-gas analyser at hourly intervals. Interstitial glucose (IG) levels can be measured with the Minimed Continuous Glucose Monitoring System (CGMS). The device is recalibrated every 6 hrs. IG measurements are a reliable guide to BG measurements [1], including during hypothermia in patients undergoing CPB. However, haemodilution at the start of CPB and sensor drift were two significant sources of error. We assessed whether regular recalibration would eliminate sensor drift and improve its accuracy.

**Method:** 10 patients scheduled for cardiac surgery were studied. After induction of anaesthesia the subcutaneous electrode was inserted in the upper arm and calibrated. The CGMS was either recalibrated with each BG sample (Cal, n = 5), or not (No Cal, n = 5). BG samples were grouped into Pre CPB, CPB, or Post CPB. The corresponding IG readings were subsequently retrieved from the downloaded data.

**Results:** The difference between BG and IG was not significantly different between Cal and No Cal groups at any time point (Student's *t*-test). Frequent recalibration decreased the variance at all time points except the initial reading pre-CPB.



**Discussion:** Frequent recalibration reduced the variance of BG-IG. This would permit a clinically relevant alarm setting on the CGMS giving an extra level of surveillance during the maintenance of tight glycaemic control.

**Reference:**

- 1 Monsod TP, Flanagan DE, Rife F, et al. Do sensor glucose levels accurately predict plasma glucose concentrations during hypoglycaemia and hyperinsulinemia. *Diabetes Care* 2002; **25**: 889–893.

### P-123

#### Effect of high thoracic epidural on left ventricular function in patients with ischaemic heart disease

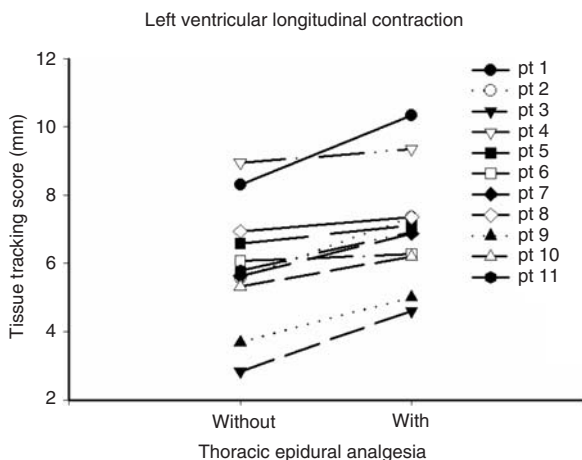
E. Nygård, K. Norrild, J. Nielsen, H. Kirkegaard, P. Torp, S. Sloth

*Gentofte Univ. Hospital, Copenhagen, Denmark; Skejby Univ. Hospital, Aarhus, Denmark*

**Introduction:** In patients with ischaemic heart disease high thoracic epidural analgesia (TEA) has been proposed to improve myocardial function and flow by inhibition of cardiac sympathetic tone [1]. Doppler Tissue Imaging, DTI, is a tool for quantitative determination of myocardial function. A derivative of DTI is Tissue Tracking (TT), which allows quantitative assessment of the longitudinal systolic displacement of the myocardium [2]. We evaluated the effect of TEA on left ventricular function in patients with ischaemic heart disease.

**Method:** Eleven male patients with multivessel ischaemic heart disease were studied. An epidural catheter was inserted between the second and third thoracic vertebral interspace (Th2-Th3). A bolus dose of 3 mL of 0.5% bupivacaine was given epidurally to achieve a sensory blockade corresponding to at least Th1 to Th5 assessed by regional loss of cold sensation. A 16-segment model of motion amplitude assessed left ventricular longitudinal contraction and the average of the segments was calculated and presented as the tissue tracking score.

**Results:** The mean TT score index, reflecting the global longitudinal systolic contraction amplitude of the left ventricle, increased significantly in all patients with high TEA,  $6 \pm 1.6$  mm compared with  $6.8 \pm 1.5$  mm ( $P < 0.03$ ).



**Conclusions:** In patients with multivessel ischaemic heart disease high thoracic epidural blockade significantly improved longitudinal systolic contraction of the myocardium.

**References:**

- 1 Nygård E, Kofoed KF, Freiberg J, et al. Effects of high thoracic epidural analgesia on myocardial blood flow in patients with ischemic heart disease. *Circulation* 2005; **111**: 2165–2170.
- 2 Andersen NH, Poulsen SH. Evaluation of the longitudinal contraction of the left ventricle in normal subjects by Doppler tissue tracking and strain rate. *J Am Soc Echocardiogr* 2003; **16**: 716–723.

### P-124

#### Evaluation of the effect of priming solution on extra vascular lung water in patients undergoing coronary artery surgery

E. Camci, Z. Sungur, A. Suzer, M. Tugrul, K. Pembeci

*Department of Anesthesiology, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Turkey*

**Introduction:** The aim of this study was to compare the effects of two different priming solutions (with hypertonic saline or succinated gelatine added to lactated Ringer's) on fluid balance, extravascular lung water and pulmonary outcome after coronary artery surgery.

**Method:** After obtaining informed consent and ethic committee approval, 14 patients undergoing CABG surgery participated and were randomized to receive one of these two prime solutions. Group HS ( $n = 7$ ) received a combination of hypertonic saline (7.5%) lactated Ringer's and mannitol (20%) whereas in Group SG ( $n = 7$ ) hypertonic saline was replaced by succinated gelatine. In addition to our standard open heart procedure all patients were monitored with a trans-aortic thermodilution catheter placed via the femoral artery and connected to the pulse contour cardiac output (PICCO) monitor [1] to follow cardiac index, intrathoracic blood volume index (ITBVI) and extra vascular lung water index (EVLWI). Colloid osmotic pressure, fluid balances, transfusion and diuretic requirements, gas exchange parameters during 24 hours postoperatively as well as mechanical ventilation duration and length of ICU stay, were recorded.

**Results:** There were no significant differences in demographic and operative characteristics, mechanical ventilation time, ICU time and colloid osmotic pressures at 12 and 24 hours between groups. In Group HS end-bypass ( $703 \pm 295$  mL vs.  $1414 \pm 664$  mL;  $P = 0.0237$ ), end-operation ( $1758 \pm 880$  mL vs.  $3424 \pm 1120$  mL;  $P = 0.009$ ) and end of first postoperative day ( $808 \pm 170$  mL vs.  $1102 \pm 272$  mL;  $P = 0.032$ ) fluid balance was significantly less positive compared to Group SG. We also observed that Group SG patients received more blood products during the same period to achieve a targeted haematocrit level ( $1.17 \pm 75$  U vs.  $3.4 \pm 1.8$  U.  $P = 0.016$ ). These data were parallel to PICCO derived EVLW values (table)

	End CPB		Postop			
		Operation	4h	8h	12h	24h
HS	$531 \pm 100$	$469 \pm 84$	$417 \pm 107$	$421 \pm 148$	$427 \pm 128$	$442 \pm 141$
SG	$685 \pm 121$	$667 \pm 97$	$675 \pm 115$	$628 \pm 88$	$654 \pm 115$	$595 \pm 123$

**Discussion:** This preliminary study showed us that the addition of 7.5% hypertonic saline to pump priming in CABG surgery provided a more advantageous postoperative period relating to fluid retention, also demonstrated by PICCO monitor indices. But this less positive balance did not offer any advantage to HS patients for earlier discontinuation of mechanical ventilation or discharge from ICU compared to SG patients.

**Reference:**

- 1 Wiesenack C, Prasser C, Keyl C, et al. Assessment of intrathoracic blood volume as an indicator of cardiac preload: single transpulmonary thermodilution technique versus assessment of pressure preload parameters derived from a pulmonary artery catheter. *J Cardiothorac Vasc Anesth* 2001; **15**: 584–588.

### P-125

#### Video Assisted Thoracic Surgery (VATS) for spontaneous pneumothorax treatment using epidural anaesthesia: our experience

M. Di Nardo, E. Marin, R. Gemignani, M. Volpe, F. Lapolla, F. Melfi, M. Lucchi, A. Mussi, F. Guarracino

*Cardiothoracic Anesthesia, Cisanello University Hospital, Pisa, Italy*

**Introduction:** In this study we show our experience using thoracic epidural anaesthesia (TEA) in the treatment of spontaneous pneumothorax (SP).

**Method:** 12 patients with SP were treated with TEA (group A) while a second control group B of 12 patients received general anaesthesia. Both groups were similar for age ( $45 \pm 5$  yr), ASA (I–II), and sex (M).

General anaesthesia was accomplished with intravenous propofol (2 mg/Kg), fentanyl 0.1 mg, and atracurium (0.75 mg/Kg) and maintained with end tidal sevoflurane 1.4%–1.7%.

Epidural anaesthesia (single shot) was performed between T4-T5 to achieve somatosensory and motor block from T1 to T8 level with lidocaine 60 mg, ropivacaine 1% (10 mL) and fentanyl 0.1 mg.

Patients of group A received nebulized lidocaine 2% and O<sub>2</sub> through a ventimask for 20 minutes before starting surgery, furthermore they were sedated with propofol infusion (0.5–2 mg kg<sup>-1</sup> h<sup>-1</sup>). Both groups were pre-medicated with intramuscular atropine 1 mg and hydroxyzine chlorhydrate 100 mg. Postoperative analgesia was provided at the patient's demand with intravenous ketorolac if not contraindicated. Heart rate (HR), mean arterial pressure (MAP), SpO<sub>2</sub>, global operative time (induction of anaesthesia and surgical time), patient's satisfaction (excellent = 4, good = 3, satisfactory = 2, unsatisfactory = 1) and postoperative pain assessment (VAS) were recorded in both groups.

**Results:** We found no differences in global operative time (group A 120 ± 15 min, group B 118 ± 12 min, Student's *t*-test *P* > 0.05), patients' satisfaction (stated 2 for both groups) and postoperative pain assessment (VAS = 2.5–3 for both groups). HR and MAP during the surgical procedure were statistically different in the group A 59 ± 5 vs. 70 ± 6 (B) *P* < 0.05 for HR and 58 ± 5 mmHg (A) vs. 86 ± 3 mmHg (B) *P* < 0.05). SpO<sub>2</sub> remained between 95%–100% in both groups.

**Discussion:** Even though we didn't find a great statistical difference in the two groups in all the targets evaluated, we believe that TEA should always be performed in selected cases. Mechanical ventilation should be avoided in high risk patients (difficult airways management, recurrent bilateral pneumothorax for pulmonary dysplasia). In this situation we perform TEA. We considered the TEA approach absolutely contraindicated in patients using intercostal muscles for ventilating, and relatively contraindicated in patients with severe bradycardic rhythm or AVB 2-3.

#### Reference:

- 1 Pompeo E, Mineo D, Rogliani P, et al. Feasibility and results of awake thoracoscopic resection of solitary pulmonary nodules. *Ann Thorac Surg* 2004; **78**: 1761–1768.

## P-126

### The effects of N-acetyl cysteine on renal function after coronary artery bypass surgery

M. Selcuk, T. Titiz, N. Sahin, H. Kabukcu, A. Mete

Akdeniz University School of Medicine, Antalya, Turkey

**Introduction:** In patients undergoing CABG on cardiopulmonary bypass (CPB), the incidence of renal dysfunction (manifest as a postoperative increase in serum creatinine or urea) varies between 3 and 15%. In the cardiac surgical patient, postoperative acute renal failure (ARF) is accompanied by increased intensive care unit stay and increased overall length of hospital stay. N-acetylcysteine (NAC) is perhaps the most widely studied antioxidant in clinical and experimental settings. Recently, NAC has been shown to reduce the incidence of radiocontrast-induced acute tubular necrosis in high-risk patients. NAC has been used in several small randomized trials involving cardiac surgical patients. The aim of this study was to investigate whether infusion of NAC, a potent antioxidant, administered before and during CPB, could ameliorate the progression of early postoperative renal dysfunction.

**Method:** Following ethical committee approval and patient informed consent, a prospective, double blinded, randomized study was performed on 50 patients in ASA II–III. The treatment group (n = 25) received NAC 100 mg kg<sup>-1</sup> bolus followed by a continuous infusion of 20 mg kg<sup>-1</sup> h<sup>-1</sup> and the placebo group (n = 25) received 0.9% isotonic solution. Blood and urine samples were taken for blood urea nitrogen (BUN), creatinine, creatinine clearance, blood and urine electrolytes (Na, K), glomerular filtration rate (GFR), blood proteins, daily urine before induction, end of the operation and 24th hour after the operation. The time to extubation, and duration of intensive care unit and hospital stay were noted. For statistical analysis Mann-Whitney U and Chi-squared tests were used.

**Results:** Demographic and haemodynamic data, duration of aortic cross-clamp and bypass, the need for inotropic support and mechanical ventilation were similar in two groups.

	Preop	Postop
<b>BUN</b>		
Group I	19.5 ± 1.3	20.4 ± 1.5
Group II	19.5 ± 1.9	18.0 ± 1.6
<b>Creatinine</b>		
Group I	1.2 ± 0.2	1.3 ± 0.3
Group II	1.1 ± 0.2	1.4 ± 0.3
<b>GFR</b>		
Group I	87.8 ± 8.0	100.2 ± 7.5
Group II	77.5 ± 6.2	93.8 ± 11.4
<b>Creatinine clearance</b>		
Group I	87.2 ± 4.7	95 ± 8.1
Group II	92.7 ± 6.3	90 ± 8.7
<b>Urine proteins</b>		
Group I	5.2 ± 0.3	9.2 ± 1.0
Group II	5.4 ± 0.8	7.8 ± 0.7

There was no statistically significant difference between the groups in BUN, creatinine, creatinine clearance, blood and urine electrolytes, GFR, blood proteins and daily urine before induction, urine specific gravity (*P* > 0.05). Compared with before induction values, in the NAC group creatinine clearance, urine proteins and GFR increased significantly. But in the placebo group creatinine clearance and urine creatinine decreased significantly (*P* < 0.05). In the NAC group extubation time, intensive care and hospital stay were shorter than the placebo group.

**Conclusions:** We found a non-significant difference in renal functions between NAC and placebo-treated patients). NAC may be effective for the prevention of renal dysfunction. It is questioned whether there was not sub-clinical renal dysfunction in the placebo group. However, further randomized studies are clearly needed.

#### References:

- 1 Szakmany T, Marton S, Molnar Z. Lack of effect of prophylactic N-acetylcysteine on postoperative organ dysfunction following major abdominal tumour surgery: a randomized, placebo-controlled, double-blinded clinical trial. *Anaesth Intensive Care* 2003; **31**(3): 267–271.
- 2 Pannu N, Manns B, Lee H, et al. Systematic review of the impact of N-acetylcysteine on contrast nephropathy. *Kidney Int* 2004; **65**: 1366–1374. Review.

## P-127

### Emergency conversion from off-pump to CPB-CABG: predictors, outcome and learning curve

G. Landoni, G. Crescenzi, F. Pappalardo, C. Rosica, G. Aletti, S. D'Avolio, A. Franco, A. Zangrillo

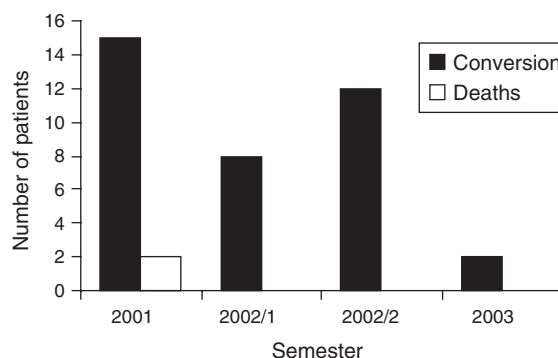
Department of Cardiovascular Anaesthesia and Intensive Care, Vita-Salute University of Milan, IRCCS San Raffaele Hospital, Milano, Italy; Department of Mathematics, University of Milano, Milano, Italy

**Introduction:** Off-pump CABG has been increasingly performed thanks to the development of renal dysfunction devices and increased surgeons' experience [1]. Patients undergoing off-pump CABG may need to be placed on cardiopulmonary bypass for circulatory collapse during the operation [2].

**Method:** We prospectively identified patients who required emergency conversion from off-pump to cardiopulmonary bypass in a 2 year period. Prolonged hospital stay (>7 days), temporal trends and risk factors for conversion were studied.

**Results:** Among patients where surgery was started off-pump (n = 450), 37 (8.2%) required conversion to cardiopulmonary bypass on an emergency basis. Patients who had emergency conversion had a higher mortality (5.4%) as compared to the off-pump group (1.5%) and the cardiopulmonary bypass group (0.4%): *P* = 0.02. The incidence of prolonged hospital stay (>7 days) was higher in the study group (27%) than in the other groups, 12.3% and 17.6%, *P* = 0.02. We did not identify any perioperative characteristic significantly associated to the risk of requiring conversion. Interestingly the conversion rate was uniformly distributed in the study period demonstrating that the conversion did not depend on surgeon expertise. (figure 1)

Numbers of conversions and of patients who died in four different semesters



**Discussion:** Patients who are converted during attempted off-pump procedures are at higher risk of death and prolonged hospital stay. This population should be included in comparative studies as "intention to treat" in the off-pump group.

#### References:

- 1 Wijesundera DN, Beattie WS, Djaiani G, et al. Off-pump coronary artery surgery for reducing mortality and morbidity: meta-analysis of randomized and observational studies. *J Am Coll Cardiol* 2005; **46**: 872–882.

- 2 Zangrillo A, Annalisa F, Crescenzi G, et al. Underreporting of conversion from off-pump coronary artery bypass surgery. *Anesthesiology* 2005; **103**: 902.
- 3 Legare JF, Buth KJ, Hirsch GM. Conversion to on pump from OPCAB is associated with increased mortality: results from a randomized controlled trial. *Eur J Cardiothorac Surg* 2005; **27**: 296–301.

## P-128

### Economic implications of EuroSCORE in open heart surgery

D. Filipescu, M. Luchian, I. Raileanu, A. Oprea, M. Persu, L. Iliuta, D. Tulbure

*Institute of Cardiovascular Diseases, Bucharest, Romania*

**Introduction:** The additive EuroSCORE model correlates to in-hospital operative mortality in cardiac surgery [1]. The aim of this study was to determine if the EuroSCORE can predict duration of ventilation support, cardiac care unit stay and direct costs.

**Method:** We evaluated all patients who underwent open heart surgery at our institution between July 1, 2005 and November 24, 2005. EuroSCORE was collected prospectively for all cases. Direct variable costs (disposable materials and drugs) were calculated for each patient. The duration of post-operative ventilation support as well as the cardiac care unit length of stay (CCU-LOS) was registered. Values are given as mean  $\pm$  standard deviation. Univariate linear regression analysis was used to test the correlation between the EuroSCORE and either costs, duration of ventilation support or CCU-LOS.

**Results:** Of the 133 patients enrolled 63.2% were males, mean age  $55.9 \pm 12.5$  yr. According to EuroSCORE, 55 patients (41.4%) were at low, 41 (30.8%) at medium, and 37 (27.8%) at high risk. The relationship EuroSCORE vs. direct costs, duration of ventilator support and CCU-LOS respectively are shown in the table:

Parameters	EuroSCORE		
	0–2	3–5	6
CCU-LOS (days)	$2.8 \pm 1.3$	$5.0 \pm 8.1$	$6.2 \pm 6.3$
Ventilator support (hours)	$9.3 \pm 4.2$	$36.3 \pm 123.9$	$44.7 \pm 81.6$
Direct costs (Euro)	$2155 \pm 658$	$2421 \pm 1086$	$3381 \pm 3380$

Costs were correlated with preoperative assessed risk with a correlation coefficient of 0.424 ( $P < 0.001$ ). CCU-LOS and the duration of postoperative ventilator support were correlated with EuroSCORE with a correlation coefficient of 0.266 ( $P < 0.01$ ) and 0.217 ( $P < 0.05$ ), respectively.

**Conclusions:** In our patients, there is a strong correlation between the EuroSCORE and both direct costs and CCU-LOS. There is also a correlation between the score and the duration of ventilation support. Preoperative prediction of CCU-LOS and costs may be used in clinical practice for better resource utilization.

#### Reference:

- 1 Nashef SAM, Roques F, Hammill BG, et al. Validation of European System for Cardiac Operative Risk Evaluation (EuroSCORE) in North American cardiac surgery. *Eur J Cardiothorac Surg* 2002; **22**: 101–105.

## Echocardiography/Monitoring

## P-130

### Comparison of four methods of cardiac index measurement – Bolus thermodilution, Continuous cardiac output, PCCO™ and Flowtrac™ – in patients undergoing off-pump coronary artery bypass surgery (OPCAB)

M.R. Chakravarthy, V.S. Jawali, T.A. Patil, J. Krishnamurthy, P.B. Kalligudd, D. Prabhakumar

*Wockhardt Heart Institute, Bangalore, Karnataka, India*

**Introduction:** In this prospective observational study, we compared 4 techniques of cardiac output measurements: bolus thermo dilution cardiac output (TDCO), continuous cardiac output (CCO), pulse contour cardiac output (PCCO)™, Flowtrac™ (FCCO). All were used simultaneously in the same patient during OPCAB.

## P-129

### Development of beating heart coronary surgery in a medium size European Centre

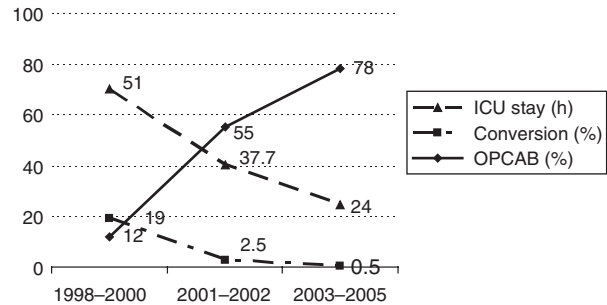
I. Rätsep, A. Kink

*North Estonian Regional Hospital, Society of Transplantology and Implantology, Tallinn, Estonia*

**Introduction:** Off-pump coronary surgery (OPCAB) is the biggest change in coronary surgery over the last 30 years. OPCAB is still gaining popularity in some European centres, while in other centres initial conflicting results discouraged surgeons to continue with this technique. The aim of this study was to explore the learning curve of our centre.

**Method:** Data of all coronary surgery cases from 1998 to November 2005 were collected from our cardiac surgical database.

**Results:** 3 periods were analysed: During the first 3 years the most significant changes were a decrease of conversion rate (failure to operate without cardiopulmonary bypass) and shorter need for intensive care compared to on-pump coronary patients. The second period (2 years) was characterized with less careful selection of patients and increase of overall OPCAB rate to 55%. The last 3 years until very recently has a 78% OPCAB rate for non-selected patients with EuroSCORE  $5.2 \pm 2.9$  (mean  $\pm$  SD), preoperative left ventricular EF 49.4%, and in-hospital mortality of 1%. The number of grafted vessels is now comparable to patients operated when the heart was arrested.



**Discussion:** To date the confirmed indication for OPCAB is significant risk of embolic stroke [1]. For the rest of the patients the benefit depends on skills and enthusiasm of the surgeon. Results are good and likely to be improved. Developments in beating heart surgery have stimulated our team to use an early extubation technique and shorten ICU stay to benefit for patients and medical care providers.

#### Reference:

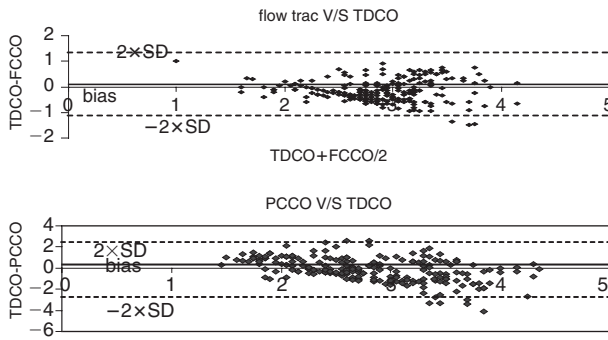
- 1 Bucerius J, Gummert JF, Borger MA, et al. Stroke after cardiac surgery: a risk factor analysis of 16,184 consecutive adult patients. *Ann Thorac Surg* 2003; **75**: 472–478.

**Method:** Five patients received a PA catheter (capable of measuring TDCO & CCO Edward lifesciences™), a PCCO (Pulsion medical systems) arterial cannula (measures CO with presence of central venous line and arterial cannula) and FCCO (monitors CO with only arterial cannula). Cardiac index (CI) was obtained every five minutes during surgery and every ten minutes in the first 24 h of the postoperative period. TDCO was treated as 'control' and the rest as 'test' values.

Statistical methods: Bland and Altman plot for estimation of bias and precision and Pearson's coefficient for correlation.

**Results:** 448 sets of data were obtained from 5 patients. Whenever the CI was  $2–3 \text{ L/m}^2$  or more, PCCO and FCCO correlated well with TDCO. (figs. 1 & 2). Whenever CI was  $< 2.0$ , CCO was  $1.62 \pm 0.39$ , PCCO was  $3.51 \pm 1.64$  and FCCO was  $2.11 \pm 0.33$ . 'Scatter' of data on the Bland Altman plots of both FCCO and PCCO suggests lack of correlation at times.  $r$  values of CCO ( $0.4$ )  $>$  FCCO ( $0.3$ )  $>$  PCCO ( $0.2$ ).

Bland Altman plots for PCCO and FCCO



**Table.** Shows the bias & precision.

Techniques	Bias l/m <sup>2</sup>	Precision L/m <sup>2</sup>
TDCO/CCO	0.03	1.4
TDCO/PCCO	0.13	2.3
TDCO/FCCO	0.15	1.5

**Conclusion:** Cardiac indices measured by these techniques in patients undergoing OPCAB show good correlation (bias of <0.06l/min) when the cardiac index is >2.0, but not during low CO states.

**Reference:**

1 Manecke GR. Edwards FloTrac sensor and Vigileo monitor: easy, accurate, reliable cardiac output assessment using the arterial pulse wave. *Expert Rev Med Devices.* 2005; 5: 523–527.

**P-131**

**Validation of CeVOX for continuous central venous oxygenation measurement in patients undergoing off-pump coronary artery bypass grafting**

C.K. Hofer, M.T. Ganter, P. Fodor, M. Genoni, A. Zollinger

*Institute of Anaesthesiology and Intensive Care Medicine, Triemli City Hospital, Zurich, Switzerland; Perioperative Care, University of California, San Francisco, San Francisco, United States; Department of Cardiac Surgery, University Hospital Zurich, Zurich, Switzerland*

**Introduction:** Less invasive measurement of central venous O<sub>2</sub> saturation (ScvO<sub>2</sub>) has shown to be a valuable alternative to the determination of mixed venous O<sub>2</sub> saturation for monitoring of O<sub>2</sub> supply/demand [1]. The aim of this study was to compare ScvO<sub>2</sub> measured continuously by the new CeVOX (Pulsion Medical System, Munich, Germany) device (CScvO<sub>2</sub>) with ScvO<sub>2</sub> determined by blood gas co-oximetry (BScvO<sub>2</sub>).

**Method:** 10 ASA III patients undergoing elective off-pump coronary artery bypass grafting were studied during the operation (OP) and during their intensive care unit stay (ICU). In addition to the standard haemodynamic monitoring according to institutional policy, a CeVOX fibreoptic probe was introduced into a standard central venous catheter placed via internal jugular vein access. OP and ICU measurement started after *in-vivo* calibration of CeVOX. BScvO<sub>2</sub> and CScvO<sub>2</sub> readings were recorded at intervals of 30 min during OP and 120 min during ICU. Data were statistically analysed using Bland-Altman analysis, Pearson correlation and *t*-test for a set of 3 consecutive measurements during OP immediately after calibration (OP<sub>cal</sub>) and 4 h later (OP<sub>4h</sub>) as well as immediately after calibration on the ICU (ICU<sub>cal</sub>) and 14 h later (ICU<sub>14h</sub>). Trend analysis was done calculating differences (Δ) between consecutive measurements. *P* < 0.05 was considered significant.

**Results:** 129 matched sets of data were obtained (OP: n = 78, ICU: n = 51) with a wide range of ScvO<sub>2</sub> values (BScvO<sub>2</sub> = 48–91%, CScvO<sub>2</sub> = 49–94%). OP observation time was 4–6.5 h and ICU measurement sequence was 14–20 h. Bland-Altman analysis revealed an overall mean bias ±2SD (limits of agreement) of -1 ± 8% for CScvO<sub>2</sub>-BScvO<sub>2</sub> during OP and -1 ± 12% during ICU. There was no significant difference between CScvO<sub>2</sub> and BScvO<sub>2</sub> (OP: *P* = 0.120, ICU: *P* = 0.167). Correlation coefficient (*r*<sup>2</sup>) for CScvO<sub>2</sub> vs. BScvO<sub>2</sub> was 0.885 (OP) and 0.592 (ICU). Statistics for OP<sub>cal</sub>, OP<sub>4h</sub> and ICU<sub>cal</sub> were comparable, whereas for ICU<sub>14h</sub> bias ± 2SD increased and *r*<sup>2</sup> decreased (Table 1).

	OP <sub>cal</sub>	OP <sub>4h</sub>	ICU <sub>cal</sub>	ICU <sub>14h</sub>
Mean bias ± 2SD	-0.3 ± 7.2%	-0.1 ± 8.4%	-0.7 ± 8.6%	-1.9 ± 14.0%
<i>r</i> <sup>2</sup>	0.849	0.853	0.832	0.358

Trend analysis showed no significant difference (OP: ΔBScvO<sub>2</sub> = -1.3 ± 9.0%, ΔCScvO<sub>2</sub> = -1.1 ± 8.6%, *P* = 0.663; ICU: ΔBScvO<sub>2</sub> = -0.4 ± 6.8%, ΔCScvO<sub>2</sub> = -0.4 ± 5.8%, *P* = 0.828).

**Conclusions:** These preliminary results indicate that ScvO<sub>2</sub> can be reliably assessed by CeVOX. Scheduled re-calibration at intervals <14 h may be mandatory.

**Reference:**

1 Ladakis C, Myrianthefs P, Karabinis A, et al. Central venous and mixed venous oxygen saturation in critically ill patients. *Respiration* 2001; 68: 279–285.

**P-132**

**Intraoperative quantification of regional myocardial function: Strain echocardiography study**

M. Kukucka, A. Koster, H. Kuppe

*Deutsches Herzzentrum Berlin, Berlin, Germany*

**Introduction:** In daily practice, intraoperative echocardiography is widely used to study myocardial segmental wall function. However such qualitative wall motion analysis is unable to identify small differences after therapeutic procedures. Recently developed techniques can quantify regional myocardial deformation [1] (strain and strain rate) and distinguish between passive and active motion. We aimed to compare the results of qualitative analysis with peak systolic strain measurements immediately before and after CABG in patients with reduced left ventricular (LV) function.

**Method:** Ten patients with reduced LV function undergoing coronary revascularization were studied using Vivid 7(GE) before and immediately after the procedure. B-mode cine-loops were acquired using standard 4- and 2-chamber views for computer off-line analysis and for visual wall motion scoring (WMS). To calculate strain we used the non-Doppler-based method of 2-D strain [2]. The software takes advantage of temporally stable acoustic speckles to determine velocity maps and to calculate the deformation parameter in radial axis in each segment.

In addition myocardial wall segments (basal, mid and apical) were scored from the same B-mode cine-loops according to the ASE recommendations: normokinesia (N,1), hypokinesia (H,2), akinesia (A,3) and dyskinesia (D,4).

**Results:** The mean ejection fraction using conventional biplane measurement was 25.8 ± 8.3% preoperatively and 27.9 ± 10.5% immediately after CABG. A total number of 120 myocardial segments were included in the analysis. In WMS there were 29 normokinetic, 69 hypokinetic, 19 akinetik and 3 dyskinetic segments preoperatively and 26 (N), 65 (H), 21 (A), 8 (D) after the procedure. Values for radial peak systolic strain were 39.7 ± 10.9 (N) 15.4 ± 8.3 (H), 3.3 ± 5.5 (A), -17 ± 1.5 (D) preoperatively and 41.7 ± 15.7 (N), 13.8 ± 8.1 (H), 2.7 ± 3.3 (A) and -6.4 ± 4.9 (D) postoperatively. Using linear regression analysis, radial strain measurements revealed correlation with WMS of 0.83 with *R*<sup>2</sup> = 0.68 preoperatively and 0.78, *R*<sup>2</sup> = 0.62 postoperatively.

**Conclusion:** Two-dimensional strain allows non-Doppler-based calculation of deformation parameters using B-mode images. Lower systolic strain is associated with wall motion abnormalities. This simple and reliable method makes the intraoperative quantification of myocardial segmental function possible.

**References:**

1 Kowalski M, Kukulski T, Jamal F, et al. Can natural strain and strain rate quantify regional myocardial deformation? A study in healthy subjects. *Ultrasound Med Biol* 2001; 27(8): 1087–1097.  
 2 Leitman M, Lysyansky P, Sidenko S, et al. Two-dimensional strain—a novel software for real-time quantitative echocardiographic assessment of myocardial function. *J Am Soc Echocardiogr* 2004; 17(10): 1021–1029.

**P-133**

**Changes of regional myocardial function during VAD explantation: Echocardiographic strain study**

M. Kukucka, A. Koster, H. Kuppe

*Deutsches Herzzentrum Berlin, Berlin, Germany*

**Introduction:** The use of a ventricle assist device (VAD) to unload the failing heart may achieve reverse remodelling, which allows weaning from VAD with partially restored heart function [1]. Newly developed echocardiography techniques can quantify regional myocardial deformation [2]. Previous studies showed that unloading improves the molecular and cellular alteration that characterize the failing myocardium. The impact of these changes on myocardial function has not been defined. We aimed to analyse the intraoperative changes in regional myocardial function at the time of VAD explantation.

**Method:** One patient with end-stage dilated cardiomyopathy and acute decompensation was studied at various time points. Echocardiography studies were performed using Vivid 7 (GE). Strain (S) is expressed as the percent change from original dimension. To calculate S the non-Doppler-based method of 2-D strain was used. We analysed radial strain of anterior (A), anteroseptal (AS), septal (S), inferior (I), posterior (P) and lateral (L) segments at mid-papillary level and their synchronicity (Syn) as the time between the earliest and latest maximal S and the LVEDD and EF. We performed measurements at the following time points: before LVAD explantation (T1), with

reduced pump flow (T2), 2h after explantation (T3), after chest closure (T4), at 19 days after explantation (T5).

#### Results:

	A%	AS%	S%	I%	P%	L%	Syn ms	LVEDD mm	EF%
T1	25.7	11	40	47	50	42.7	57	40	67
T2	23.9	22.5	30.6	39	41.3	34.1	47	47	47.5
T3	10.7	6.4	13.9	33.2	33.8	22.0	80	56.2	42.7
T4	16.2	14.1	46	49.3	32.3	16.2	57	48.6	50.3
T5	35.6	32.4	28.8	30.8	34.6	36.5	18	45.2	53.7

**Conclusion:** Two-dimensional strain may be a useful tool in assessing current changes during VAD explantation and may recognize acute alteration in LV function after loading of LV. It may be more sensitive than geometric echocardiography measurements. In this case study we show for the first time the quantitative changes during VAD explantation.

#### References:

- Dandel M, Weng Y, Siniawski H, et al. Long-term results in patients with idiopathic dilated cardiomyopathy after weaning from left ventricular assist devices. *Circulation* 2005; **112**(9 Suppl): I37–I45.
- Kowalski M, Kukulski T, Jamal F, et al. Can natural strain and strain rate quantify regional myocardial deformation? A study in healthy subjects. *Ultrasound Med Biol* 2001; **27**(8): 1087–1097.

## P-134

### Preoperative evaluation of patients with concomitant coronary and carotid artery disease using transcranial Doppler

D. Rubes, M. Matias, S. Romaniv, M. Dobias, M. Lips, M. Stritesky  
General Teaching Hospital, Charles University, Prague, Czech Republic

**Introduction:** Management of patients with concomitant coronary artery disease (CAD) and asymptomatic carotid artery stenosis (ACAS) remains controversial. This study investigates the relationship between the preoperative evaluation of cerebrovascular reactivity to hypercapnoea and perioperative monitoring with transcranial Doppler (TCD) and cerebrovascular events in patients with ACAS undergoing coronary artery bypass grafting (CABG).

**Method:** Prospective pilot cohort study. Patients with unilateral or bilateral ACAS  $\geq 70\%$  were preoperatively evaluated with transcranial Doppler to detect perfusion characteristics in the main cerebral arteries and cerebrovascular reactivity to hypercapnoea in the middle cerebral artery (MCA).

Prophylactic carotid endarterectomy was not performed prior to CABG in patients with normal symmetric flow velocity in the middle cerebral artery and preserved cerebrovascular reactivity (Breath Holding Index  $>0.69$ ) in its territory. Cerebral perfusion was monitored with TCD during CABG. Patients were followed up for the 30 day incidence of type 1 neurological injury.

**Results:** 11 consecutive patients with ACAS  $\geq 70\%$  were evaluated preoperatively. 2 of these patients had impaired cerebrovascular reactivity (Breath Holding Index  $< 0.69$ ) in the territory of the middle cerebral artery and underwent carotid endarterectomy prior to CABG.

The remaining 9 patients had preserved cerebrovascular reactivity (Breath Holding Index  $> 0.69$ ) in the territory of the MCA. In these patients carotid endarterectomy was not performed.

All patient were carefully monitored using TCD in all crucial haemodynamic phases of the operation. No type 1 neurological injury occurred within 30 days postoperatively in these 11 patients.

**Discussion:** This pilot study suggests possible management of patients with concomitant CAD and ACAS.

#### References:

- Naylor AR, Cuffe RL, Rothwell PM, et al. A systematic review of outcomes following staged and synchronous carotid endarterectomy and coronary arteries. *Eur J Vasc Endovasc Surg* 2003; **25**(5): 380–389.
- Silvestrini M, Vernieri F, Pasqualetti P, et al. Impaired cerebral vasoreactivity and risk of stroke in patients with asymptomatic carotid artery stenosis. *JAMA* 2000; **283**(16): 2122–2127.
- Sloan MA, Alexandrov AV, Tegeler CH, et al. Therapeutics and Technology Assessment Subcommittee of the American Academy of Neurology. Assessment: transcranial Doppler ultrasonography: report of the Therapeutics and Technology Assessment Subcommittee of the American Academy of Neurology. *Neurology* 2004; **62**(9): 1468–1481.

## P-135

### The Vigileo™ Flow Trac cardiac output system versus bolus thermodilution cardiac output in cardiac surgery patients

C. Kufner, A. Zimmermann, S. Hofbauer, R. Schistek, J. Steinwendner, W. Hitzl, S. Hargasser, G. Pauser

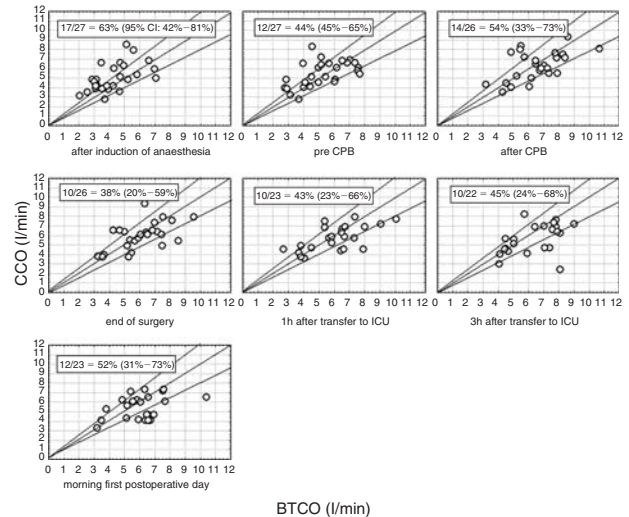
Paracelsus Medical Private University, University clinics for Anaesthesiology, Perioperative Medicine and Intensive Care, Salzburg, Austria, Technische Universität München, Munich, Germany

**Introduction:** The Vigileo™ Flow Trac Monitor is a new, less invasive continuous cardiac output (CCO) measurement system using the arterial pulse

wave. The purpose of the study was to compare the new system to the bolus thermodilution cardiac output (BTCO) measurement technique.

**Method:** After Ethics Committee Approval and obtaining patient informed consent, comparative measurements were performed at the following times in 30 patients undergoing cardiac surgery with cardiopulmonary bypass (CPB): after induction of anaesthesia; pre CPB, after CPB, end of surgery, one hour after transfer to ICU, three hours after transfer to ICU and morning of first postoperative day. BTCO values were repeated four times for an average. Two independent observers (one per measurement technique) documented CCO and BTCO data. The statistical evaluation was performed per time of measurement by counting the number of patients exceeding the 20%-range compared to the BTCO-method (20%-criteria) with corresponding 95% confidence intervals.

**Results:** After cleaning process, 174 data pairs were included. The closeness of agreement of the results was comparable between different measurement times (figure 1).



**Figure 1.** Categorized scatterplots of CCO compared with BTCO at seven points in time together with the number of patients exceeding the 20% range of the PAC-method.

**Discussion:** The Vigileo™ CCO system may be a less invasive alternative to BTCO in cardiac surgery patients. With respect to the clinical importance, the observed differences between the methods need further investigation.

#### Reference:

- Lester et al. *J Clin Monit* 1999; **15**: 85–91.

## P-136

### Assessment of cardiac output by a modified pulse contour analysis: preliminary results

E.E.C. de Waal, C.J. Kalkman, W.F. Buhre

University Medical Center, Utrecht, Netherlands

**Introduction:** The Vigileo® system, using the FloTrac® sensor is a new continuous cardiac output measurement device (Vigileo-CO, Edwards Lifesciences, Irvine, CA) which should enable measurement of cardiac output (CO) based on analysis of the arterial pulse curve according to a proprietary algorithm. No published clinical data comparing the results of this device with a reference technique is available now. Therefore, we conducted a study comparing the new technique with transcardiopulmonary thermodilution (TCPCO) and pulse contour derived cardiac output (PCCO) (PiCCO®, Pulsion, Munich, Germany). We present preliminary results, obtained in 7 CABG patients.

**Method:** After ethical approval and written informed consent, patients scheduled for elective CABG surgery were included in this study. Patients with emergency operations, intracardiac shunts and significant valvular heart disease were excluded. All cardiac medications were continued until the day of surgery, except digoxin, ACE-inhibitors and diuretics. After induction of anaesthesia, a 5-F thermistor-tipped catheter (PV2015L20A, Pulsioath®; Pulsion Medical systems, Munich, Germany) was inserted into the femoral artery and connected to the FloTrac® Sensor (Edwards Lifesciences, Irvine, CA) and the PiCCO pressure transducer, positioned on the mid-axillary line. PiCCO delivers transpulmonary thermodilution cardiac output (TPCO) measurements by central venous injection of 15 mL cold isotonic saline. TPCO was used for the calibration of pulse contour cardiac output (PCCO). The patient was in the supine position. Demographic parameters were recorded together with CO, mean arterial pressure, heart rate (HR) and central venous pressure (CVP) intra- and postoperatively: after induction of

anesthesia ( $t_1$ ), after sternotomy ( $t_2$ ), immediately after a volume load of 10 mL/kg hetastarch 6% ( $t_3$ ), 20 min after volume load ( $t_4$ ), 15 minutes after weaning from bypass ( $t_5$ ), after retransfusion of autologous blood (from the extracorporeal circulation) ( $t_6$ ), after arrival at the intensive care unit ( $t_7$ ), immediately after a volume load of 10 mL/kg hetastarch 6% ( $t_8$ ) and 20 min after volume load ( $t_9$ ). Correlation coefficient and Bland-Altman analysis were used for comparison of the cardiac output data. A  $P$ -value  $<0.05$  was considered statistically significant. SPSS (version 11.5 for Windows XP, SPSS, Chicago, IL) was used for statistical analysis.

**Table 1.** Cardiac output mean, SD, maximum and minimum of pooled data.

	TPCO	Vigileo-CO	PCCO
Mean	5.44	5.83	5.56
SD	1.02	1.10	1.26
Max	8.06	9.00	8.83
Min	3.25	3.40	3.06

**Results:** A total of 47 sets of measurements were available for analysis. The overall correlation coefficient between Vigileo CO and TPCO was 0.72. Bland and Altman statistics showed a bias of 0.07 L/min and a precision ( $=2SD$ ) of 1.62 L/min. Respective results for Vigileo CO versus PCCO were a correlation coefficient of 0.6, bias of  $-0.5$  L/min and precision 2.13 L/min. **Conclusion:** These preliminary data demonstrate no significant bias between TPCO, Vigileo-CO and PCCO. However, the limits of agreement between both Vigileo-CO and PCCO versus intermittent thermodilution are above 20%.

**References:**

- 1 Manecke GR. Edwards FloTrac sensor and Vigileo monitor: easy, accurate, reliable cardiac output assessment using the arterial pulse wave. *Expert Rev Med Devices* 2005; **2**: 523–527. Review.
- 2 Buhre WF, Weyland A, Kazmaier S, et al. Comparison of cardiac output assessed by Pulse-Contour Analysis and Thermodilution in patients undergoing minimally invasive direct coronary artery bypass grafting. *J Cardiothor Vasc Anesth* 1999; **13**: 437–440.

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