

Reply

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EDITOR:

We thank Dr Renner and colleagues for their interest in our article and their comments. We are grateful for all input into the discussion about our article on cardiac output monitoring during off-pump coronary artery bypass (OPCAB) surgery.

We agree with Dr Renner and colleagues that aortic transit-time ultrasound (ATTUS) cardiac output measurement is the true clinical gold standard for instantaneous cardiac output measurements. However, to our knowledge, in the case of OPCAB surgery, ATTUS has not yet been compared with other cardiac output measurement techniques. Indeed, continuous cardiac output measurements with either pulmonary artery catheter or partial CO₂ rebreathing (PRCO) techniques do not provide continuous beat-to-beat assessment of cardiac output. Ideally, the best monitoring equipment should be non-invasive and beat-to-beat, and neither PRCO nor ATTUS achieve both of these ideals.

Concerning ventilation during OPCAB surgery, our anaesthetists only exceptionally have to decrease tidal volume below 10 mL kg⁻¹ in order to adjust to the needs of the surgeons. End-tidal CO₂ is maintained by adjusting respiratory rate. As we mentioned in our article, no changes in cardiac output readings were observed, suggesting that acute haemodynamic events recorded by either method were related to changes in ventilatory settings. The differences in attitudes of surgeons and between institutions towards tidal volume during OPCAB surgery might be the reason why we were not concerned about the theoretical link of low tidal volume and inadequate rebreathing under our operating conditions. In addition, as mentioned by Tachibana and colleagues [1], the accuracy of the non-invasive cardiac output (NICO) technique can be maintained even at small tidal volumes if normocapnia is achieved by adjusting the respiratory rate. Conversely, the same authors also stated that

the NICO underreports cardiac output at small tidal volumes. On the other hand, it is the variation of cardiac output which gives more information about acute haemodynamic changes than the absolute number itself. A disadvantage of underestimation of cardiac output could rather serve as an incentive to react quicker to haemodynamic changes. The assumption of a stable pulmonary capillary blood flow during NICO measurement cycles is indeed a drawback, and recalibration is needed in case of changes of S_pO₂ and F_iO₂.

We stated that the NICO showed a faster response than the pulmonary artery catheter during OPCAB surgery. In fact, this statement was based on observation and it is correct to add that it has not been substantiated by any of our data. Bein and colleagues [2] correctly concluded that NICO as compared to ATTUS is not suitable for cardiac output determination during quickly changing haemodynamic conditions applicable to their setting of aortic reconstruction. However, to our knowledge ATTUS has neither been examined nor brought into practice as a monitoring tool for OPCAB surgery. Therefore, in this context, even with a delayed response time of 165 s, NICO still remains an interesting monitoring option for OPCAB surgery [3].

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