



Renal Blood Flow in Twins

M. K. Kornacka¹, E. Burzyńska¹, J. Gadzinowski²

¹Chair and Neonatal Department, University School of Medical Sciences Poznań;

²Head of Neonatal Department, Poznań, Poland

Abstract. The aim of this preliminary study was the estimation of renal blood flow in 16 premature newborns from twin pregnancies with mean body weight 1270 g and mean gestational age 29 weeks.

In control group we have 16 singleton newborns with mean gestational age 29 weeks and mean birth weight 1240 g. In both intervention and control group we have the similar clinical symptoms. The renal blood flow was carried out in the first day of life with the Acuson 128 XP Colour Doppler using the 6 and 7 MHz linear transducer. The renal blood flow parameters-PI, RI, Vmax, Vmin Vmean were measured in right and left renal arteries in theirs courses from the aorta to the renal hilus, by color sinal. In the investigation group the mean value of RI in right and left renal artery was 0,88. Mean PI in right vessel was 1,67 and in left 1,56. Mean V min in right and in left artery was 0,03 and mean V max in right artery was 0,34 and in left 0,33. Mean value of mean velocity in right vessels was 0,18 and in left 0,19.

In control group we observed in right artery mean value of PI 1,74 and in left 1,6. Mean RI was 0,86 and 0,86 in right vessel in left vessel. Mean V min was 0,05 in right and 0,04 in left artery. Mean V max was 0,37 in right and 0,34 in left artery. Mean value of V mean was 0,19 in right artery and 0,18 in left artery.

Using the student, Mann-Whitney and Shapiro-Wilk tests we have not observed statistically significant difference of Doppler parameters between control and investigation group and between the left and right artery. Although in newborns with broad PDA we noted significant higher value of RI (0,97, 0,98) than in newborns without PDA (0,78, 0,81).

Key words: Newborn twins, Twin pregnancies, Renal blood flow, Doppler

INTRODUCTION

Multiple pregnancies constitute a special perinatal problem. A more unique problem is created by premature newborns from multiple pregnancies. Mortality and morbidity in this group is higher than in singletons and each next born newborn from the same preg-

nancy can be more hypoxic and is more likely to have higher incidences of abnormal clinical symptoms.

The twins very often differ from each other as to general condition, Apgar score, birth weight, value of hematocrit, blood pressure etc.

The hemodynamic perturbances seem to be more serious in twin pregnancies because of vascular joining between fetuses, twin to twin transfusion, and more frequent incidence of hypoxia.

Hypoxic newborns are at risk of having the fetal brain-sparing effect more frequently [5]. The sparing effect causes the increase of cerebral blood flow and can be a risk factor for the development of intraventricular hemorrhage. In the same time during hypoxia we should observe the decrease of intestinal and renal blood flow.

If hypoxia is more frequent in multiple pregnancies, the cerebral and renal blood flow disturbances are also likely to be more often present.

Premature newborns from multiple pregnancies are exposed to the following factors which create the risk of developing the vasomotor nephropathy [2, 3]:

- low systemic blood pressure;
- hypovolemia and decrease of renal blood flow;
- decrease of glomerular filtration;
- increase of renal resistance;
- hypercapnia;
- metabolic acidosis.

The aim of this preliminary study was to estimate the renal blood flow in 16 premature newborns from twin pregnancies with body weight < 1500 g and with different disorders like: RDS, PDA, IVH. 13 of these babies were treated with IMV and SIMV ventilation.

MATERIAL

Table 1 shows the character of the material. The body weight ranged from 940 g to 1600 g (mean 1270.6 mg) and gestational age was from 25 to 31 weeks (mean 29 weeks). Majority of these babies were hypoxic. The cord pH in 8 newborns was 7.2 and in 4 < 7.2.

Apgar score in the first minute of life was in 8 newborns < 3 and in 10 < 6 (mean 4, 6). In the 5th minute of life – 2 babies had Apgar score < 3 (mean 6, 6) (Tab. 1). Twins from four pregnancies were delivered by caesarean section and the rest by normal vaginal delivery. The mean blood pressure of babies in the first hour of life ranged from 26 to 39 mm Hg (mean 31.5 mm Hg). The systolic blood pressure was between 50 to 39 mm Hg (mean 44.2 mm Hg) and diastolic from 17 to 28 mm Hg (mean 23.5 mm Hg) (Tab. 1).

The control group consisted of 16 newborns with mean gestational age 29 weeks and mean birth weight 1241.8 g.

The range of Apgar score in the 1st minute of life was 1-8 (mean 3.4) and in the 5th minute of life 5-9 (mean 7.2) points. Mean blood pressure in the newborns' control group was 31.5 (Tab. 2).

Table 1 - Character-intervention group

Parameter	Range	Mean Value
Gestational	25-32	29
Birth weight/g/	790-1600	1270,6
Apgar score 1'	1-9	4,6
Apgar score 5'	2-10	6,6
Diuresis /ml/kg/h/	0,38-4,3	1,70
Mean blood pressure /mmHg/	26-37	31,5

Table 2 - Character control group

Parameter	Range	Mean Value
Gestational age (weeks)	24-33	29
Birth weight (g)	700-1760	1241,8
Apgar score 1'	1- 8	3,4
Apgar score 5'	5-9	7,2
Diuresis /ml/kg/h/	0,4-4,7	1,63
Mean blood pressure /mmHg/	18-56	35,5

Table 3 – Clinical symptoms

Clinical Symptoms	control group /number of newborns/	intervention group/number of newborns/
RDS	9	11
IVH	8	9
PDA	5	8
Anemia	6	4
Hipotensia	4	6
Intrauterine hypoxia	4	2
Deaths	1	–

In both, intervention and control groups we have similar clinical symptoms (Tab. 3). We observed RDS in 9 control and in 11 intervention group babies. IVH was diagnosed in 8 control and 9 intervention group newborns. PDA was present in 5 control and in 8 from intervention group. Anemia was diagnosed in 6 control and 4 investigation group babies. Hypotension was diagnosed in 4 control and in 6 intervention group babies. Intrauterine hypoxia was diagnosed in 4 control and 2 intervention group newborns. Only one newborn from the control group died.

METHODS

The renal blood flow examination was carried out by means of Acuson 128 XP Colour Doppler using the 6 and 7 MHz linear transducer. Vascular investigations and calculations were made by this device automatically. We also made video recording. The Doppler investigation was carried out in prone position, in transverse and longitudinal sections of kidneys. The vessels were insonated at the angle of 0,1 - 0,5°.

The renal blood flow was measured in right and left renal arteries in their courses from the aorta to the renal hilus by the colour signal. The evaluation of the renal blood flow was made on the basis of measurements of blood flow velocity V_{max} , V_{min} and V_{mean} , in the right and left renal arteries, as well as on the basis of pulsatility – PI and resistance – RI index calculations.

All examinations were performed in the first hour of life. All babies were under sedation with Phenobarbital, and other drugs such as: catecholamin or indomethacin were not used.

RESULTS

The results of our investigation are presented in Tables 4, 5, 6.

These tables show the parameters of renal blood flow in the right and left artery as well as clinical symptoms (Fig. 1).

RI the right renal artery in the investigation group ranged from 0.75 to 1.0 (mean 0.88) and in the left one from 0.73 to 0.98 (mean 0.88). PI in the right vessel was from 1.29 to 2.17 (mean 1.67) and in the left one from 1.13 to 1.96 (mean 1.56). V_{min} in the right artery was between 0 to 0.08 (mean 0.03) (Fig. 2) and in the left one from 0.01-0.09 (mean 0.03). V_{max} in the right renal vessel ranged from 0.20 to 0.48 (mean 0.34) and in the left one from 0.22-0.47 (mean 0.33). Mean value of velocity in the right vessel was from 0.13 to 0.27 (mean 0.18) and in the left one from 0.13-0.30 (mean 0.19), (Fig. 1, Fig. 2) In the control group we observed the following: in the right artery PI ranged from 1.36-2.98 (mean 1.74) and in the left one it was 1.2 to 2.03 (mean 1.67). RI was from 0.7-1 (mean 0.86) in the right vessel and 0.67 to 0.98 (mean 0.85) in the left vessel. V_{min} ranged from 0 to 0.12 (mean 0.05) in the right and 0.01 to 0.1 (mean 0.04) in the left artery. V_{max} was calculated from 0.18 to 0.73 (mean 0.37) in the right and from 0.16 to 0.54 (mean 0.34) in the left artery. V_{mean} was 0.09 to 0.33 (mean 0.19) in the right artery and 0.07 to 0.32 (mean 0.18) in the left artery.

The ranges of mean values of blood flow parameters for control and investigation groups are presented in Tables 5, 6, 7, 8. Using student-test, Mann-Whitney and Shapiro-Wilk tests we did not observed any statistically significant differences between control and investigation groups and between the left and right vessels' parameters in both groups. However, in newborns with wide, patent arterial duct one observed much higher values of RI 0.97, 0.96 and 0.98 than in newborns in whom wide, patent arterial duct was not stated, and the RI values were 0.78, 0.81 and 0.75.

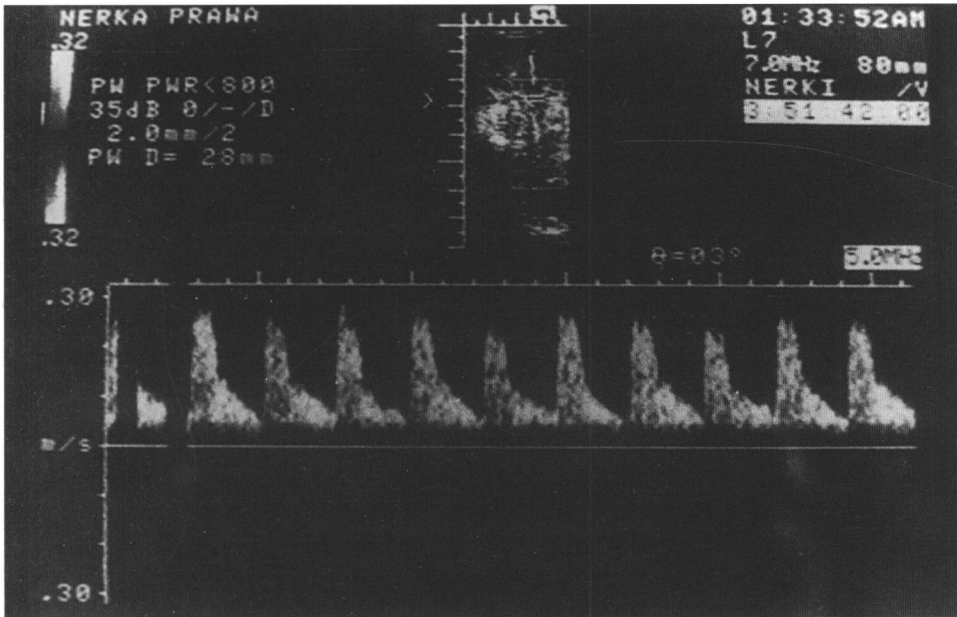


Fig. 1 - Normal renal blood flow.

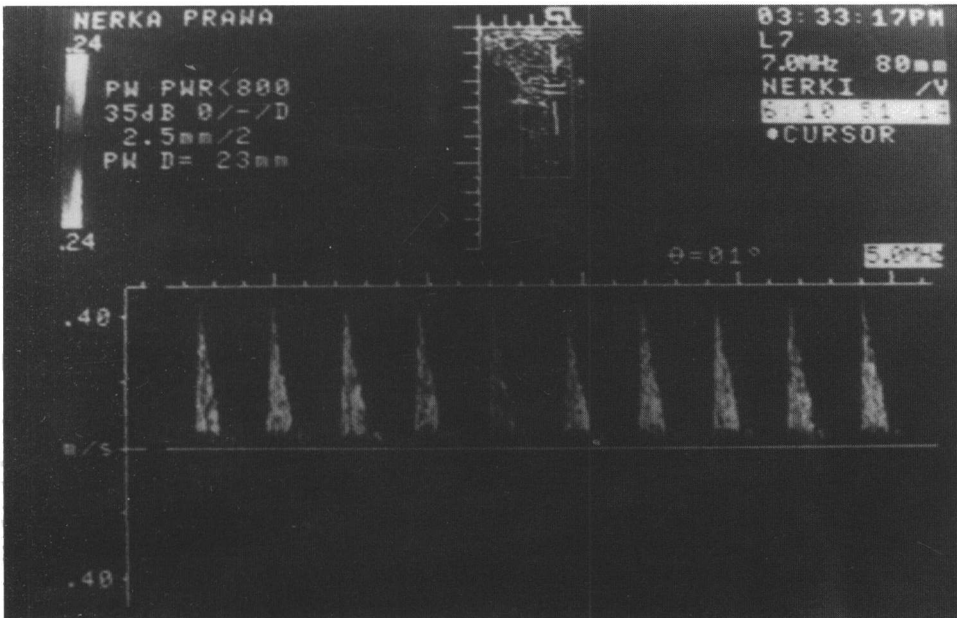


Fig. 2 - Abnormal renal blood flow-absent of diastolic flow.

Table 4 - Parametres of renal blood flow and clinical symptoms in newborn twins

No.	PI R/L	RI R/L	Vmin R/L	Vmax R/L	Vśr R/L	Htk	PDA	IVH (grade)	RDS (grade)
I t.1	1,4 7/1,53	0,84/0,89	0,05/0,03	0,33/0,26	0,19/0,15	0,54	2,1 mm	II	III
I t.2	1,8 2/1,65	0,96/0,90	0,01/0,03	0,28/0,32	0,15/0,18	0,55	2,2 mm	II	III
II t.1	2,1 7/1,13	0,81/0,81	0,07/0,05	0,36/0,27	0,13/0,2	0,41 me	-	I	-
II t.2	1,4 /1,35	0,83/0,95	0,04/0,01	0,24/0,20	0,14/0,14	0,36 me	-	I	-
III t.1	1,9 5/1,74	0,87/0,93	0,05/0,03	0,38/0,4	0,17/0,24	0,38	-	-	II
III t.2	1,7 2/1,43	0,97/0,97	0,01/0,01	0,34/0,33	0,19/0,22	0,61	1,8 mm	-	III
IV t.1	1,4 7/1,86	0,92/0,91	0,03/0,03	0,37/0,34	0,23/0,17	0,51	2 mm	-	III/IV
IV t.2	1,4 2/1,38	0,79/0,81	0,05/0,04	0,25/0,22	0,14/0,13	0,54	0,8 mm	I	II
V t.1	1,5 8/1,54	0,97/0,98	0,01/0,01	0,29/0,47	0,18/0,3	0,58	2 mm	II	III
V t.2	1,8 8/1,61	0,95/0,98	0,02/0,01	0,44/0,42	0,22/0,26	0,57	2,1 mm	II	IV
VI t.1	1,8 6/1,88	0,98/0,89	0,01/0,05	0,44/0,47	0,23/0,22	0,47	1,8 mm	IV	IV
VI t.2	1,9 2/1,8	0,95/0,93	0,02/0,03	0,48/0,47	0,24/0,25	0,43	-	IV	IV
VII t.1	1,2 9/1,32	0,78/0,76	0,04/0,06	0,20/0,25	0,12/0,14	0,48	-	-	-
VII t.2	1,9 4/1,95	1/0,97	0/0,01	0,41/0,36	0,21/0,18	0,24 me	-	-	II
VIII t.1	1,3 5/1,34	0,75/0,73	0,07/0,07	0,28/0,26	0,16/0,14	0,59	-	-	-
VIII t.2	1,4 8/1,44	0,78/0,75	0,06/0,07	0,27/0,28	0,14/0,15	0,44	-	-	-

me = blood transfusion

R/L = right and left renal artery

Htk = hematocrit

RDS = respiratory distress syndrome

PDA = patent ductus arteriosus

Table 5 - Value of renal blood flow in investigation group (first day of life)

Parameters	Range	Mean Value
PI right	1,29-2,17	1,67
RI right	0,75-1	0,88
V min m/s	0-0,08	0,03
V max m/s	0,2-0,48	0,34
V mean m/s	0,13-0,27	0,18
PI left	1,13-1,96	1,56
RI left	0,73-0,98	0,88
V min m/s /	0,01-0,09	0,03
V max m/s /	0,22-0,47	0,33
V mean m.s /	0,13-0,3	0,19

Table 6 - Value of renal blood flow in control group (first day of life)

Parameters	Range	Mean Value
PI right	1,36-2,98	1,74
RI right	0,7-1	0,86
V min m/s	0-0,12	0,05
V max m/s	0,18-0,73	0,37
V mean m/s	0,09-0,33	0,19
PI left	1,2-2,03	1,67
RI left	0,67-0,98	0,85
V min m/s /	0,01-0,1	0,04
V max m/s /	0,16-0,54	0,34
V mean m/s /	0,07-0,32	0,18

DISCUSSION

The value of renal blood flow examinations based on evaluation of blood flow parameters – V_{max} , V_{min} and V_{mean} in both renal arteries has not been confirmed, yet. There are very few reports concerning this problem in newborns with low body weight and it has not been studied in newborns from multiple pregnancies. According to data from literature, the normal pulsatility index in renal arteries ranges from 0.84 to 0.86 and for RI it is 0.65 – 0.1 [1, 6]. In healthy newborns, Schoolbach observed RI values in the right

renal artery in the ranges of 0.62 to 0.76, in the left one they were 0.65 to 0.75; PI in the right renal artery ranged from 1.01 to 1.52 and in the left one – from 1.07 to 1.57 [7]. In the examined premature born newborns from multiple pregnancies, we observed RI values ranging from 1.29 to 2.17 for the right renal artery, and 1.13 to 1.96 for the left one (Tab. 5). RI for the right renal artery ranged from 0.75 to 1, and for the left one from 0.73 to 0.98. In the newborns examined in this study, similarly to the control group, RI was higher than described data in normal full-term newborns [6, 7, 8].

This fact proves the occurrence of decreased renal filtration. In the examined newborns, one did not find any interdependence between RI and urine output which was low in all cases due to the fact that all examinations were performed on the first day of life. No correlations between RI and cord pH or Apgar score were found, either. It must be pointed out, however, that markedly higher values were observed in 3 newborns with PDA (Tab. 4). In the pair of twins No IV, the newborn with a two times wider arterial duct had markedly higher RI. Kempley also observed the increase of pulsatility index in thoracic aorta and renal arteries in newborns with intrauterine growth retardation. It has also been suggested that it was the consequence of brain sparing effect in hypoxic IUGR newborns [4]. In the study, mean values of measurements in particular arteries were evaluated. Such measurements seem to be more valuable than evaluation of mean values in both vessels together [7]. In one of the twins from pair No II, one observed a marked difference of PI in the right and left renal arteries (2.17/2.13) (Tab. 4). One also stated markedly decreased urine output - 0.53 ml/kg/h in this newborn. A similarly marked difference of values was observed in a twin from pair No 4. In this case, diuresis was also very low - 0.38 ml/kg/h.

These conditions were not reflected in the measurements of systemic pressure taken by means of noninvasive method.

Monitoring of these changes in time and their observation during the follow-up after the closure of arterial duct and stabilization of urine output, would surely be of great importance.

One did not observe any significant difference of Doppler parameters in relation to the control group.

Our preliminary examinations clearly point at usefulness of renal blood flow examinations on condition of observing the dynamics of changes depending on pathophysiological factors. The evaluation of renal blood flow itself without any simultaneous estimation of hemodynamic changes in brain vessels, and, particularly without evaluating the character of flow in the great arterial duct and the advancement of clinical changes' severity (the degree of RDS) poses serious difficulties in interpretation. Absolute values of this evaluation may be only indicative. PI is most clearly reflected in glomerular filtration measured by urine output in the newborn. Precise evaluation of urine output seems to constitute the basic parameter of the newborn's renal function on the first day of life. Normal systemic pressure (measured by noninvasive method) is not always a guarantee of normal renal blood flow and filtration. Mean values of measurements in both vessels separately – the right and left arteries – are much more useful than mean values for both vessels.

CONCLUSIONS

1. Decrease of RBFV in multiple pregnancies is associated with prematurity and severity of disorders.
2. Patent ductus arteriosus is connected with disturbances in RBFV.
3. The evaluation of RBFV itself without any simultaneous estimation of hemodynamic changes in brain vessels and without evaluating the character of flow in ductus arteriosus has difficulties in interpretation.
4. PI is most clearly reflected in newborns' urine output.
5. Noninvasive measurement of systemic blood pressure is not always adequate for normal renal blood flow and filtration.
6. Mean values of measurements in both vessels separately – the right and left arteries – are much more useful than mean values for both vessels.

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Correspondence: Dr. M.H. Kornacka, University School of Medical Sciences, Polna 33, 60535 Poznań, Poland, e-mail: kornacka@sk3.usoms.poznan.pl.