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INDICATORS OF BLOOD FLOW IN THE KIDNEYS DEPENDING ON THE ACUTE KIDNEY INJURY IN PREMATURE INFANTS WITH HEMODYNAMICALLY SIGNIFICANT PATERN DUCTUS ARTERIOSUS

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Abstract. The abstracts present data on changes in blood flow in the kidneys in premature infants with hemodynamically significant patent ductus arteriosus (hsPDA) with acute kidney injury. Were examined 40 premature infants with a gestational age of 29-36 weeks. All children on the first, third and tenth days of life investigated Doppler ultrasound of the kidneys to determine blood flow in the renal arteries (Main Renal Artery and Interlobar Artery): the maximum systolic blood flow rate, minimum blood flow rate in diastole, and RI. Children were divided into 2 groups in the presence of acute kidney injury. Group I (n = 17) did not have AKI, group II (n = 23) had AKI. The obtained data allow us to consider the most informative for the diagnosis of acute renal injury in premature infants with HsPDA decrease in systolic and diastolic blood flow in the interlobar artery, and an increase in RI in the first three days of life.

Key words: premature babies, acute kidney injury, hemodynamically significant patent ductus arteriosus, Doppler ultrasound kidney.

Introduction.

Prediction and early diagnosis of acute kidney injury (AKI) in newborns is an important and complex issue in the emergency care setting (1). The most common causes of AKI in newborns are the development of tissue hypoperfusion (2). The functioning of the patent ductus arteriosus PDA in premature infants exacerbates hypoperfusion, especially hemodynamically significant patent ductus arteriosus (HsPDA), leading to complications (3). One of the methods of diagnosing disorders of hemodynamics of organ blood flow is Doppler ultrasound test(4,5). The question of what indicators are the most indicative in the diagnosis of signs of AKI (6).

Main text.

Were examined 40 premature infants with a gestational age of 29-36 weeks with HsPDA. All children on the first, third and tenth day of life underwent Doppler ultrasound test of the kidneys to determine blood flow in the renal arteries (Main Renal Artery and Interlobar Artery) to determine the maximum systolic blood flow velocity (Vs), the minimum diastolic blood flow velocity (Vd) and Resistance Index (RI) according to standard methods. Diagnosis and stratification of the severity of AKI was performed according to the criteria of neonatal modification of KDIGO (7).

Inclusion criteria: premature infants at 29-36 weeks of gestation with HsPDA, signed informed parental consent to participate in the study.

Exclusion criteria: congenital malformations, intracerebral, intraventricular hemorrhage III-IV degree, neonatal sepsis, severe asphyxia in childbirth, skin diseases, intrauterine growth retardation.

Gestational age averaged 32.9 ± 0.22 weeks. Low birth weight 1501-2400 g was observed in half of children in both groups, very low birth weight <1500 g - in every sixth child. Children were divided into 2 groups in the presence of AKI. Group I (n =



17) did not have acute kidney injurious, group II (n = 23) had acute kidney injurious. Six children dropped out of the study due to the development of exclusion criteria. Children in the groups were representative in the Apgar score, the main diagnosis.

Analyzing the state of blood flow in the kidneys in children with HsPDA depending on the development of AKI we can observe statistically significant changes from the first to the tenth day (table 1)

Table 1

Indicators of blood flow in the kidneys depending on the AKI

Indicators	day	AKI - , n=17 (17)	AKI + n=23 (17)	p<
Interlobar Artery				
Maximum systolic blood flow rate, cm / sec	I	18,48±3,014 (18,6; 16,35-20,9)	11,10±3,329 (11,3; 7,71-12)	0,001
	III	19,12±4,730 (21; 16-22,5)	15,57±4,541 (16; 12-18) ***	0,02
	X	22,71±5,882 (24; 18,5-25,5) **^^	20,82±5,812 (20; 17,5-23,5) ***^^	ns
Minimum blood flow rate in diastole, cm / sec	I	6,16±2,447 (5,6; 4,75-7,7)	2,83±2,063 (2,2; 1,1-4,15)	0,001
	III	5,83±1,919 (6; 4,5-7)	3,48±1,532 (3,1; 2-5)	0,001
	X	6,71±3,405 (5; 4,5-8,5)	4,65±2,644 (4; 2,5-6,5) ** ^	ns
RI	I	0,666±0,1216 (0,67; 0,6-0,74)	0,758±0,137 (0,8; 0,65-0,83)	0,02
	III	0,693±0,0869 (0,7; 0,63-0,72)	0,76±0,1588 (0,82; 0,69-0,86)	0,03
	X	0,715±0,0937 (0,72; 0,67-0,8)	0,776±0,1127 (0,8; 0,69-0,87)	ns
Main Renal Artery				
Maximum systolic blood flow rate, cm / sec	I	25,4±6,17 (24; 22-27,5)	20,6±5,87 (22; 16-23)	0,02
	III	28,6±5,32 (29; 23-33) *	26,7±6,60 (28; 22-32) ***	ns
	X	30,2±5,57 (30; 26-35) ***	30,5±4,85 (32; 25-34) ***^^	ns
Minimum blood flow rate in diastole, cm / sec	I	6,6±3,08 (6; 4,5-9)	5,2±3,10 (4; 2-8)	ns
	III	7,9±3,17 (7; 5,5-9)	7,1±3,95 (6; 4-11) *	ns
	X	8,8±2,77 (9; 6,5-11) *	6,9±2,03 (7; 5,5-8) *	0,04
RI	I	0,741±0,0921 (0,74; 0,66-0,8)	0,752±0,1256 (0,79; 0,68-0,86)	ns
	III	0,725±0,0789 (0,73; 0,68-0,8)	0,723±0,1516 (0,78; 0,61-0,86)	ns
	X	0,707±0,0877 (0,7; 0,66-0,77)	0,772±0,0636 (0,78; 0,72-0,82)	0,02

Notes:

1. The sample size for the 10th day is given in parentheses.
2. When comparing independent samples, the Mann-Whitney test was used ("ns" - no significant discrepancy was observed).

*, **, *** – significant difference from the level of the 1st day;

^, ^^, ^^ – of the 3 day, relatively $p < 0,05$, $p < 0,01$ i $p < 0,001$ by the criterion of sign ranks of Wilcoxon.

The most significant changes in Vs, Vd and RI in children with AKI were in the Interlobar Artery. Moreover, the difference Vs in children with AKI and without AKI from the first day was 39% ($p < 0.001$), remained on the third day -17% ($p = 0.02$). Vd was statistically different on the first and third days - almost twice as high in children without AKI ($p < 0.001$), and 40% higher on the third day ($p < 0.001$). RI of vessels at children with AKI was above norm on the first and third days.

In the Main Renal Artery on the first day, Vs in children without AKI was 25% higher ($p = 0.02$) than in children with AKI, and Vd was lower by 27% ($p = 0.04$) on the tenth day. RI in children with AKI was above normal on the first and third days, while in children without AKI it was within normal limits for the first three days and was significantly lower by 10 days.

Summary and conclusions.

1. Decreased maximal systolic blood flow rate, minimum diastolic blood flow rate in the Interlobar Artery, and increased RI in the first three days of life are predictors of the development of AKI in premature infants with HsPDA.

2. In the Main Renal Artery decrease in the minimum rate of diastolic blood flow on the tenth day may indicate the possibility of developing AKI in premature infants with HsPDA.

3. Children with HsPDA and a decrease in blood flow in the kidneys in the first day of life should be assigned to the group at risk of developing AKI.

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