Prevalence and risk factors of acute kidney injury after cardiac surgery in newborns

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Introduction:

Acute Kidney Injury (AKI) is a frequent complication of cardiac surgery. Its incidence is associated to higher morbidity and mortality. Many factors contribute to AKI, such as hemolysis, use of Cardio-Pulmonary Bypass (CPB), low-cardiac-output states, and hypotension. While many studies focused on adult and pediatric populations, there is a paucity of data describing newborns undergoing cardiac surgery.

Methods:

Retrospective study including newborns consecutively admitted to our ICU following cardiac surgery between 2016 and 2018. Clinical and biochemical variables were collected pre-operatively, intra-operatively, and post-operatively, until hospital discharge. Every patient has been monitored intra-operatively with cerebral and somatic Near Infrared Spectroscopy (NIRS). The somatic sensor was located on the back of the newborn, at the T10-T12 level, for renal oximetry. Postoperative AKI was defined according to pRIFLE criteria in the first 48-hours after surgery. Differences between groups were assessed by Mann-Whitney test or Fishers' exact test as appropriate. Risk factors for AKI were evaluated by multiple regression analysis.

Results:

Among 43 patients enrolled, 15 (35%) developed AKI. Table 1 shows patient charateristics, Table 2 comparisons between AKI and non-AKI group. RHACS-1 score, use of CPB, lowest intraoperative hematocrit, maximal intraoperative lactate level, minimal intraoperative NIRS value and maximal intraoperative Vasoactive-Inotropic Score (VIS) were included in multiple regression analysis. The use of CPB (OR 712; p=.01), somatic NIRS (every 10 points OR 0.28; P=.012) and hematocrit (every 10 points OR 0.005; p=.037) were identified as independent risk factors.

Discussion:

Similarly to what previously reported in adult and pediatric cohorts, the use of CPB is a strong risk factor. Moreover, anemia and kidney hypoperfusion, estimated by somatic NIRS, might further promote AKI incidence. Additional studies are needed in order to clarify the whether specific intraoperative strategies aiming at reducing the risk for AKI might be implemented in newborns undergoing cardiac surgery.

Table 1. Preoperative and intraoperative characteristics of patients

Characteristics	**Patients n = 43**
Preoperative data	
Age (days)	11 [2-30]
Males (n)	29 (67.4)
Weight (kg)	3 [2.7-3.5]
Cyanogenic heart disease (n)	34 (79.1)
Preoperative prostaglandins (n)	29 (64.7)
Nephrotoxic drugs (n)	13 (30.2)
RACHS> = 3 (n)	22 (51.2)
Pathology (n) - Aortic coarctation - Transposition of large vessels - Patent ductus arteriosus - Other	 13 (30.2) 12 (27.9) 4 (9.3) 14 (32.5)
SCr (mg/dL)	0.52 [0.36-0.75]
Intraoperative data	
Cardiopulmonary by-pass (n)	22 (51.2)
Postoperative open chest (n)	13 (30.2)
Ultrafiltration (n)	22 (51.2)
Modified Ultrafiltration (MUF) (n)	18 (41.9)
Cardiopulmonary by-pass time (min)	165.4 [133-190]
Minimum hemoglobin (g/dL)	10.4 [9.7-10.9]
Maximum lactates (mmol/dL)	3.5 [2.2-5.4]
Minimum T ° (°)	33 [28-35]
Somatic near-infrared spectroscopy (NIRS)	51 [41-61]
Cerebral NIRS	56 [43-60]
Intraoperative vasoactive inotropic score (VIS)	9 [2-12]

Data are shown with units + percentage (%) or median + [interquartile ranges]

Table 2. Comparison of intraoperative features between infants with and without acute renal failure (AKI)

Features	**AKI (n = 15)**	**NO AKI (n = 28)**	**p value**
Cardiopulmonary by-pass (n)	13 (86.6)	9 (32.1)	0.001
Cardiopulmonary by-pass time (min)	164 [120-199]	181 [151-190]	0.738
Ultrafiltration (n)	13 (86.6)	9 (32.1)	0.001
Modified Ultrafiltration (MUF) (n)	10 (66.6)	8 (28.5)	0,027
Intraoperative vasoactive inotropic score (VIS)	12 [10-14.5]	5 [0-10.5]	0.001
Lower hemoglobin (g/dL)	10 [9,5-10,7]	11.1 [9.8-10.3]	0,046
Lower hematocrit (%)	29 [28-31.5]	33 [29-35.5]	0.081
Higest lactates (mmol/dL)	5.18 [3.9-6.1]	2.45 [1.82-4.76]	0.003
Somatic near-infrared spectroscopy (NIRS)	47 [34-57]	54 [45-65]	0,184
Lower T ° (°)	28 [28-31.5]	34 [30-35]	0,007
Postoperative open chest (n)	7 (46.6)	6 (21.4)	0,163

Data are shown with units + percentage (%) or median + [interquartile ranges]