

Acute Kidney Injury in Children after Open Heart Surgery is Associated with Positive Fluid Balance

*Jekabs Krastins*¹, *Karina Mahlina*², *Dagne Gravele*³,
*Aigars Petersons*⁴, *Aivars Petersons*⁵

¹ *Children's Clinical University Hospital,*

Clinic of Anesthesiology and Intensive Care, Latvia

² *Rīga Stradiņš University, Department of Paediatrics, Latvia*

³ *Children's Clinical University Hospital, Clinical and Biochemical Laboratory, Latvia*

⁴ *Rīga Stradiņš University, Department of Paediatric Surgery, Latvia*

⁵ *Rīga Stradiņš University, Department of Internal Diseases, Centre of Nephrology, Latvia*

Introduction. Cardiac surgery with cardiopulmonary bypass (CPB) is commonly perceived as a risk factor for decline in renal function. Hypothermia, hypoxia, hypotension, non-pulsatile blood flow during CPB affects kidney and contributes to the acute kidney injury (AKI). In kidney and in heart dysfunction, positive fluid balance is generally regarded as an important clinical condition. Paediatric and adult studies have demonstrated the detrimental effect of an excessive positive fluid balance (FB) on a variety of disease outcomes. Fluid overload exerts greater venous pressure on the kidney, reducing kidney perfusion and glomerular filtration. Positive FB is a common occurrence in the early postoperative period in paediatric cardiac surgery patients. Low cardiac output syndrome (LCOS), systemic inflammation, release of antidiuretic hormone and AKI all lead to fluid accumulation. However, fluid overload often remains symptomless for several days until clinical symptoms set in and treatment is usually initiated.

Aim. The goal of this study is to evaluate early postoperative FB in children undergoing open heart surgery and to establish the impact of fluid overload on kidney function and outcome.

Material and Methods. Postoperative fluid balance in 84 paediatric patients, undergoing open heart surgery at the Children's Clinical University Hospital during 2011–2014 years was retrospectively analyzed. There were 47 boys and 37 girls with median body weight of 7.8 kg and median age of 10 months (range from 2 weeks to 14 years). Fluid balance data were entered automatically from the infusion pumps or automated syringes either manually into the IntellyView Clinical Information System (Philips). Data were retrieved from the electronic data sheets for further calculations. Fluid balance (ml/kg) during the first postoperative day was calculated according to the formula: Fluid input (ml) - fluid output/admission weight (kg). Serum Creatinine (SCr) was determined by Jaffé's method (Cobas 6000 analyzer, Roche) at 12-hour intervals during the first 48 postoperative hours. Urine output, body temperature, duration of aortic cross clamping and CPB time, duration of mechanical ventilation and lengths of stay in the hospital (LOS) also were recorded. Patients were scored according to the risk assessment for congenital heart surgery (RACHS-1) score. Doses of diuretics administered postoperatively and vasoactive inotropic score (VIS) was calculated, too.

Results. Median intra-operative urine output was 2.32 ml/kg/h (range from 0.42 < 5.87 ml/kg/h). Median CPB time was 163 min, median aortic cross-clamping time was 97.9 min, cooling during CPB to 29.5°C. 29 patients (29.5%) developed AKI by meeting at least KDIGO stage 1 criteria (SCr rise of 50% or ≥ 26.5 mmol/l). Median FB in AKI group was 45.22 ml/kg (range - 63 < 229.1 ml/kg) versus 10 ml/kg in no-AKI group, ($p = 0.0002$). In two patients (2.3%) severe AKI developed with fluid overload, requiring peritoneal dialysis.

Conclusion. Early postoperative FB can be used as a biomarker for a rapid detection of patients at risk for the development of AKI. Maximum expression of SCr was delayed by 48 hours after CPB in our patients.