



ORIGINAL ARTICLE

Acute kidney injury after pediatric cardiac surgery: Risk factors and outcomes. Proposal for a predictive model[☆]



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Received 13 April 2015; accepted 25 June 2015

Available online 16 February 2016

KEYWORDS

Acute kidney injury;
Cardiac surgery;
Congenital heart
disease

Abstract

Objectives: To characterize the epidemiology and risk factors for acute kidney injury (AKI) after pediatric cardiac surgery in our center, to determine its association with poor short-term outcomes, and to develop a logistic regression model that will predict the risk of AKI for the study population.

Methods: This single-center, retrospective study included consecutive pediatric patients with congenital heart disease who underwent cardiac surgery between January 2010 and December 2012. Exclusion criteria were a history of renal disease, dialysis or renal transplantation.

Results: Of the 325 patients included, median age three years (1 day–18 years), AKI occurred in 40 (12.3%) on the first postoperative day. Overall mortality was 13 (4%), nine of whom were in the AKI group. AKI was significantly associated with length of intensive care unit stay, length of mechanical ventilation and in-hospital death ($p < 0.01$). Patients' age and postoperative serum creatinine, blood urea nitrogen and lactate levels were included in the logistic regression model as predictor variables. The model accurately predicted AKI in this population, with a maximum combined sensitivity of 82.1% and specificity of 75.4%.

Conclusions: AKI is common and is associated with poor short-term outcomes in this setting. Younger age and higher postoperative serum creatinine, blood urea nitrogen and lactate levels were powerful predictors of renal injury in this population. The proposed model could be a useful tool for risk stratification of these patients.

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[☆] Please cite this article as: Cardoso B, Laranjo S, Gomes I, Freitas I, Trigo C, Fragata I, et al. Insuficiência renal aguda no contexto de cirurgia cardíaca pediátrica: fatores de risco e prognóstico. Proposta de um modelo preditivo. Rev Port Cardiol. 2016;35:99–104.

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PALAVRAS-CHAVE

Insuficiência renal aguda;
Cirurgia cardíaca;
Cardiopatias congênitas

Insuficiência renal aguda no contexto de cirurgia cardíaca pediátrica: fatores de risco e prognóstico. Proposta de um modelo preditivo**Resumo**

Introdução e objetivos: Caracterizar, no nosso centro, a epidemiologia, fatores de risco e impacto prognóstico da insuficiência renal aguda no pós-operatório cardíaco. Desenvolver um modelo de regressão logística para estimativa do risco de insuficiência renal aguda na população em estudo.

Métodos: Estudo retrospectivo e monocêntrico em que foram incluídos doentes pediátricos consecutivos com cardiopatia congênita, submetidos a cirurgia cardíaca entre janeiro de 2010 e dezembro de 2012. Foram excluídos aqueles com doença renal prévia, história de diálise ou transplantação renal.

Resultados: Foram incluídos 325 doentes, idade mediana = 3 anos (um dia; 18 anos). Quarenta (12,3%) doentes desenvolveram insuficiência renal aguda no primeiro dia após a cirurgia. Nove (69%) dos 13 doentes falecidos no pós-operatório integravam o grupo com insuficiência renal. A ocorrência de insuficiência renal aguda condicionou um aumento do tempo de internamento na unidade de cuidados intensivos, da duração da ventilação mecânica invasiva e da mortalidade intra-hospitalar ($p < 0,01$). Foi construído um modelo de regressão logística (variável dependente: insuficiência renal aguda pós-operatória, variáveis preditoras: idade e valores séricos de creatinina, ureia e lactatos registados no primeiro dia de pós-operatório). O modelo previu de forma significativa a ocorrência de insuficiência renal aguda pós-operatória nesta população, com uma sensibilidade e especificidade máximas combinadas de 82,1 e 75,4%.

Conclusões: No pós-operatório cardíaco a insuficiência renal é comum e determina um mau prognóstico. A idade mais jovem e a elevação precoce da creatinina, ureia e lactatos séricos foram preditores robustos da ocorrência de insuficiência renal nesta população, permitindo a construção de um modelo analítico objetivo que poderá ser útil na estratificação de risco nestes doentes.

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Introduction

Congenital heart disease (CHD) is the most common congenital abnormality and occurs in around 0.8% of live births. Around half of cases will require surgical repair, and some of these may present in critical condition, particularly in the neonatal period.¹

Acute kidney injury (AKI) is common after pediatric cardiac surgery, with an estimated prevalence of 5%–33%.² It is associated with significant morbidity and mortality of 20%–79%, depending on the definition of AKI.² The pathogenesis of AKI in this context is unknown; it is probably caused by multiple factors including low cardiac output, hypoxemia, inflammation and use of nephrotoxic drugs.³ Retrospective studies suggest that AKI associated with cardiac surgery may affect not only short-term outcomes but also the risk of developing chronic renal failure.⁴ A thorough understanding of its pathophysiology and associated risk factors is therefore necessary to reduce the incidence of AKI in these patients.

The aims of this study were to characterize the epidemiology and risk factors for AKI after pediatric cardiac surgery in our center and to determine its impact on length of mechanical ventilation, length of intensive care unit (ICU) stay and in-hospital mortality.

We also set out to develop a logistic regression model that will predict the risk of AKI in a consistent and

objective manner, based on easily obtained clinical and laboratory parameters.

Methods**Study design and patient selection**

This was a single-center, retrospective, observational study based on data collected from the medical records of consecutive pediatric patients who underwent cardiac surgery in our center between January 2010 and December 2012.

All patients with CHD aged <18 years were included, except those with a history of renal disease, dialysis or renal transplantation.

Clinical and laboratory variables

Preoperative variables were age at time of surgery, gender, weight, height, type of CHD (classified as cyanotic or acyanotic), and serum creatinine and blood urea nitrogen on preoperative laboratory testing.

Intraoperative variables were cardiopulmonary bypass time, aortic cross-clamp time and circulatory arrest time. The Aristotle score was used to classify the complexity of the procedures on a scale of 1 to 4.⁵

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