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Predicting cardiac surgery–associated acute kidney injury: The CRATE score

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ABSTRACT

Purpose: Acute kidney injury (AKI) is a frequent complication after cardiac surgery and is associated with increased mortality. The aim was to design a nondialytic AKI score in patients with previously normal renal function undergoing cardiac surgery.
Methods: Data were collected on 909 patients who underwent cardiac surgery with cardiopulmonary bypass between 2012 and 2014. A total of 810 patients fulfilled the inclusion criteria. Patients were classified as having AKI based on the RIFLE criteria. Postoperative AKI occurred in 137 patients (16.9%). Several parameters were recorded preoperatively, intraoperatively, and at intensive care unit admission, looking for a univariate and multivariate association with AKI risk. A second data set of 741 patients, from 2 different hospitals, was recorded as a validation cohort.
Results: Four independent risk factors were included in the CRATE score: creatinine (odds ratio [OR], 9.66; 95% confidence interval [CI], 4.77-19.56; $P < .001$), EuroSCORE (OR, 1.40; CI, 1.29-1.52; $P < .001$), lactate (OR, 1.03; CI, 1.01-1.04; $P < .001$), and cardiopulmonary bypass time (OR, 1.01; CI, 1.01-1.02; $P < .001$). The accuracy of the model was good, with an area under the curve of 0.89 (CI, 0.85-0.92). The CRATE score retained good discrimination in validation cohort, with an area under the curve of 0.81 (95% CI, 0.78-0.85).
Conclusions: CRATE score is an accurate and easy to calculate risk score that uses affordable and widely available variables in the routine care surgical patients.

1. Introduction

Acute kidney injury (AKI) is a frequent and severe complication after cardiac surgery, being this kind of surgery the second most common cause of AKI in the intensive care unit (ICU) [1]. In this context and depending on the definition used, AKI could affect up to 39% of patients undergoing cardiac surgery procedures, with 1% to 5% needing renal replacement therapy (RRT) [2]. Patients developing AKI have increased morbidity and worse surviving rates than those with normal renal function. In addition, it increases ICU and inhospital stay, risk of infection, and hospitalization cost [3]. Therefore, AKI is an important complication closely related to cardiac surgery using cardiopulmonary bypass (CPB). This particular relation gave rise to the appearance of the term *cardiac surgery–associated acute kidney injury* (CSA-AKI) [4].

Risk stratification has become essential in cardiac surgical practice, specifically focused in mortality (ie, EuroSCORE and ACEF score) [5]. Because of the implications of CSA-AKI in outcome, this clinical entity has been targeted in risk stratification models. Previously, some authors have developed several algorithms trying to predict renal failure not requiring dialysis [6]. The Multicenter Study of Perioperative Ischemia Research Group (MCSPI) model proposed by Aronson et al [7] included patients who underwent coronary artery bypass grafting (CABG) surgery, evaluating preoperative and intraoperative variables. Brown et al [8] produced an algorithm, the Northern New England Cardiovascular Disease Study Group (NNECDSG) score, with preoperative characteristics that included patients scheduled for CABG. None of these models take into account the early postoperative period, which is considered by some authors as the best time to apply a cardiac surgery–specific score because of the influence of intraoperative variables in the clinical course of these patients [9]. Therefore, it would be necessary to use a clinical tool estimating the risk by using preoperative, intraoperative, and postoperative variables. Palomba et al [9] followed up 603 patients

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