

Case Report

Renal Resistivity Index as a Guide for Treatment of Severe Postoperative Renal Failure in Cardiac Surgery: A Case Report

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Abstract

We report a case of postoperative renal failure in a patient submitted to cardiac surgery operation. Usually we adopt the renal resistivity index as a guide for the treatment, particularly about the titration of vasoactive drugs. We consider that renal resistivity index may be a simple and safe support for therapy-guiding in this kind of patients.

Introduction

The renal resistive index (RRI) is an echo-Doppler detectable parameter that measures the resistance of renal arterial blood flow. In a normal situation, the renal artery's blood flow occurs throughout systole and diastole. On the contrary, in case of several pathological conditions (shock, systemic inflammation, obstruction, etc.), arterial renal flow is reduced and even reversed during diastole. When it happens, the resistive index is expected to be elevated [1,2].

Increasing evidence of a direct correlation between RRI and cardiovascular damage is more and more confirmed. Renal resistivity index seems to be an excellent indicator of prognosis in patients with severe hypertension [2,3]. Furthermore, RRI was used as a monitoring parameter in critical patients. Recently Bossard et al. [4] studied the risk of renal failure after cardiac surgery. Authors calculated the renal resistivity index at admittance in intensive care unit. They found that renal resistivity index was higher in patients who developed kidney failure. In addition the resistivity index correlates well with the severity of kidney damage [4].

Starting from these backgrounds we used RRI to titrate therapy of a critical postoperative patient who experienced severe acute renal failure, aiming to verify whether reducing RRI below 0.7 might correspond to normal kidney function restoring.

Case Report

A 67 years old male patient underwent coronary artery surgery with cardiopulmonary bypass. Three coronary bypass were carried out: on left anterior descendent coronary artery (LAD) with the left internal mammary artery (LIMA), on circumflex coronary artery (CxA) and right coronary arteries (RCA) with saphenous vein.

Patient clinical history included arterial hypertention (treated with ACE inhibitors and beta-blockers), without any other comorbidities. Preoperative renal function was normal (serum creatinine 0.9 mg/ dl, creatinine clearance 80 ml/min). The immediate postoperative period was characterized by vasoplegia that required the use of Norepinephrine (0.2 mcg/kg/min) and Dopamine (3 mcg/kg/min) to obtain a stable hemodynamic setting, with plasmatic lactate level never more than 1.5 mEq/L. Eight hours after the operation, blood sample test showed a severe increase of serum creatinine (1.9 mg/dl) with important reduction of creatinine's clearance ($C_{\rm lcr}$ 25 ml/min). In order to obtain a better hemodynamic monitoring, a pulmonary artery catheter (PAC) was inserted: cardiac index (CI) and mean arterial pressure (MAP) were maintained around 2.2-2.4 l/min/m² and 65-75 mmHg respectively. Six hours later serum creatinine showed a further

deterioration up to 3.9 mg/dl (C_{lcr} 19 ml/min), outlining a situation of renal failure type RIFLE-F [5].

In the meantime diuresis decreased to <0.5 ml/kg/h, and Furosemide administration started at 0.3 mg/kg/h. During the following hours diuresis decreased up to the oligoanuria condition. After 12 hours from the onset of renal failure the determination of renal resistive index (RRI) was performed. The first determination showed a value of 0.9. Since the critical assessment we decided to take RRI as reference to titrate the therapy of renal failure trying to reduce it approximately around 0.7. Dopamine infusion was immediately stopped and was replaced with infusion of Fenoldopam 0.1 mcg/Kg/min. After 30 min of Fenoldopam administration RRI resulted 0.8.

In order to further reduce the value of renal resistive index, Fenoldopam infusion was increased to 0.2 mcg/Kg/min; also Norepinephrine infusion was increased aiming to maintain MAP at least 65 mmHg. Renal resistive index was measured after 1 hour, and it was 0.77. Since our goal was to achieve a renal resistive index of 0.7, we decided to make CI increase to 2.8-3.0 l/min/m² by Enoximone administration at 2.5 mcg/kg/min. All these therapeutic maneuvers have led to obtain a renal resistive index of 0.72. Ten hours later, diuresis normalized up to 1 ml/kg/h. During the following days of ICU staying, RRI resulted always around 0.7, and serum creatinine lowered to normal values (1.2 mg/dl). Enoximone and Fenoldopam were stopped after 3 and 7 days of treatment respectively. Renal function back to normal assessment at 8th postoperative day (Figure 1). Patient returned to ward from ICU after 9 postoperative days and the follow up was uneventful until his discharging form hospital.

Discussion

The incidence of cardiopulmonary bypass-associated acute kidney injury is 20-30% with a high risk of poor outcome. It is a very important issue in patients underwent on-pump cardiac surgery [6].

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Consequently it is mandatory a close monitoring of such critical patients, perioperatively, aiming to prevent or early treat renal failure when it occurs.

During the last decade several trials were published about Renal resistive index (RRI) as a predictive factor of the outcome in critically ill patients.

Ngai et al. [7] reported that RRI is a good predictor of Acute renal failure (ARF) in septic patients needing ICU admission (sensitivity 1; specificity 0.9) [7]. In addition to serum creatinine, other markers of ARF showed to be precocious indicators of kidney injury: Neutrophil gelatinase-associated lipocalin (N-GAL) and plasmatic Cystatin-C permit the estimation of glomerular function in the early phase of renal impairment [8-10]. But their test requires a blood sample and time wasting due to laboratory elaboration. On the contrary, echodoppler RRI measurement can be performed bed-side, immediately and inexpensively; it is a simple not-invasive procedure and it can be repeated as requested during treatment.

Bossard et al. [4] showed that RRI was able to predict acute renal failure in patients submitted to on-pump cardiac surgery: Authors found that 0.74 might be the cut-off value of RRI that could predict acute renal failure [4].

We did not use RRI in the management of ARF prevention, but based on published data we decided to employ RRI to guide the treatment of acute kidney injury, assuming that ≤ 0.7 might indicate sufficient renal perfusion.

Lauschke et al. [11] showed that "renal dosage" of Dopamine can increase RRI in postoperative renal failure [11]. Since Dopamine may exert constrictive effects on renal circulation, to avoid this risk we decide to administer Fenoldopam as it is a DA1-receptors specific stimulating drug.

We consider that RRI measurement is a very simply, safe and notinvasive method to identify acute kidney injury early; furthermore, it may be a very good index to titrate the treatment of postoperative acute renal failure.

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