Institutional report - Valves

Effect of preoperative mild renal dysfunction on mortality and morbidity following valve cardiac surgery

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Abstract

The objective of this study was to investigate the effect of preoperative mild renal dysfunction (RD) not requiring dialysis on mortality and morbidity after valve cardiac surgery (VCS). We studied 681 consecutive patients (2002–2006) who underwent valve cardiac surgery with or without coronary artery bypass graft (CABG). Preoperative RD was calculated with the abbreviated Modification of Diet in Renal Disease formula and was defined as a glomerular filtration rate < 60 ml/min/1.73 m². Logistic regression analysis was used to assess the effect of preoperative renal dysfunction on operative and adverse outcomes. Two hundred and seven patients (30%) had preoperative mild RD. Patients with preoperative RD were older, had a higher rate of preoperative anaemia (43% vs. 25%, P < 0.001) and more comorbidities. Patients with preoperative RD had worse outcomes with more reoperation (6.8% vs. 2.3%, P < 0.001). Preoperative RD was significantly and independently associated with more red blood cell transfusions and longer hospital stay (median 9 vs. 8 days, P < 0.001). Mortality was similar in both groups (3.4% vs. 2.3%, P = 0.43). Preoperative mild renal dysfunction in patients undergoing cardiac valve surgery is an independent marker of postoperative morbidity.

Keywords: Valve cardiac surgery; Preoperative renal dysfunction; Mortality; Morbidity

1. Introduction

Preoperative renal dysfunction (RD) not requiring dialysis is a recognised risk factor for postoperative morbidity and mortality after CABG [1–5]. Outcome research in valve cardiac surgery has been widely studied [6, 7] but the impact of preoperative RD on valve replacement outcome is not well known. In one study [8], mild RD was independently associated with adverse outcome but most of the patients were men. The association between preoperative mild RD and adverse effects after cardiac surgery was stronger when renal function was analysed by estimated glomerular filtration rate [9] using serum creatinine-based prediction equations than by serum creatinine level.

Preoperative anaemia has been associated with a higher in-hospital mortality and morbidity after elective valve replacement [10]. An interaction exists between chronic kidney disease (CKD) and anaemia that worsens outcome in congestive heart failure [11], conditions that are also frequently present in cardiac surgery patients and might increase risk after surgery.

The aim of our study was to investigate whether preoperative renal dysfunction is a risk marker for mortality and morbidity in patients who underwent valve cardiac surgery. A secondary objective was to examine the relationship between preoperative RD and anaemia with outcomes in valve cardiac surgery.

2. Methods

2.1. Data

We studied 681 consecutive patients undergoing cardiac valve surgery (both repair and replacement) with or without combined CABG between November 2002 and December 2006. Patients with chronic dialysis were excluded. The study is based on data collected from routine care, thus individual consent was waived. Our database was initiated in November 2002 coinciding with the implementation of cardiac surgery in the public university Son Dureta hospital, a teaching and referral centre of Balearic Isles for providing assistance to a population of 1,000,000 habitants. The database was designed to prospectively collect data of all patients undergoing cardiac surgery. It contains detailed information of demographic data, risk factors, clinical preoperative characteristics, operative description including location and category of operated valve, postoperative complications, operative mortality and postoperative length of hospitalisation.

2.2. Surgical and postoperative aspects

All the patients underwent cardiac surgery through medium sternotomy and standard cardiopulmonary bypass. They
were operated on under passive moderate hypothermia and myocardial protection was accomplished with antegrade or antegrade-retrograde crystalloid cold cardioplegia. Antibiotic prophylaxis with first-generation cephalosporins was begun just before the onset of surgical intervention and discontinued after 24 h in the ICU. Patients were transferred to the ICU mechanically ventilated and sedated. During the postoperative period, patients were treated at the ICU following the same standard care. Exubation was done in awake and stable patients according to well-established criteria. Criteria for transfusion of red blood cells (RBC) depended ultimately on the physician in charge of the patient but we transfused when the haemoglobin was lower than 8 g/dl, lower than 10 g/dl in patients with myocardial or cerebral dysfunction and during severe active bleeding. From the second postoperative day, patients were transferred to the cardiac surgery ward, considering that they did not need intensive care treatment.

2.3. Data definition

Preoperative risk factors such as age, gender, weight, body mass index, habit of smoking, hypertension, diabetes, anaemia (Hb level <12 g/dl) were included. Associated comorbidities such as chronic obstructive pulmonary disease (COPD), peripheral vascular disease, stroke, left ventricular dysfunction (ejection fraction <30%), atrial fibrillation, previous cardiac surgery, angina, myocardial infarction were included. Global preoperative risk was calculated by logistic and additive EuroSCORE.

2.4. Renal function

Preoperative serum creatinine (Cr) was determined in all patients within two days of cardiac surgery. Estimated glomerular filtration rate (GFR) was calculated following the abbreviated Modification of Diet in Renal Disease (MDRD) formula [12]:

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GFR = \frac{186.3 \times \text{(serum creatinine)}^{-1.154} \times \text{(age)}^{0.203}}{1.212 \times \text{(if black)} \times 0.742 \times \text{(if female)}}.
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Serum creatinine is measured in mg/dl, age in years and GFR is expressed in ml/min per 1.73 m². Preoperative renal dysfunction was defined as an estimated GFR value <60 ml/min/1.73 m². Postoperative renal dysfunction was defined [13] as a postoperative increase in serum creatinine level >25% from preoperative baseline value or an increase >0.5 mg/dl. Percent change in serum creatinine (% ΔCr) was calculated by: \((\text{highest postoperative Cr} - \text{preoperative Cr}) \div \text{preoperative Cr}\) × 100. We recorded the requirements for renal replacement therapy (RRT) during hospitalisation.

2.5. Outcome

The primary outcomes of this study were mortality and hospital morbidity. Mortality was defined as death occurring during hospital stay or within 30 days after hospital discharge. Hospital morbidity was defined as mechanical ventilatory support for 24 h, postoperative renal, cardiac, neurological, pulmonary, gastrointestinal and vascular complications. Major adverse cardiac events were defined as cardiac arrest or cardiogenic shock. Postoperative atrial arrhythmia was defined as the occurrence of a new atrial arrhythmia in the absence of preoperative arrhythmias. Perioperative acute myocardial infarction was defined as the presence of typical acute ischemic ECG changes and or a CK-MB value greater than five times the upper limit of normality. We defined postoperative stroke by the presence of a new focal neurological deficit persisting for at least 24 h confirmed by CT-scan. Postoperative bleeding was defined as any bleeding that required surgical reoperation after initial departure from the operating theatre. Criteria for diagnosing mediastinitis and pneumonia were in accordance with the guidelines published by the Centres for Disease Control and Prevention.

The length of mechanical ventilation was the time that the patient needed ventilatory support after cardiac surgery from ICU admission to extubation. Postoperative hospital length of stay was the time that the patient remained in hospital since cardiac surgery to discharge and ICU length of stay was the time the patient spent in the ICU after cardiac surgery.

2.6. Statistical analysis

Continuous variables are presented as mean with standard deviation (S.D.) or median with interquartile range when appropriate. Categorical variables were expressed as real numbers and percentages. Categorical variables were analysed using Pearson x²-tests or Fisher’s exact tests. Continuous variables were evaluated using the Student’s t-test or the Mann-Whitney U-test if not normally distributed. Logistic regression analysis was used to examine the relationship between preoperative renal function and postoperative outcomes. Stepwise selection of variables with P≤0.05 in the univariate analysis was performed and variables were retained when P≤0.05. Statistical analyses were done with SPSS 11.0 (SPSS, Inc, Chicago, IL). A P-value <0.05 was considered statistically significant.

3. Results

3.1. Preoperative data

A total of 207 patients (30%) had preoperative renal dysfunction not requiring dialysis. Table 1 shows the distribution of comorbid risk factors across patients with and without preoperative RD. A total of 209 patients (31%) had preoperative anaemia and the incidence was significantly higher in patients with preoperative RD (43% vs. 25%, P<0.001). Creatinine levels were significantly higher in this group (1.5±0.5 vs. 0.89±0.2 mg/dl, P<0.001). The use of angiotensin converting enzyme (ACE) inhibitors was higher in patients with (52%) than in patients without RD (39%, P<0.001) and beta blockers (26%) and aspirin (27%) were used in a similar manner in both groups.

3.2. Preoperative data

Within this population (Table 2), 487 patients (71%) underwent VCS and 194 patients (29%) had combined CABG and
valvular surgery. A total of 19 (2.8%) patients were operated on for active endocarditis. Patients with preoperative RD had statistically significant increased use of vasoactive drugs during ECC and RBC transfusion.

3.3. Postoperative data

The 30-day mortality rate was 2.6% (CI 1.9%–3.8%) and there was no significant difference between both groups. Patients with preoperative RD had increased duration of mechanical ventilation, reintubation, hospital stay and reoperation for bleeding (Table 3). No differences were found in major cardiac events. Postoperative stroke was diagnosed in five patients (0.7%). Postoperative RRT was needed in six of the 678 patients (0.9%).

Of the 681 patients, 529 patients (77.6%) received RBC concentrates. Patients with preoperative anaemia received more RBC units (4.5 ± 3.7 vs. 2 ± 2.2, P < 0.0001). Preoperative anaemia was statistically associated with higher postoperative RD (41% vs. 25%, P < 0.001) but not with mortality (3.8% vs. 2.1%, P = 0.2).

Logistic regression analysis (Table 4) showed that after adjusting for age and preoperative anaemia, preoperative renal dysfunction was significantly and independently associated with longer hospital stay and more RBC transfusion.

4. Discussion

In this study, preoperative renal disease was common in patients undergoing cardiac valve surgery with or without combined CABG surgery. In addition, it was statistically associated with prolonged hospital stay and greater number of units of transfused red blood cells.

In our study, patients with preoperative renal dysfunction were older, had more comorbidities and preoperative anaemia. They received more units of transfused RBC and
needed more vasoactive support during ECC. EuroSCORE overestimated our observed mortality in both groups, a finding also demonstrated in recent studies of patients undergoing CABG surgery that estimation of GFR is associated with postoperative renal failure stronger than with serum creatinine [9]. Approximately one-third of our patients had an estimated GFR suggestive of mild chronic kidney disease, a similar incidence previously reported. Approximately 26% of our patients with preoperative serum creatinine lower than 1.2 mg/dl had a GFR < 60 ml/min/1.73 m², which represents occult renal dysfunction, a finding that supports that serum creatinine levels can be normal even when renal function is impaired.

Acute renal failure after cardiac surgery is a severe complication associated with a high mortality rate. The definition of ARF has varied widely and many methods have been used to characterise ARF, and we used a definition that was associated with hospital mortality after CABG [13]. Interestingly, we find the same incidence of postoperative renal dysfunction in both groups of patients and the incidence of postoperative RRT was lower than that reported by previous studies [9].

4.1. Limitations

Several limitations have to be considered when interpreting our results. These data were originated from a single centre. Further, in order to estimate preoperative risk after valve cardiac surgery our series seems relatively small to draw firm conclusions. The number of events in our study (death, ARF) is small and may limit the interpretation. The clinical relevance of the incorporation of an estimated GFR in the preoperative assessment of valve cardiac surgery seems small and introduces more complexity to the preoperative assessment process.

5. Conclusion

Patients undergoing valve cardiac surgery with preoperative mild renal dysfunction are at increased risk of postoperative morbidity. The association between preoperative RD and anaemia with mortality needs to be confirmed.

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References


