

Outcomes of On-Pump versus Off-Pump Coronary Artery Bypass Graft Surgery in the High Risk (AusSCORE > 5)



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Background

Coronary artery bypass graft surgery (CABG) has been established as the preferred intervention for coronary revascularisation in the high-risk population. Off-pump coronary artery bypass (OPCAB) may further reduce mortality and morbidity in this population subgroup. This study presents the largest series of high-risk (AusSCORE > 5) OPCAB patients in Australia and New Zealand.

Methods

We reviewed the Australian and New Zealand Society of Cardiac and Thoracic Surgeons' (ANZSCTS) database for high-risk patients (n=7822) undergoing isolated CABG surgery and compared the on-pump coronary artery bypass (ONCAB) (n=7277) with the OPCAB (n=545) technique. Preoperative and intraoperative risk factors, and postoperative outcomes were analysed. Survival analysis was performed after cross-matching the database with the national death registry to identify long-term mortality.

Results

The ONCAB and OPCAB groups had similar risk profiles based on the AusSCORE. Thirty-day mortality (ONCAB vs OPCAB 3.9% vs 2.4%, p=0.067) and stroke (ONCAB vs OPCAB 2.4% vs 1.3%, p=0.104) were similar between the two groups. OPCAB patients received fewer distal anastomoses than ONCAB patients (2.5±1.2 vs 3.3±1.0, p<0.001). The rates of new postoperative atrial arrhythmia (28.3% vs 33.3%, p=0.017) and blood transfusion requirements (52.1% vs 59.5%, p=0.001) were lower in the OPCAB group, while duration of ICU stay in hours (97.4±187.8 vs 70.2±152.8, p<0.001) was longer. There was a non-significant trend towards improved 10-year survival in OPCAB patients (74.7% vs. 71.7%, p=0.133).

Conclusions

In the high-risk population, CABG surgery has a low rate of mortality and morbidity suggesting that surgery is a safe option for coronary revascularisation. OPCAB reduces postoperative morbidity and is a safe procedure for 30-day mortality, stroke and long-term survival in high-risk patients.

Keywords

Coronary artery bypass graft • CABG • Elderly • High risk • Off-pump • On-pump

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Introduction

The recently concluded SYNTAX and FREEDOM trials have confirmed that coronary artery bypass graft surgery (CABG) is still the standard of care for patients with complex coronary disease and comorbidities like diabetes, peripheral vascular disease, left main disease, etc. [1,2] These patients are often termed as 'high-risk'. Cardiopulmonary bypass (CPB) and cardioplegic arrest have been the mainstays of CABG surgery for close to three decades. However, the association with systemic inflammation and multiorgan dysfunction [3,4] has led to some surgeons avoiding the use of CPB. The 'off-pump' approach (OPCAB) has been gaining momentum with 20.4% of all isolated CABG cases in US in 2007, being performed as OPCABs [5]. Off-pump coronary artery bypass has been shown to reduce mortality and morbidity, specifically stroke rates, transfusion requirements, atrial arrhythmia rates and renal dysfunction [6–9]. The paper by Puskas, et al. showed that the high-risk population benefits in terms of mortality from the OPCAB approach [5]. We wanted to see how the high-risk Australian population fared after undergoing an OPCAB surgery. We looked at real life registry data collected by the ANZSCTS database, and compared the 'on-pump' (ONCAB) and OPCAB approach in the high-risk population. High-risk status was determined by an additive AusSCORE greater than 5. The AusSCORE risk prediction model has shown greater accuracy at predicting operative mortality than the EuroSCORE in the Australian cohort [10].

Materials and Methods

Patient Selection

Patient data collected by the ANZSCTS database between January 2001 and January 2012 was included. A total of 7822 high-risk patients underwent isolated CABG within 19 public and six private hospitals in Australia. Of these, 93% had an ONCAB procedure and 7% an OPCAB procedure. End points included 30-day mortality and morbidity, one-year mortality and, five- and 10-year survival. Long term mortality was identified by cross-matching the ANZSCTS database with the Australian Institute of Health and Welfare's National Death Index. The date of survival follow-up used is 12 January 2012. The reported results place patients according to the surgery type they ultimately received and do not take into account conversions in either direction as this data is not collected by the ANZSCTS database.

Definition of Terms

Definitions of the preoperative risk factors and postoperative complications were made according to the Australian Society of Cardiac and Thoracic Surgeons Data Definitions Manual version 3.0 [11]. The data definitions that changed in 2008 from version 2 (2006) to version 3 were cardiogenic shock and urgent surgery. In version 2 cardiogenic shock was defined as, "a systolic blood pressure \leq 80 mmHg and/or a cardiac index \leq 1.8 despite maximal treatment, or IV inotropes

and/or IABP use necessary to maintain a systolic blood pressure $>$ 80 mmHg and/or a cardiac index $>$ 1.8". In version 3 cardiogenic shock was defined as "hypotension (a systolic blood pressure $<$ 90 mmHg) &/or a cardiac index $<$ 2.0 for at least 30 minutes, or the need for supportive measures to maintain a systolic pressure \geq 90 mmHg or a cardiac index $>$ 2.0". In version 2 urgent surgery was defined as, "not a routine medical reason for operating during that admission and did not include scheduling operation within that admission for convenience". In version 3 this definition changed to "not a routine medical reason for operating during admission either within 72 hours from angiography if on the same admission that angiography was performed (in this case, 'same admission' includes the situation when angiography is performed at another hospital and the patient is transferred directly to the hospital where surgery is to be performed), or within 72 hours after an unplanned admission (in a patient who had a previous angiogram and was scheduled for surgery but was admitted acutely)". Data definitions that differed between the ANZSCTS and STS databases have been listed in Table 1a.

Surgical Technique

The surgical technique selected (ONCAB or OPCAB) was based on individual surgeon preference and the preoperative and postoperative work up of patients was based on individual hospital protocols. The ONCAB technique generally involved aortic and right atrial cannulation and the application of an aortic cross clamp and intermittent cardioplegic solution for cardioplegic arrest. Proximal anastomoses to the aorta and distal coronary anastomoses were then performed in a relatively bloodless field.

The OPCAB technique differs by minimising aortic manipulation. This avoids aortic cannulation as well as the cross clamp and instead, uses a side-biting aortic clamp to perform proximal aortic anastomoses, or avoids the aorta altogether by the use of a composite or "T" graft based on internal mammary artery inflow approach. Distal anastomoses are then performed on the beating heart with or without the use of coronary stabilisation devices and/or intravascular shunts.

Statistical Analysis

Statistical analyses were performed using SPSS v20 [12]. Categorical data are presented as percentages and were analysed using the Chi square test or Fisher's exact test. Continuous data are presented as the mean and standard deviation. Continuous variables were analysed using the Mann-Whitney test.

Long term survival was estimated by Kaplan Meier curves and analysed with the log-rank test. Additionally, unadjusted and adjusted hazard ratios were calculated using the Cox proportional hazards model. A level of significance $\alpha < 0.05$ was considered significant.

Propensity matching was attempted but the two groups could not be matched due to the disparity in the types

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