

# Comparison of the Safety and Efficacy of On-Pump (ONCAB) versus Off-Pump (OPCAB) Coronary Artery Bypass Graft Surgery in the Elderly: A Review of the ANZSCTS Database



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## Background

The elderly population (age >70 years) incurs greater mortality and morbidity following CABG. Off-pump coronary artery bypass (OPCAB) may mitigate these outcomes. A retrospective analysis of the results of OPCAB in this population was performed.

## Methods

We reviewed the Australian and New Zealand Society of Cardiac and Thoracic Surgeons' (ANZSCTS) database for elderly patients (n=12697) undergoing isolated CABG surgery and compared the on-pump coronary artery bypass (ONCAB) (n=11676) with OPCAB (n=1021) technique. Preoperative and intraoperative risk factors, and postoperative outcomes were analysed. Survival analyses were performed after cross-matching the database with the national death registry to identify long-term mortality.

## Results

High-risk patients were more prevalent in the ONCAB group ( $p < 0.05$ ). OPCAB patients received fewer distal anastomoses than ONCAB patients ( $2.4 \pm 1.1$  vs  $3.3 \pm 1.0$ ,  $p < 0.001$ ). Thirty-day mortality and stroke rates between OPCAB and ONCAB were not significantly different (2% vs 2.5% and 1.1% vs 1.8%, respectively). There was a non-significant trend towards improved 10-year survival in OPCAB patients using multivariate analysis (78.8% vs. 73.3%,  $p = 0.076$ , HR 0.83; 95% CI 0.67-1.02).

## Conclusions

Mortality and stroke rates following CABG surgery are extremely low in the elderly suggesting that surgery is a safe management option for coronary artery disease in this population. OPCAB did not offer a

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significant advantage over ONCAB with regards to 30-day mortality, stroke and long-term survival. Further prospective randomised trials will be necessary to clarify risks or benefits in the elderly.

### Keywords

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

## Introduction

Australia's population, like that of most developed countries, is ageing, with increasing life expectancy. The median age has increased by 4.8 years over the last two decades [1]. According to the Australian Bureau of Statistics, the proportion of the population aged 65 years and over will increase from 14.4% in 2013 to 24% in 2056 [1]. The number of people undergoing coronary artery bypass graft (CABG) surgery older than 65 years has also increased [2].

Advanced age is associated with diminishing physiological reserve and increasing comorbid illnesses, including diabetes, chronic obstructive pulmonary disease, cerebrovascular disease, and peripheral vascular disease [3]. This results in increased rates of perioperative mortality and morbidity in the elderly (more than 70 years of age) population undergoing CABG surgery [4,5].

Nevertheless, recent registry studies have demonstrated that CABG is a safe and effective treatment in elderly patients and achieves long-term outcomes at least equivalent to age-adjusted populations. Moreover, trial data have demonstrated superiority to percutaneous coronary intervention (PCI) in many clinical settings [5–7].

In an effort to avoid morbidity, particularly stroke, and mortality that may be attributable to aortic manipulation, global myocardial ischaemia, and the systemic inflammatory response associated with cardiopulmonary bypass (CPB) used in conventional CABG surgery, some surgeons have embraced off-pump surgery (OPCAB) [8–11].

The ROOBY trial, however, showed better one-year composite and patency outcomes in the on-pump (ONCAB) group [12], albeit with several criticisms [13], while the CORONARY trial showed equivalent outcomes at 30 days for stroke and mortality [14] with reduced renal injury in the OPCAB group [15], even in the population above 70 years.

On the other hand, Puskas *et al.* have shown a mortality benefit from OPCAB, particularly in high-risk groups which includes the elderly population [9,16,17]. The impact of OPCAB on outcomes, therefore, is currently unclear.

We studied real-life registry data from the Australian and New Zealand Society of Cardiac and Thoracic Surgeons (ANZSCTS) database [18], comparing ONCAB and OPCAB revascularisation techniques in the elderly population (age  $\geq 70$  years). Seventy years was chosen as the cut-off age to achieve comparability with the CORONARY trial.

## Materials and Methods

### Patient Selection

Patient data collected by the ANZSCTS database between January 2001 and January 2012 were included. A total of

12,697 patients over the age of 70 years underwent isolated CABG in 19 public and six private hospitals in Australia. Of these, 92% had an ONCAB procedure and 8% an OPCAB procedure. Endpoints 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.

### Definition of Terms

Definitions of the preoperative risk factors and postoperative complications were made according to the ANZSCTS Data Definitions Manual version 3.0 [19].

### 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 [20]. Categorical data are presented as percentages and were analysed using the Chi square test or Fisher's exact test. Continuous data are presented as means and standard deviations. Continuous variables not normally distributed 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 (HR) were calculated using the Cox proportional hazards model.

A level of significance  $\alpha < 0.05$  was considered significant.

## Results

Overall proportions of OPCAB surgery performed over the years has remained relatively constant (Figure 1). Preoperative data for each group are shown in Table 1. Patients with

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