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REVIEW

Geriatric Cardiac Surgery: Chronology vs. Biology

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Cardiac surgery is increasingly performed in elderly patients, and whilst the incidence of common risk factors associated with poorer outcome increases with age, recent studies suggest that outcomes in this population may be better than is widely appreciated. As such, in this review we have examined the current evidence for common cardiac surgical procedures in patients aged over 70 years.

Coronary artery bypass grafting (CABG) in the elderly has similar early safety to percutaneous intervention, though repeat revascularisation is lower. Totally avoiding instrumentation of the ascending aorta with off-pump techniques may also reduce the incidence of neurological injury.

Aortic valve replacement (AVR) significantly improves quality of life and provides excellent short- and long-term outcomes. Combined AVR and CABG carries higher risk but late survival is still excellent. Mini-sternotomy AVR in the elderly can provide comparable survival to full-sternotomy AVR. More accurate risk stratification systems are needed to appropriately select patients for transcatheter aortic valve implantation.

Mitral valve repair is superior to replacement in the elderly, although choosing the most effective method is important for achieving maximal quality of life. Minimally-invasive mitral valve surgery in the elderly has similar postoperative outcomes to sternotomy-based surgery, but reduces hospital length of stay and return to activity. In operative candidates, surgical repair is superior to percutaneous repair.

Current evidence indicates that advanced age alone is not a predictor of mortality or morbidity in cardiac surgery. Thus surgery should not be overlooked or denied to the elderly solely on the basis of their ''chronological age'', without considering the patient's true ''biological age''.

Keywords Elderly • Septuagenarian • Octogenarian • Cardiac surgery • Valvular disease • Coronary artery disease

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''Age does not matter if the matter does not age.''
General Carlos P. Romulo

Introduction

The United Nations predicts that the population aged ≥80 years in developed countries will increase from 54 million in 2011 to 122 million in 2050 due to increasing life expectancy, improved health care, and low fertility rates [1]. As a result, the number of elderly patients requiring cardiovascular invention is increasing, and it has been estimated that the number of cardiac surgical patients >80 years old has increased up to 24-fold over the last two decades [2]. It is important that the most beneficial treatment is selected, whether medical, interventional or surgical, and therefore we aim to review the modern outcomes of common cardiac operations in this population. In earlier studies the definition of ''elderly'' was usually those aged >70 years, however it now more commonly refers to >80 years old, due to the effect increasing life-expectancy has on the discrepancy between one's ''chronological age'' and ''biological age''.

The risks of cardiac surgery in the ''biological'' elderly are largely due to the adverse cardiovascular effects of aging. Oxidative stress and inflammation increases and impairs vascular function [3]. Large and medium sized arteries become thickened due to calcium deposition and collagen build-up, increasing left ventricular afterload and work. While cardiac systolic function may be relatively well preserved, concentric hypertrophy impairs diastolic function, which declines by up to 50% by the ninth decade (3). Significantly reduced lung compliance, respiratory muscle strength, and hypoxic respiratory drive increase the risk of postoperative ventilatory failure [4], while changes to kidney structure and function increase the risk of acute renal failure [5]. Age-related central and peripheral nervous system impairment contribute to postoperative delirium, delayed recovery and rehabilitation. Poor nutritional status and anaemia are common [6]. Pharmacokinetic and dynamic impairment increases the risk of adverse drug reactions and reduce the effectiveness of cardiovascular drugs [7].

Coronary Surgery

Coronary artery bypass grafting (CABG) may not be considered in elderly patients because of the perceived risk involved and because of their limited life expectancy. This group of patients is thus frequently excluded from trials comparing PCI and CABG. However, CABG is increasingly performed in the elderly [8], and they may benefit from this intervention over PCI because they are more likely to present with complex multi-vessel disease [9,10] and because the risks of long term anti-platelet therapy are avoided. A recent meta-analysis compared PCI (n=909) to CABG (n=1,477) in patients aged >70 years [11]. There was no significant difference in all cause-mortality at 30 days (3.9% vs. 5.7%, OR 0.72, 95% CI: 0.41 to 1.26), 12 months (6.0% vs. 7.8%, OR 0.80, 95% CI: 0.53 to 1.22) and 22 months (10.6% vs. 13.0%, OR 1.00, 95% CI: 0.73 to 1.38). There was also no significant difference in MACCE (composite endpoint of death, nonfatal myocardial infarction, stroke, and repeat revascularisation) at 30 days (11.0% vs. 18.3%, OR 0.60, 95% CI: 0.34 to 1.05), 12 months (16.6% vs. 20.3%, OR 0.82, 95% CI: 0.47 to 1.41), and 22 months (26.2% vs. 21.9%, OR 1.27, 95% CI 0.81 to 1.98). However, stroke was more common in the CABG patients at 30 days (0.7% vs. 6.6%, OR 0.14, 95% CI: 0.02 to 0.76) and 12 months (0.52% vs. 5.95%, OR 0.14, 95% CI 0.03 to 0.60), but repeat revascularisation was higher in the PCI at 22 months (15.5% vs. 3.5%, OR 4.34, 95% CI 2.69 to 7.01). They found similar results in a subgroup analysis of an older cohort of patients aged ≥ 75.

Off-pump CABG (OPCABG) offers two main potential advantages: it can avoid complications associated with cardiopulmonary bypass (CPB), including the systemic inflammatory response [12]. It also provides an opportunity to perform CABG without any manipulation or clamping of the ascending aorta (a ''no touch'' or ''anaortic'' technique), which may decrease the rate of neurological events by avoiding dislodgement and embolisation of atherosclerotic plaque. Puskas and colleagues compared predicted mortality (using the STS Score) vs. observed mortality in over 14,000 patients undergoing OPCABG vs. on-pump CABG. The group showed no difference in mortality between the groups in low risk patients, but a survival benefit for OPCABG patients when predicted risk exceeded 2.5-3% (3.2% vs. 6.7%, OR 0.45, 95% CI: 0.33 to 0.63) [13].

In the recent GOPCABE trial 2,539 patients aged ≥75 years were randomised to OPCABG or on-pump CABG; the difference in a composite endpoint of death, myocardial infarction, stroke, new renal replacement therapy or repeat revascularisation did not reach statistical significance (7.8% vs. 8.2%, p=0.74), though OPCABG patients had significantly fewer red blood cell transfusions (2.0% vs. 2.4%, p<0.001) [14]. However, the rate of side-clamp use (for proximal anastomosis of the aorto-coronary graft) in the OPCABG group was not reported, hence the potential benefit of an anaortic OPCABG technique was not tested in this trial. In a meta-analysis of over 10,000 patients, anaortic OPCABG patients had a significantly lower stroke rate than OPCABG patients where a side-clamp was used (0.29% vs. 1.34%, p=0.006). When anaortic OPCABG was compared with conventional CABG the rate of stroke was 0.41% vs. 1.98%, respectively, p<0.001 [15]. Our group reported the largest case series of elderly patients undergoing anaortic OPCABG. In 1,135 patients aged >70 years, 30 day mortality was 2.1% and stroke rate was 0.4%. In 318 patients aged >80 years, mortality was 2.8% and stroke 0.9% [16]. This compares favourably to contemporary series of PCI in octogenarians, which report mortality of 1.5-2.5% of those revascularised for stable angina, and 5.7-6.9% if revascularised for unstable angina or non-ST elevation MI [17,18].

Surgery is therefore a safe option for revascularisation of elderly patients and should be considered for those with