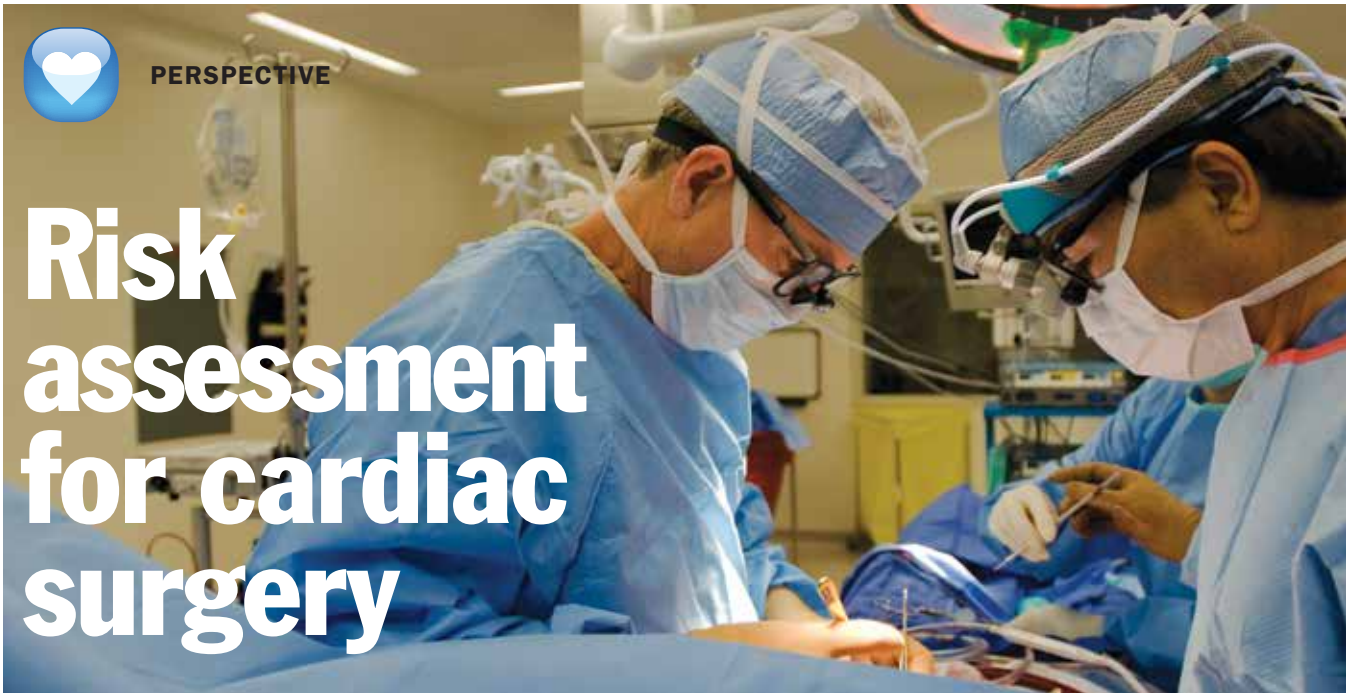

PERSPECTIVE

Risk assessment for cardiac surgery

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Cardiac surgery is reproducible, effective and increasingly safe. Although outcomes have improved over time, there are still significant risks associated with cardiac surgery. Risk stratification tools can allow clinicians to identify high-risk patients and tailor their management accordingly.

Key points

- **Cardiac surgery is safe and effective, even in elderly patients.**
- **Patients should be given the opportunity to meet a cardiac surgeon to assess formally their risk for surgery.**
- **Risk stratification tools can allow us to identify people at higher risk and tailor their treatment accordingly.**

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Cardiac surgery in its current form began with the advent of the heart–lung machine in the 1950s. Numerous large registry studies have shown that operative morbidity and mortality has decreased and survival outcomes have improved since then, even though the patient cohort has become steadily older and sicker.[1-3] Today, despite the emergence of alternative treatment techniques, cardiac surgery is a valuable treatment option for several conditions, including ischaemic heart disease and valvular heart disease, both of which are leading causes of mortality and morbidity worldwide.

What is risk assessment and why do we need it?

Both early and late outcomes after cardiac surgery have significantly improved over time. Thirty-day mortality after cardiac surgery in high-volume centres has decreased from 4 to 6% in the 1980s to 1 to 3% more recently.[4,5] A review of cardiac surgery procedures performed in Australia from 2001 to 2009 showed that 30-day mortality for patients undergoing coronary artery bypass graft (CABG) surgery and aortic valve replacement (AVR) surgery was 1.7% and 1.9%, respectively.[6,7] Similar trends have been observed worldwide.[4] Nevertheless, cardiac surgery remains a sizeable undertaking for both patients and clinicians alike. It is imperative to preoperatively assess a patients' suitability for surgery, including a thorough assessment of their risk profile.

Standardised risk assessment for invasive procedures is important and useful for three main tasks in cardiac surgery (Table 1). The first is to inform patients and clinicians about risk. It is vital to provide an adequate assessment of risk to patients, specifically because there may be nonsurgical approaches available to them and their clinicians that modify risks, especially for sicker patients. For high-risk patients with ischaemic heart disease, optimal medical management or less invasive percutaneous treatment options may be more suitable than surgery. For high-risk patients with aortic stenosis, there are few effective medical therapies, but transcatheter aortic valve implantation (TAVI) has been shown to have similar short-term and longer-term results (up to two years) compared with open surgery.[8] Overall, risk assessment assists clinicians and patients in choosing the most suitable treatment option.

Secondly, collection of risk assessment data allows the performance of particular units to be benchmarked against the general population. Arguably, the improved outcomes in cardiac surgery in recent decades largely reflect the increased scrutiny on patient outcomes by registries.

Thirdly, risk assessment allows the impact of innovative new therapies on performance to be monitored. In cardiac surgery, for example, the safety of novel operative techniques such as off-pump cardiac surgery (not requiring cardiopulmonary bypass) has been established by comparing the safety of this procedure in patients with a similar risk profile who underwent conventional surgery. Simply put, risk assessment and evaluation facilitates innovation and scientific discovery.

Table 1. Summary of potential uses and disadvantages of risk scoring systems

Benefits and uses	Disadvantages
Inform patients and clinicians about risk	Overestimation of risk for patients, especially for high-risk patients
Benchmark performance of particular units against general population	Confounding by unknown variables
Monitor impact of innovative new therapies	Infrequent updates
Evaluate the efficacy on investment of health promotion strategies	Variation in use of variables between scoring systems
Improved data management	Demographic differences in patients across countries

The use of risk assessment tools in cardiac surgery

Given the considerable benefits of both the collection and analysis of risk assessment data, several risk assessment scoring systems have been developed for cardiac surgery. Most were developed to predict the risk of operative mortality.[9] Nonfatal outcomes have been difficult to accurately assess because of the low incidence of some outcomes for patients undergoing cardiac surgery. The most common significant nonfatal outcomes after cardiac surgery include permanent stroke (0.5 to 2%), acute myocardial infarction (0.5 to 2%), new renal failure (4 to 6%) and return to theatre (6 to 10%).[4,6,7]

Early studies used single-institution data to generate a risk-prediction algorithm, whereas more recent studies have used multi-institutional data with larger patient samples.[10-13] This explains why there is significant variation in the clinical factors incorporated for the assessment of risk in the various scoring systems; that is, because of variations in the patients being studied (Table 2).[9-16] Some factors, however, such as advanced age, nonelective procedures, acute renal failure and impaired left ventricular function have ubiquitously been associated with poorer outcomes.[9-13]

The most commonly used scoring systems are the European System for Cardiac Operative Risk Evaluation (EuroSCORE; www.euroscore.org/calc.html) and the American Society of Thoracic Surgeons (STS; http://riskcalc.sts.org/de.aspx) risk score.[12-14] Both of these can be easily accessed online and provide a near immediate assessment of a patient's risk of perioperative mortality provided their comorbidities are accurately known. Studies have validated both scoring systems.[17,18] These scoring systems, however, must be used with caution (Table 1). Studies have also shown that they may overestimate the risk of operative mortality, especially in high-risk groups.[19,20] A study on the applicability of the EuroSCORE in an Australian patient cohort, for example, showed that it overestimated the risk of operative mortality by a factor of two.[19] If the EuroSCORE alone was used to select patients for surgery, many patients who would have a reasonable outcome may be inappropriately excluded. Scoring systems have also been developed using data from the Australian database (provided by the Australian and New Zealand Society of Cardiothoracic Surgery) for cardiac surgery procedures.[16,21,22] These may be more applicable for the Australian patient population but further studies are required to validate their utility more generally.

It is important to note that risk scoring systems are often developed at a particular time and are infrequently updated. This is the primary reason why they frequently overestimate operative risks. As cardiac surgery continues to evolve with improvements in operative technique, anaesthesia and both preoperative and postoperative care, operative mortality will, presumably, continue to decline. In the past decade alone, cardiac surgery has evolved such that minimally invasive techniques including robotic and endoscopic CABG surgery and valve replacements are being performed routinely in some centres. This trend is set to continue. Concurrently, the patient population undergoing cardiac surgery is getting older and sicker given the increased efficacy of medical therapies and use of percutaneous interventions in patients with less advanced disease.

As such, contemporary scoring systems need to be continuously updated to reflect the changes in operative techniques and patient demographics. In 2011, the new EuroSCORE II algorithm was released to correct for the overestimation of hospital mortality by the original EuroSCORE.[23] It has shown improved performance in more contemporary series.[24] It must also be noted that many clinical and patient-related factors that cannot be accounted for may influence outcomes. Additionally, factors that can be accounted for may not have been measured in the various datasets from which these risk assessment scoring systems are derived. Hence, although risk stratification tools help to delineate risk in patient populations, it is important for clinicians to recognise their limitations.

Controversial areas

There is considerable controversy regarding whether patients over 80 years of age should undergo cardiac surgery. This is an important clinical question given the ageing population of Western countries and a demographic shift in patients undergoing cardiac surgery, towards the elderly. All of the scoring systems acknowledge that

Table 2. Risk score items

	Parsonnet Score[10]	Cleveland Clinic Score[11]	STS Score[12,13]	EuroScore[14]	Pons Score[15]	ANZSCTS Score[16]
Patient data						
Age	+	+	+	+	+	+
Body weight	+	+	+			+
Gender						+
Cardiac						
Unstable angina				+	+	
Aortic stenosis	+	+			+	
Active endocarditis				+	+	
Congenital heart defect	+					
Hypertension, arterial	+					
Hypertension, pulmonary	+			+		
Left ventricular aneurysm	+		+			
Left ventricular ejection fraction	+	+		+	+	
Mitral valve insufficiency		+	+			
Myocardial infarction			+	+	+	
New York Heart Association class			+		+	+
Post-myocardial infarction VSR				+		
Ventricular tachycardia/fibrillation			+	+		
Pulmonary						
Asthma	+			+		
COPD		+		+	+	
Renal						
Dialysis	+		+			+
Creatinine		+	+	+	+	
Acute renal failure	+			+		
Other						
Anaemia		+				
Diabetes	+	+	+			
Liver disease					+	
Transient ischaemic attacks/stroke history		+	+	+		
Paraplegia	+					
Pacemaker	+					
Vascular						
Peripheral arterial disease		+	+	+		+
History of vascular surgery		+				
Preoperative						
Ventilation				+	+	
Intra-aortic balloon pump	+		+	+		
Inotropes	+		+	+		+
Resuscitation				+		
Cardiogenic shock	+		+			
Operation						
Combined surgery	+		+	+	+	
Urgent/emergency	+	+	+	+	+	
Reoperation	+	+	+	+	+	

Abbreviations: ANZSCTS = Australian and New Zealand Society of Cardiothoracic Surgeons; COPD = chronic obstructive pulmonary disease; STS = Society of Thoracic Surgeons; VSR = ventricular septal rupture.

advanced age is a risk factor for operative mortality. Nevertheless, there has been considerable improvement in the outcomes of elderly patients undergoing cardiac surgery in recent times.

An analysis of Australian data demonstrated that 30-day mortality in elderly patients (≥80 years) undergoing isolated CABG and AVR surgery was 4.2% and 4.0%, respectively.[25,26] Quite remarkably, the long-term survival of these patients was equivalent if not better than the age-matched Australian population. Even concomitant CABG–AVR surgery is well tolerated by well-selected elderly patients.[27] It is also important to evaluate health-related quality of life (HRQoL) in older patients; fortunately, recent systematic reviews have demonstrated that HRQoL in elderly patients is equivalent to that in younger patients undergoing identical procedures.[28,29] In particular, there were excellent functional gains after surgery. Overall, elderly status should not preclude patient consideration for cardiac surgery. It is important, however, to acknowledge the additional risk that advanced age confers.

Other controversial areas include the role of cardiac surgery in the management of other high-risk patients, such as those with severe left ventricular dysfunction, chronic renal failure or dialysis. Even in these patients, improved outcomes have been recently reported.[30]

Conclusion

Cardiac surgery in the contemporary era is reproducible, effective and increasingly safe. Outcomes have improved significantly over time and this trend is set to continue. Nevertheless, there are significant risks associated with cardiac surgery. Risk factors for cardiac surgery may relate to the patient and their overall state of health or to factors associated with the procedure. Risk stratification tools can be helpful to allow clinicians to identify high-risk patients and tailor their management accordingly. These tools and their results should be interpreted with caution. It is always prudent to optimise a patient's overall health and obtain an opinion about the suitability of surgery from a cardiologist or cardiothoracic surgeon. **CT**

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