Preoperative assessment for cardiac surgery

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Abstract

Patients presenting for cardiac surgery pose many challenges for the anaesthetist. The clinician has to manage both the presenting cardiac pathophysiology and, increasingly, significant co-morbid disease. Thorough preoperative assessment, investigation and preparation allow identification of those patients at higher risk of perioperative complications, and permits development of individualized care plans in order to minimize these risks. Assessment should be based on a focused anaesthetic history and examination, as well as analysis of cardiovascular investigations, including simple blood tests and complex investigations of cardiac anatomy and function. Scoring systems incorporating biomarkers are often employed as a means of risk stratification and can be used not only to aid perioperative planning and informed consent, but also as an audit and quality improvement tool.

This article describes a structured approach to anaesthetic preassessment for patients undergoing cardiac surgery. Commonly used preoperative scoring systems are introduced, and the application and interpretation of commonly employed cardiac investigations are summarized.

Keywords Anaesthesia; cardiac surgery; investigations; preoperative assessment; scoring systems

Royal College of Anaesthetists CPD Matrix: 2A03

Learning objectives

After reading this article, you should be able to:

- perform a thorough preoperative anaesthetic assessment of a cardiac surgical patient
- describe some of the risk stratification scoring systems commonly in use for this group of patients
- understand some of the major medical predictors of postoperative morbidity and mortality
- understand the principles of currently available investigations of cardiac anatomy and function
- identify and discuss with the patient any potential difficulties and complications associated with their anaesthetic care and formulate an individualized care plan to minimize these risks

Patients presenting for cardiac surgery often suffer from significant co-morbid disease and in recent years, older increasingly frail patients have become commonplace. The incidence of complications after coronary bypass grafting in patients older than 75 years has been reported as high as 10%.

Preoperative risk stratification, that is, an individualized risk–benefit analysis must be carried out.

The aims of the assessment include:

- commencement of an important relationship between the anaesthetic team and the patient
- an understanding of the pattern and severity of the cardiac disease and its anaesthetic implications
- evaluation of the severity and implications of any co-morbid disease to help produce a tailored perioperative management plan
- review of all preoperative investigations
- consideration of appropriate resource allocation, including staffing, equipment and the most appropriate postoperative care environment
- quantification of perioperative risk to inform the discussion with the patient and multidisciplinary team, thus facilitating shared decision-making and informed consent.

Scoring systems and risk stratification

Patients presenting for cardiac surgery are possibly the most investigated of surgical groups. Large outcome databases have facilitated the development of risk stratification models, from which independent risk factors may be identified, weighed, and incorporated into predictive risk scores. These models can assist with resource allocation, audit, research, and counselling of patients.

Models range from simple, additive scores, to sophisticated systems involving the application of logistical regression algorithms. Despite efforts to keep scoring systems current, evidence suggests that over time, the prediction of risk may become less accurate; this is may be due to changing patient demographics, alterations in surgical techniques and use in populations differing from those in the original design and validation process. The use of such scoring systems must therefore always be complementary to clinical judgement rather than replacing it.

Anaesthetists are familiar with the American Society of Anesthesiologists (ASA) scoring system to classify a patient's fitness for anaesthesia. This system remains useful as a broad indicator of risk, but in the context of cardiac surgery, where many patients present with ASA scores of three or above, it lacks the subtlety necessary to delineate small but relevant differences in risk between individual patients.

In 1996, Jones and colleagues put forward seven 'core' and 13 'level 1' variables that are strongly associated with perioperative mortality in cardiac surgery. The 'core' variables encompass 45–83% of the predictive power of these 20 variables and are commonly used across a variety of scoring systems (Table 1).

Chronological age does not always accurately reflect biological age, so a broad assessment of frailty can aid further risk stratification and informed consent. This assessment can include assessment of activities of daily living (ADL, feeding, bathing, dressing etc.).

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Core and level one variables strongly associated with perioperative mortality in cardiac surgery

Core variables	Level 1 variables
Age	Height
Sex	Weight
Operation urgency	PCI during current admission
Previous cardiac surgery	Date of most recent MI
Reduced ejection fraction	History of angina
	Raised creatinine level
Percentage left main stenosis	Ventricular arrhythmia
Number of coronary arteries with >70% stenosis	CHF
	Mitral regurgitation
	Diabetes mellitus
	Cerebrovascular disease
	Peripheral vascular disease
	COPD

CHD, congestive heart failure; COPD, chronic obstructive pulmonary disease; MI, myocardial infarction; PCI, percutaneous coronary intervention.

Table 1

A simple system may include:

- no frailty (able to perform all ADLs and perform a 5-m walk in <6 seconds)
- mild frailty (unable to perform one ADL or unable to perform a 5-m walk in <6 seconds)
- moderate to severe frailty (unable to perform more than two ADLs).

Specific scoring systems based upon cardiac symptom severity have been well validated in cardiac surgery. A simple assessment of cardiac failure can be made using the New York Heart Association (NYHA) functional classification (Box 1). Higher grades are associated with greater risk of ventricular dysfunction and worse outcomes. Anginal symptoms can be graded using the Canadian Cardiovascular Society (CCS) classification (Box 2). Increasing class suggests a lower ischaemic threshold and a greater likelihood of perioperative myocardial ischaemia; indeed there is a linear relationship between CCS grade and severity of coronary artery disease on angiography.

Several global scoring systems are available which have been clinically validated; higher scores being associated with an increased risk of postoperative complications, increased length of stay and decreased chance of discharge to home. These have been developed from large patient outcome databases, EuroSCORE II and the American STS-PROMs being the most common.

EuroSCORE (European System for Cardiac Operative Risk Evaluation) is a complex scoring system first developed in 1995 by regression analysis of data from over 19,000 patients from 128 European centres undergoing a wide range of cardiac procedures. It was an additive model (the score being approximately equivalent to the percentage risk of perioperative mortality) and was well validated and widely used both in the UK and Europe.

In 2012 EuroSCORE II (Table 2) was published in response to evidence that the original EuroSCORE was increasingly over-predicting mortality, having been originally calibrated for data collected in the 1990s. The EuroSCORE II was a more accurate logistic regression model with greater discrimination; an online EuroSCORE II calculator is available at www.euroscore.org. Despite these changes, EuroSCORE II may still over-predict mortality and will likely be replaced by further iterations or alternatives in coming years.

History and examination

The format of the preoperative assessment is similar to that for non-cardiac surgery including history, examination, case-note review (including medications) and investigation analysis. In addition to the usual features of an anaesthetic assessment, emphasis is placed on detailed evaluation of the cardiovascular and respiratory systems.

Cardiac patients commonly present with pulmonary disease, diabetes mellitus, renal impairment and peripheral vascular disease. Impaired preoperative renal function is particularly important as it is directly related to an increased risk of postoperative acute kidney injury, renal replacement therapy and dialysis.[1] The development of acute kidney injury after cardiac surgery is important as it is associated with up to 40% mortality.[2]

Diabetes mellitus is present in approximately 25% of patients presenting for coronary artery bypass grafting (CABG) and is also associated with a worse outcome. Strict perioperative glucose control should be planned, as this has been shown to reduce mortality, perhaps partially related to an anti-inflammatory role for insulin.[3]

New York Heart Association (NYHA) functional classification

Class I

Patients with cardiac disease but without resulting limitations of physical activity. Ordinary physical activity does not cause undue fatigue, palpitations dyspnoea or angina.

Class II

Patients with cardiac disease resulting in slight limitation of physical activity. Comfortable at rest. Ordinary physical activity results in fatigue, palpitations, dyspnoea, or angina.

Class III

Patients with cardiac disease resulting in marked limitation of physical activity. Comfortable at rest. Less than ordinary physical activity results in fatigue, palpitations, dyspnoea, or angina.

Class IV

Patients with cardiac disease resulting in an inability to carry out any physical activity without discomfort. Comfortable at rest. Fatigue, palpitations, dyspnoea, or angina may be present at rest. If any physical activity is undertaken the symptoms of cardiac insufficiency are increased.

Box 1

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