Risk stratification in cardiac surgery

Mr Michael Tolan

Cardiothoracic surgeons have traditionally been to the forefront when demonstrating the effectiveness of their surgical procedures. Coronary artery bypass grafting has been the subject of more audits than any other surgical operation. Nationwide databases have been in existence for adult procedures in the US, the UK and Ireland for the last decade.

There are four outcomes of interest to cardiac surgeons: mortality, morbidity, patient satisfaction and resource utilisation. Operative mortality is an easily defined, readily measured outcome and was the focus of earlier studies. Later studies broaden the focus and consider quality of life and resource utilisation. The more recent addition of risk stratification to the databases is essential to the examination of standards in cardiac surgery. It has become essential in the provision of accurate risk assessment for the proper acquisition of informed consent.

Parsonnet scoring

The most widely adopted risk assessment scoring system has been that devised by Victor Parsonnet from Newark, US. By the simple addition of a score assigned to each risk factor and translation to a graph, a percentage risk can be estimated for the operation (see Table).

The manifest need for risk-adjusted outcome evaluation prompted Parsonnet and several others to develop statistical approaches in the prospective and retrospective estimation of operative mortality based on preoperative risk factors. A logistic regression model was developed in which 47 potential risk factors were considered, and a method using only simple arithmetic and graphic interpretation was devised for approximating the estimated risk easily and quickly. The estimates provided by the simplified model correlated well with the observed mortality rates.

Comorbidities are co-existing diagnoses that are unrelated to the principal surgical diagnosis, but have an impact on the outcome of operation. The prevalence of comorbid illness in patients with cardiac disease has been well documented. In one series of patients with myocardial infarction (MI), 26% also had diabetes, 30% had arthritis, 6% had chronic lung problems and 12% had gastrointestinal disorders. Several attempts at measuring comorbidity have been made, but all are imprecise, primarily due to the inaccuracy of the databases used to form the indices. In Parsonnet's model, only risk factors amenable to objective measurement are used. Covariates even partly based on subjective judgement, such as unstable angina, diffuseness of disease and chronic obstructive pulmonary disease (COPD) only added uncertainty that compromised the validity of the model.

The benefits of risk stratification

The rapid approximation of preoperative risk is invaluable in discussions with patients and their families, assisting the surgeon in providing a realistic estimate of the potential risk of surgery. This has become essential in the proper acquisition of informed consent.

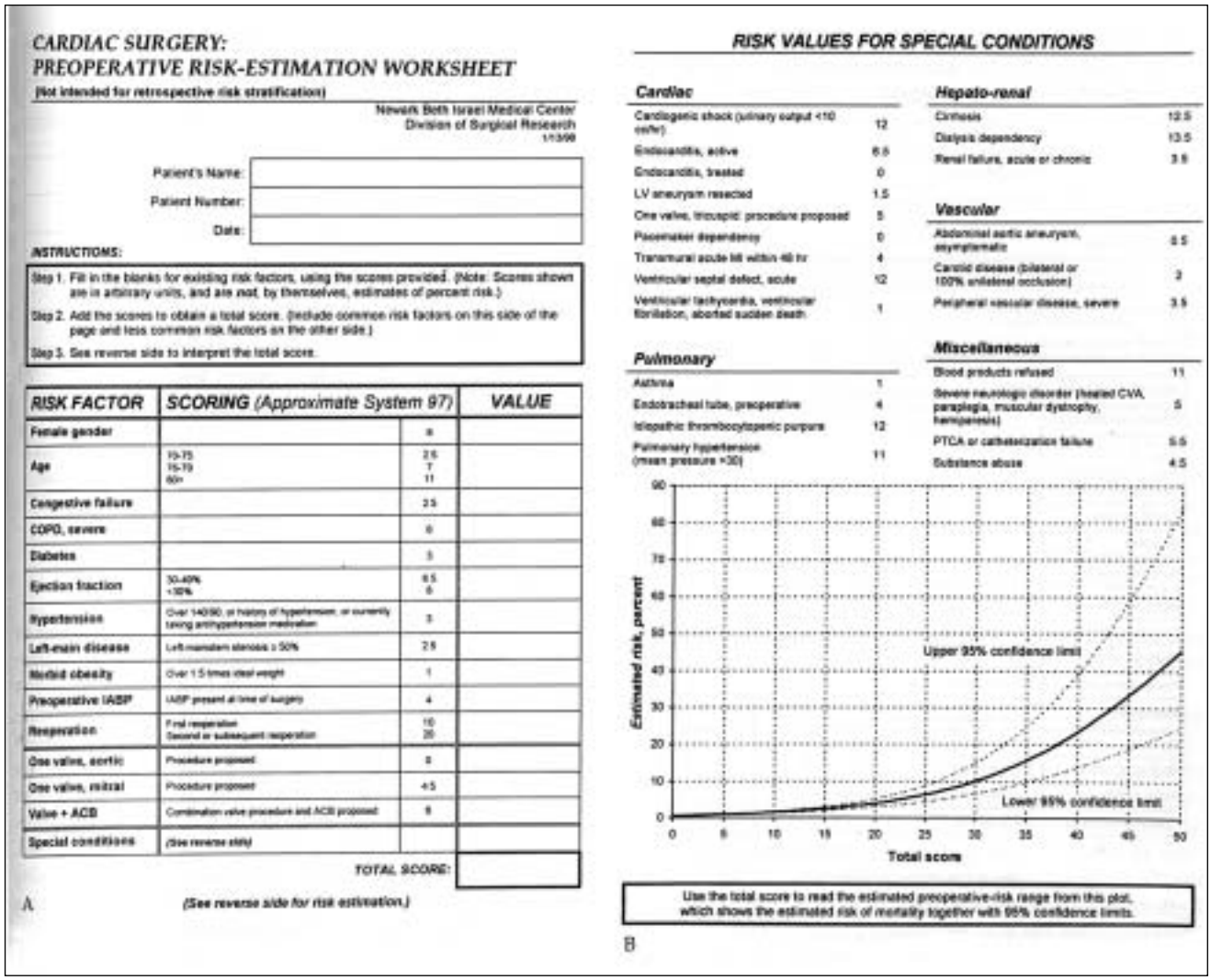
Predictive models, such as that of Parsonnet, are now often used by individual surgeons and institutions in an attempt to avoid the misunderstandings that can result from the consideration of raw mortality rates alone. The Society of Cardiothoracic Surgeons of Great Britain and Ireland has commenced a central database in which every patient who undergoes surgery or intervention is entered. Risk stratification, usually by the Parsonnet scoring system, and the detailing of complications is also entered. Site-specific feedback, comparing site data benchmarked against local/regional and national data for all important data elements is available. This permits local performance to be compared directly with the aggregate data from Ireland and the UK, thus allowing for quality improvement implementation if necessary. The existence of such a database allows ease of performing research, epidemiological studies and the rapid assessment of new procedures or treatment strategies.

The widespread use of risk assessment scoring and feedback should lead to further reductions in mortality and morbidity rates. However, these rates are already low and further reductions may be difficult. Patients with nonfatal outcomes following operations for ischaemic heart disease make up more than 95% of the pool of patients undergoing operation. Over 75% have an uncomplicated postoperative course. The complications occurring in surviving patients range from serious organ system dysfunction to minor limitation or dissatisfaction with lifestyle.

The Bristol affair

In the past two years or so, the medical profession in England, and in particular cardiac surgery, has been seriously shaken by what may be called the 'Bristol affair'. Briefly, in 1997, following concerns about the results of cardiac

The Parsonnet Scoring System



CARDIAC SURGERY:
PREOPERATIVE RISK-ESTIMATION WORKSHEET

(Not intended for retrospective risk stratification)

Newark Beth Israel Medical Center
Division of Surgical Research
1/13/99

Patient's Name:
Patient Number:
Date:

INSTRUCTIONS:

Step 1. Fill in the blanks for existing risk factors, using the scores provided. (Note: Scores shown are in arbitrary units, and are *not*, by themselves, estimates of percent risk.)

Step 2. Add the scores to obtain a total score. (Include common risk factors on this side of the page and less common risk factors on the other side.)

Step 3. See reverse side to interpret the total score.

RISK FACTOR	SCORING (Approximate System 97)		VALUE
Female gender		a	
Age	70-75 75-79 80+	2.5 7 11	
Congestive failure		2.5	
COPD, severe		0	
Diabetes		3	
Ejection fraction	30-49% <30%	0.5 0	
Hypertension	Over 140/90, or history of hypertension, or currently taking antihypertensive medication	3	
Left-main disease	Left-mainstem stenosis ≥ 50%	2.5	
Morbid obesity	Over 1.5 times ideal weight	1	
Preoperative IABP	IABP present at time of surgery	4	
Reoperation	First reoperation Second or subsequent reoperation	10 20	
One valve, aortic	Procedure proposed	0	
One valve, mitral	Procedure proposed	+5	
Valve + ACB	Combination valve procedure and ACB proposed	6	
Special conditions	(See reverse side)		
		TOTAL SCORE:	

A

(See reverse side for risk estimation.)

RISK VALUES FOR SPECIAL CONDITIONS

Cardiac	
Cardiogenic shock (urinary output <100 cc/hr)	12
Endocarditis, active	6.5
Endocarditis, treated	0
LV aneurysm resected	1.5
One valve, tricuspid: procedure proposed	5
Pacemaker dependency	0
Transmural acute MI within 48 hr	4
Ventricular septal defect, acute	12
Ventricular tachycardia, ventricular fibrillation, aborted sudden death	1

Pulmonary	
Asthma	1
Endotracheal tube, preoperative	4
Idiopathic thrombocytopenic purpura	12
Pulmonary hypertension (mean pressure >30)	11

Hepato-renal	
Cirrhosis	12.5
Dialysis dependency	13.5
Renal failure, acute or chronic	3.5

Vascular	
Abdominal aortic aneurysm, asymptomatic	5.5
Carotid disease (bilateral or 100% unilateral occlusion)	3
Peripheral vascular disease, severe	3.5

Miscellaneous	
Blood products refused	11
Severe neurologic disorder (healed CVA, paraplegia, muscular dystrophy, hemiparesis)	5
PTCA or catheterization failure	5.5
Substance abuse	4.5

Use the total score to read the estimated preoperative-risk range from this plot, which shows the estimated risk of mortality together with 95% confidence limits.

B

Form for use in preoperative estimation of surgical risk. (A) Front; (B) Back. (ACB=aortocoronary bypass; COPD=chronic obstructive pulmonary disease; CVA=cerebrovascular accident; IABP=intra-aortic balloon pump; LV= left-ventricular; MI=myocardial infarction; PTCA=percutaneous transluminal coronary angioplasty).

surgery in children at the Bristol Royal Infirmary (BRI), the General Medical Council (GMC) conducted a hearing that lasted eight months and found two cardiac surgeons and the General Manager of the hospital guilty of serious professional misconduct. Results in infants undergoing switch procedures and correction of atrioventricular septal defects (AVSD) were shown to be considerably worse with higher mortality than in other units.

Furthermore, despite this being pointed out by colleagues, the operations had continued until, following the death of a child in January 1995, they were stopped and another surgeon appointed. There is an ongoing government inquiry which is likely to take two years before its recommendations are known. The proceedings are recorded in detail on the Internet (bristol-inquiry.org.uk).

The fallout from the Bristol case has been considerable. Numerous British cardiac surgeons have been suspended pending investigation, only to be reinstated several months later with feeble apologies.

In Bristol it was the surgeons (rather like the captain of the ship) who got the blame. However, when the outcome of 100 operations was analysed by experts, the surgeons were found at fault in only six. Thus cardiologists, anaesthetists, postoperative care and inadequate funding may all have shared in the poor results. This is not excusing the surgeons, who should have had a mechanism of recognising that the results were poor and that other units were achieving much better results for whatever reason, and stopped operating. The surgeons in Bristol were quoting mortality risks that were completely at variance with their true figures.

A nationwide database with risk stratification is the audit mechanism that allows both surgeons and administration to provide the patient with proper data and reassurance thet their hospital and their surgeon are performing to an excellent standard. In this age of clinical governance there must be a method by which poor results are recognised without the need for an individual such as the anaesthetist in Bristol who raised the initial concerns about poor results.

The whole issue of 'clinical governance' and accountability has been brought to the fore by the Bristol case but it was surely in the offing even if Bristol had never happened. The establishment of the Cardiothoracic Society Registry with risk stratification should ensure that such a sorry state of affairs never recurs in cardiothoracic surgery.

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