Original Article

Why Audit?

Alexander Manché

Abstract

Decision making in surgery is based on contemporary hard data describing outcomes in a particular patient population. As a professional body, with powers of self regulation and peer review, we need to be cognisant of the expected norm of practice. This can only be derived from information that is shared amongst our colleagues both locally and abroad. We have the responsibility to contribute to this database by way of audit in a rigourous and honest fashion and to utilise it routinely in the management of our patients.

Introduction

Audit was introduced in the UK in the early nineties, in the main imposed by central government as part of the National Health Service reorganisation[1]. There was then a general reluctance on the part of surgeons to take up this new challenge, sensing that our shortfalls would be publicised and that it represented an extra workload. Time, personnel and financial aid were allocated to individual units to perform audit and slowly but surely the practice was accepted and thrived.

Having become conversant with the principal objectives of audit, namely the recording of trends of activity, outcomes, efficiency and resource management as part of a reflective practice, I was keen to apply this exercise to our newly established local cardiac surgical service in 1995. I felt it particularly important for a relatively isolated unit such as ours to compare results with those of other countries and to contribute to a European database.

Adult cardiac surgical practice is uniquely placed for audit in that a restricted diversity of procedures are performed annually in their hundreds of thousands throughout the world, variations in practice are limited, and our impact on the treatment of heart disease has been recorded for over three decades[2]. Nevertheless, any surgical procedure that conforms to an established pattern can be subjected to audit.

Keywords

Audit, surgery, outcomes, management

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Method of data collection

Data was collected prospectively and completed at the time of the patient's discharge from hospital. This included demographic information, risk stratification, length of hospital stay, the type of operation performed and any complications that arose. More detailed information from a standardised operative record as well as data regarding cardiac intensive care unit resource management were also recorded. All untoward events were recorded by senior medical staff in accordance with strict definitions of peri-operative mortality and morbidity. Data was regularly transferred onto a computer spreadsheet and analysed at the end of each year, when an annual report was issued. Interim reports were discussed at our regular cardiac audit meetings with the aim of introducing remedial measures where indicated.

Areas of audit

Certain key areas outlined above were audited from the start. However, with evolution of our practice we have discontinued the audit of data that has become irrelevant, and have included other data that is currently of interest. The audit presented in this paper pertains to our core data.

Activity

In October 2001 two other consultants were appointed and I have therefore limited the figures to my practice. The local cardiac program started in April 1995 and annual reports were issued every April until the millennium when this was changed to January to conform with the department of surgery.

Annual output has increased steadily. The factor limiting growth was initially general intensive care beds. This problem was resolved with the opening of the cardiac intensive care unit when the bottleneck moved to operating theatre sessions. Figure 1 demonstrates a favourable trend in efficiency. During 1998 we cancelled 111 operations and treated 301 patients. Our output could have reached 412 and hence our efficiency scored at 73%. In subsequent years cancellations decreased significantly and our efficiency increased correspondingly.

Waiting list

Increased output and efficiency contribute to a reduced waiting list. Figure 2 shows the annual operative rate and mean waiting time in days from angiogram to operation. This compares very favourably with places like the UK where waiting times can range from one to two years[3]. In fee-for-service countries this waiting time is even shorter than ours.

Urgent cases need wait only a few days, and patients with unstable angina unresponsive to maximal treatment undergo surgery that same day. Patients on a cardiac surgery waiting list are extremely vulnerable. In 7 years we recorded 36 deaths on our waiting list versus 35 peri-operative deaths.

Hospital stay

Post-operative hospital stay decreased over the years. Our policy of early discharge is coupled with an open referral service, where we encourage patients to turn up at any time on our step-down ward should a problem arise at home during the first two post-operative months.

In Figure 3 the grey bars represent the total mean post-operative stay which stood at 4.25 nights last year. This comprised a night on the cardiac intensive care unit (CICU) and just over 3 nights on the ward. With an ageing population I believe we are approaching our early discharge limit. Post-operative length of stay is a potentially robust measure and is useful for comparing the influence of certain patient characteristics on resource consumption. It may also be used as a surrogate measure of morbidity. Given that many centres abroad transfer their post-operative patients to the referring facility in contrast to our policy of discharge to their home, it can be said that our local patients are discharged very early indeed.

Coronary revascularisation

A mean of 3.3 vessels per case were grafted. The internal thoracic artery was utilised in 96.8% of cases. Patients over 70 years old undergoing revascularisation between April 1995 and January 2001 (n = 283) were compared with a control group under 70 (n = 1254). Figure 4 shows that the number of grafts performed in the elderly mirrored that in the younger age group[4].

Internal thoracic artery usage was 91.5% in the elderly versus 98.0% in patients under 70.

Valve implantation

In 2001, 72 valves were implanted in 67 patients, 21 with concomitant revascularisation. We endeavour to implant the largest valve size possible for a particular annulus. This avoids prosthesis/patient mismatch, or a valve that is relatively small for the recipient. That year three small valves were implanted, namely two 19mm aortic and one 25mm mitral valves, in patients with a body surface area of 1.82m^2, 1.47m^2 and 1.42m^2 respectively. The first qualifies as a mismatch.

Risk Stratification

The most important part of audit deals with mortality and morbidity. Meaningful conclusions can only be drawn if patients are scored for risk pre-operatively. The risk that any one patient will not survive surgery is dependent on a number of different factors, some of which can be quantified, such as age, gender and the existence of co-morbidities. Risk scoring systems attempt to convert these risk factors into a numeric risk score. An adverse outcome is more likely in a high risk patient[5]. However, “low risk” is not the same as “no risk”.

Since 1995 we have used the Parsonnet risk stratification[6]. This system was described in 1989 and has been in widespread use, making it useful for inter-unit comparisons. An additive score is derived from pre-operative patient variables and corresponds to a predicted peri-operative mortality. However predicted values quoted in Parsonnet’s original paper would tend to overestimate the risk as cardiac surgical practice has evolved and observed mortality has fallen. More recently the Euroscore[7] system was introduced with the purpose of describing more accurately our changing surgical population. We have utilised this system additionally since 2000. The Euroscore is a more direct measure of operative mortality than the Parsonnet score. Most patients have a score of between 0 and 3 which approximates to the average mortality for contemporary coronary artery bypass surgery. Mean Parsonnet score ranged from 6.5 to 8.7 over seven years. The mean Euroscore in 2000 and 2001 was unchanged at 2.7 but rose to 2.94 in 2002. Figure 5 shows patient risk distribution for 2001.

No scoring will ever be predictive of outcome, particularly in high risk patients[8]. Firstly we do not yet fully understand the pathophysiological response to surgery or factors influencing an individual patient’s reserve. Secondly some of the major risk factors are not easily quantifiable or definable. Thirdly some high risk patients may be difficult to characterise and the statistical denominators are relatively small. Nevertheless both the Parsonnet and Euroscore models provide a useful yardstick when examining mortality in groups of patients.

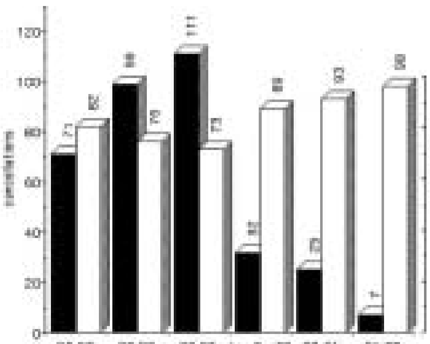

figure 1. **annual cancellations and efficiency**
black bars: cancellations white bars: efficiency

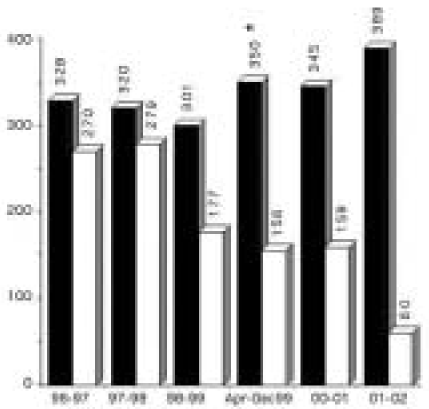

figure 2. **annual operative rate vs waiting time**
black bars: annual operative rate white bars: mean waiting time (days)
* [illegible] operations performed in 9 months

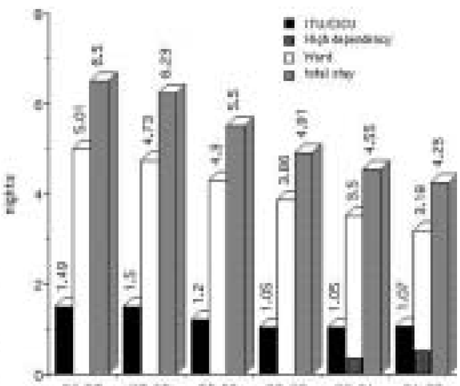

figure 3. **post-operative stay**

Table 1: *Procedure related mortality*

	Malta (n=2256)	Italian NCDB (n=2500)
routine CABG	0.65	2.3
AVR	1.4	1.7
AVR + CABG	1.3	8.4
MVR	1.5	4.9
MVR + CABG	5.3	10.8

Table 2: *Overall morbidity*
Incidence expressed as percentage

Major cardiac	
Need for IABP	2.1
Peri-operative MI	0.6
Permanent pacemaker	1.0
Ventricular arrhythmias	0.5
Major neurological	
Cerebrovascular accident	0.7
Major renal	
Necessity for haemodialysis	0.7
Major respiratory	
Vent >24hrs / reintubation	1.2
Major gastrointestinal	
Laparotomy	0.1
Major infective	
Septicaemia	0.8
Endocarditis	0.2
Mediastinitis	0.4
Serious leg infection	0.1
Resternotomy	
For haemorrhage	0.4
For tamponade	0.3
Minor cardiac	
Prolonged inotropic support	12.1
Atrial fibrillation	9.7
Atrial flutter	0.9
Minor neurological	
Transient ischaemic attack	0.7
Post-operative confusion	0.3
Peripheral neuropathy	0.5
Minor renal	
Doubling of creatinine	1.9
Minor respiratory	
Chest infection	1.5
Chest drain	0.6
Minor gastrointestinal	
Upper GI haemorrhage	0.9
Minor infective	
Minor sternotomy or leg infection	2.6

Mortality

In Figure 6 all patients (1995-2001 n=2256) are grouped according to risk. Predicted mortality by Parsonnet, a product of group size and risk, is presented next to actual mortality. Our single largest class within the extremely high predicted mortality group came from failed angioplasties, before widespread stenting was introduced.

Mortality in the over 70 age group decreased over the years whereas that for the younger patients remained fairly constant. This trend (Figure 7) may reflect our growing experience with older patients who make up an ever increasing proportion of our total practice4.

Most units now describe a procedure-related mortality and this allows for international comparisons. Table 1 includes figures published by the Italian National Cardio Anaesthesia Data Base (NCDB) with information derived from 30 institutions[9].

Morbidity

For each patient we record and categorise complications into separate systems and assign them as major or minor. Thus a major cardiovascular complication would include the necessity for intra-aortic balloon counterpulsation or permanent pacemaker, the occurrence of a peri-operative myocardial infarction (MI), or of malignant ventricular arrhythmias. Cerebrovascular accident (CVA) is a major neurological complication. The minor neurological complications included transient ischaemic attack (TIA), post-operative confusion or peripheral neuropathy. Figure 8 summarises our annual neurological complications. The overall incidence of CVA and TIA was 0.7% each. Permanent neurological damage remains a major problem in the over 70's, with a fourfold increase in incidence. As in other series[10] it was more likely to result in early postoperative death, and in the survivors rehabilitation was likely to be more prolonged and ultimately less effective. Similar data is kept for renal, respiratory, gastrointestinal, infective and

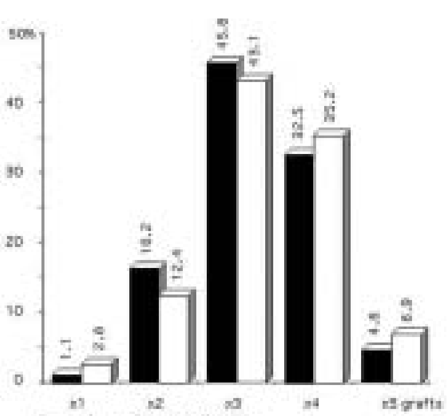

figure 4. grafts distribution
black bars: elderly patients   white bars: patients under 70

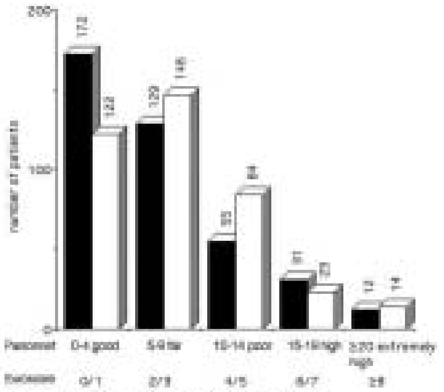

figure 5. patient risk distribution for 2001
black bars: Parsonnet   white bars: Euroscore

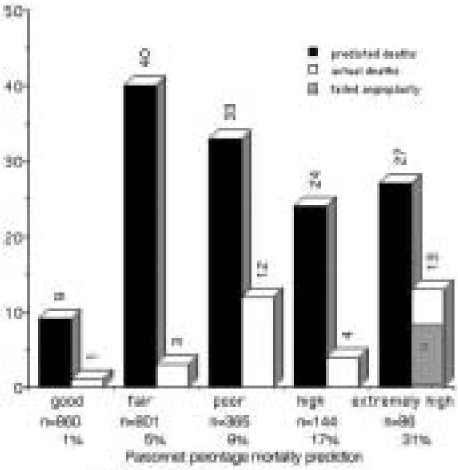

figure 6. risk-stratified deaths

haemorrhagic complications (Table 2). Table 3 compares selected complication rates, again with the Italian NCDB.

Other international comparisons

The UK National Adult Cardiac Surgical Database Report for 1999-2000 is a 160 page document containing data on mortality and activity from all UK units and more detailed patient-oriented data from almost 90% of units[8]. Almost 35000 adult cardiac surgical procedures were carried out in the UK that year, 71% were isolated CABG operations. The report contains data comparable to ours on several parameters and these are presented in Table 4. The UK population was slightly older and of comparable risk, but we provided for an increased intervention rate with a lower mortality and a shorter hospital stay. Our overall intervention rate was 77% higher whereas coronary revascularisation was almost double that in the UK. With regard to our early post-operative discharge we have the geographical advantage of short distances, enabling patients to easily return to our ward should the need arise. Our local service is based on the model of a consultant-based practice with close supervision of all junior staff. This differs somewhat from the hierarchical system operating within the UK national health service. These differences may account for our dissimilar results.

CICU resource management

Over the last two years we have audited some aspects of CICU resource management with the aim of establishing the pattern of our common practice. Thus, in 2001, patients spent a mean of 8.6 hours on mechanical ventilation following surgery. Twenty seven percent of patients were given a blood transfusion and only 14 of 389 patients required four or more units. This data has enabled us to request three rather than four units of blood to cover our surgery, an example of audit influencing a change in practice. With regard to haemostatic agents, tranexamic acid was administered in 9.6% of patients, additional protamine in 4.7% and aprotinin, an effective but costly drug, in 4.9% of patients. Post-operative haemorrhage, measured from the time of chest drain connection in theatre until the point of chest drain removal, was 485±297ml.

Cost

Every year we calculate our package cost for CABG and valve replacement. This is a laborious task as it includes the cost of drugs, infusions, disposable items, investigations, salaries and capital investment. The package prices shown in Table 5 are those for 2002. Sending patients abroad, as occurred prior to 1995, is vastly more expensive. Foreign package prices are published and so it is not difficult to make comparisons. Over this seven year period our local service has saved an estimated 9.1 million liri (Table 5).

Table 3: *Overall morbidity*
IABP: Intra-aortic balloon pump

	Malta (n=2256)	Italian NCDB (n=2500)
atrial fibrillation	9.7	11.3
need for IABP	2.1	2.1
CVA	0.7	1.0
acute renal failure	0.7	2.8
re-opening for bleeding	0.7	4.5

Table 4: *Comparisons with UK database*

	Malta (n=2256)	UK (n=34633)
intervention rate / 10^6		
all cardiac surgery	1023	577
CABG	789	412
Risk: Parsonnet	6.8	6.0
Euroscore	2.7	3.2
Mean age	61.5	63.2
Mortality routine CABG	0.65	2.2
Post-operative stay (nights)	4.25	8.5

Resident training

Our unit also provides postgraduate training in the field of cardiothoracic surgery. I practice a one-to-one apprenticeship with my assigned trainee and follow his progress continuously. Auditing trainee patient management and task performance is at best an inaccurate exercise. I have therefore limited assessment for audit purposes to cases performed per annum and ischaemic time during coronary artery revascularisation as a measure of competence in this area. All trainee cases were performed under supervision with myself acting as assistant. This data is illustrated in figure 9. As a reference point my

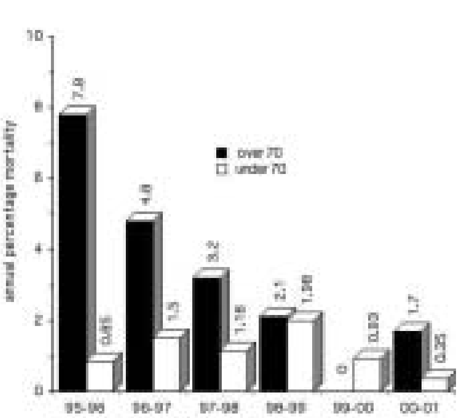

figure 7. mortality trends

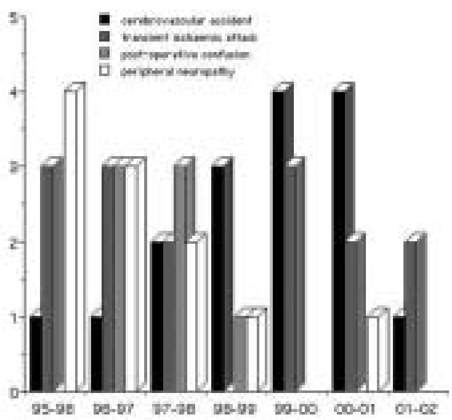

figure 8. neurological complications

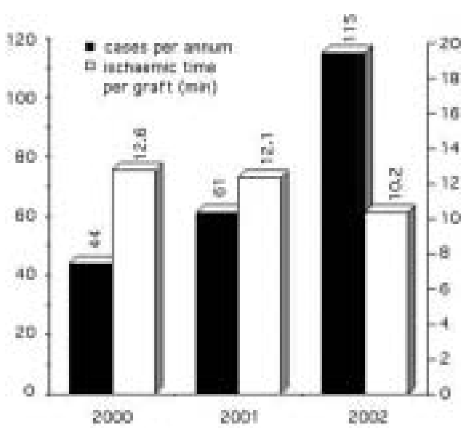

figure 9. trainee progress

Table 5: *Costings*

Cost estimation of program for 2001-2002

369 cardiopulmonary cases	
at Lm1324.13 each	Lm488 603.97
20 OPCAB cases at Lm1206.33 each	Lm24 126.60
85 valves at Lm1129 each	Lm95 965.00
Grand total	**Lm608 695.57**

Estimated savings since the start of the local cardiac programme

Year	Estimated local cost	Estimated foreign cost	Estimated savings
1995-96	Lm 368,100	Lm 1,196,605	Lm 828,505
1996-97	Lm 414,000	Lm 1,515,032	Lm1,101,032
1997-98	Lm 424,156	Lm 1,660,800	Lm1,236,644
1998-99	Lm 368,289	Lm 1,593,434	Lm1,225,145
1999-00	Lm 342,095	Lm 1,391,270	Lm1,049,175
2000-01	Lm 464,563	Lm 2,232,700	Lm1,768,137
2001-02	Lm 608,695	Lm 2,517,450	Lm1,908,755
Total	**Lm 2,989,898**	**Lm12,107,291**	**Lm9,117,393**

personal cases for coronary revascularisation during this period amounted to 614, with a mean graft ischaemic time of 8.7 minutes.

Discussion

Clinical practice receives considerable scrutiny and this puts enormous pressure on surgeons. This situation is particularly acute in cardiac surgery since the higher the risk of a procedure, then the greater the pressure on the responsible clinician. Many of our operations are proffered to patients who are stable and not uncommonly only moderately symptomatic, in the hope of ameliorating their long term outlook. Advising these patients on the best course of action is acutely dependent upon access to accurate data derived from widespread audit. Surgeons and healthcare administrators have increasingly recognised the value of comprehensive data collection for understanding severity of illness, resource allocation and outcome analysis.

Measuring outcomes against a risk stratified expectation is one way of ensuring that performance can be shown to match the international norm. Equally, partial data may serve to confuse or mislead the general public. Inadequate understanding of operative risks is a leading cause of malpractice actions. Cardiologists and cardiac surgeons may be ignorant of the changing patterns of populations undergoing surgery and this may perpetuate the professional misconception that coronary surgery carries little risk[8]. Against this background it is gratifying to see that audit is being adopted on an ever-increasing scale and has the backing of our employers and hopefully our patients.

In our particular sphere it would be more meaningful if different modalities of treatment, such as angioplasty, could be subjected to a similar audit. It is also important that accepted norms of practice and outcomes are updated regularly and stratification systems devised that are more relevant to our changing population. Hence the adoption of the Euroscore system. In 1980 there were several risk factors that clearly stood out as compelling markers for patient risk. However the trend is for a more homogenous array of odds ratios and we may be approaching a situation where death following CABG will be almost a random event and risk modelling will be virtually impossible[11]. In recent years CABG mortality has reached an international plateau of approximately 3%. As the frequency of recognised risk factors is increasing, their individual impact is decreasing, making prediction of outcomes more difficult.

Apart from achieving a minimum mortality and morbidity, delivering quality is an all-encompassing goal from admission to hospital to the surgical outpatient clinic and beyond. The technical aspect of the surgery is but a part of this process, and outcome depends more on appropriate referral and selection than it does on the quality of surgery and post-operative management. Outcome will depend on other variables such as the patient population, severity of illness and co-morbidities, standards of anaesthesia and intensive care, staff levels and training, and other hospital facilities. Patients have a right to good surgery, and to informed consent in order that they may reach a correct decision. It is our responsibility to provide appropriate information so that all parties understand the basis on which a decision for surgery was made. We cannot provide this information without up-to-date and robust local and international data. Hence the requirement for audit.

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