

# Maximising the benefit from pre-operative cardiac evaluation for elective, non-cardiac surgery

JAIDEEP J PANDIT

## Abstract

**P**atients scheduled for elective surgery are commonly cancelled because an existing cardiac problem is felt to need review. Currently, the positive yield of pre-operative cardiac review is low, largely because communication between specialties is poor and an explicit question is not asked of the cardiac team. All practitioners need to agree upon the proper criteria for cardiac referral, and upon the proper aims of the cardiac review. In particular, the term 'fit for surgery' must be abandoned.

**Key words:** cardiac surgery, risk, anaesthesia, pre-operative assessment.

*Br J Cardiol* 2004;**11**:468-73

## Introduction

Currently, the cancellation rate for elective operations on the day of surgery is high, often reaching levels of 10-15%. A common reason for cancellation is an inadequately treated medical or cardiac problem.<sup>1,2</sup> These patients are often then referred to a cardiologist or general physician for an opinion on whether they are 'fit' for anaesthesia. This article examines the anaesthetic and surgical perspective of this scenario. It examines what are the ideal aims of the medical/cardiac consultation and it also offers suggestions for improved multi-disciplinary care in this situation.

## The anaesthetic/surgical perspective Philosophy: risk reduction and risk benefit analysis

Elective surgery involves a surgical intervention planned to improve the patient's condition or quality of life but which is not of itself life-saving. Elective surgery can therefore always be planned for a time which suits the patient (or the patient's medical condition), the surgeon, the anaesthetist, and the healthcare organisation in which the surgical intervention takes place.<sup>3</sup>

There should be no additional risk to the patient by planning surgery for such a time.<sup>3,4</sup> In this context, it is a basic philosophy of good anaesthetic practice that optimal treatment of all co-existing medical problems should minimise peri-operative risk.<sup>3,4</sup>

An example of an elective operation is an inguinal hernia repair. The operative risks for this operation will be higher in an untreated hypertensive patient, as compared with the risks for a treated patient.<sup>5</sup> Since the hernia operation itself does not in any sense contribute to increased survival, a superficial risk-benefit analysis clearly favours prior treatment of the hypertension, rather than proceeding with surgery without treatment.<sup>5,6</sup> In contrast, an example of a corresponding emergency operation is a strangulated, obstructed hernia. Again, the risks of surgery will still be greater in an untreated hypertensive patient than in a treated patient. The risks of delaying surgery for antihypertensive therapy, however, will far exceed any additional risks of proceeding with surgery.

Such considerations suggest that the term 'fitness for anaesthesia' is both uninformative and misleading. A further illustration reinforces this. A young athlete scheduled for elective varicose vein surgery might reasonably be cancelled for further investigation if this patient is found to have left bundle branch block and an asymptomatic systolic murmur. On the other hand, varicose vein surgery might reasonably proceed in an elderly patient with New York Heart Association Class III heart failure on



Jaideep J Pandit

Nuffield Department of Anaesthetics, John Radcliffe Hospital, Oxford, OX3 39U.

Jaideep J Pandit, Consultant Anaesthetist

Correspondence to: Dr JJ Pandit  
(email: jaideep.pandit@physiol.ox.ac.uk)

**Table 1.** Simplified, revised cardiac risk index as developed by Lee *et al.*<sup>7</sup> There may be problems, for example, in defining what 'high-risk surgery' means; that congestive heart failure may encompass a wide range of ejection fractions; or that a very precise threshold is used for the creatinine level. Other problems and further explanation in text

<b>Predictive factor</b>	
High-risk surgery	
Ischaemic heart disease	
Congestive heart failure	
Cerebrovascular disease	
Insulin-treated diabetes	
Creatinine > 177 µmol/L	
<b>Number of factors</b>	<b>Risk of major cardiac complications</b>
0	0.4%
1	1.1%
2	4.6%
> 3	9.7%

maximum treatment. This might seem surprising: the young athlete is clearly the 'fitter' patient. However, the proper consideration being applied is that the athlete is suboptimally investigated and treated. The elderly patient is the better optimised and is as fully treated and investigated as possible.

Objective, high-quality evidence in support of this philosophy of risk reduction is sparse for all medical conditions. Large, controlled trials for all possible co-existent diseases do not exist because of: ethical issues; the heterogeneity of the patient population; the variability in surgical methods, and the variability in anaesthetic management. Therefore, for any given medical condition, it is often impossible to quote a precise numerical value indicating peri-operative risk. For cardiovascular risk, Lee *et al.* have suggested a simplified scoring system to help quantify this.<sup>7</sup> Their system is summarised in table 1. Lee and colleagues were themselves uncertain "how this system should be used by clinicians", but it would seem reasonable that for patients with  $\leq 1$  predictive factor (hence with total risk of  $< 1\%$ ), any further cardiac intervention would be unlikely to further reduce this risk. For other diseases, similar data are more sparse, but the general approach of risk reduction and a risk-benefit analysis seems sensible and is advocated by authoritative guidelines and teaching.<sup>3,4,8</sup>

### Practical anaesthetic conduct of the risk reduction approach

Even though the majority of anaesthetists adhere to the principle of cancelling elective surgical patients whose medical conditions have not been optimised, it seems that very few anaesthetists subsequently make clear to their surgical colleagues the precise reasons for postponing surgery. To achieve this aim, the anaesthetist could write in the patient's case notes, or dictate or write a letter to the surgical (or appropriate medical) team outlining the problems to be resolved. One reason why anaesthetists fail to do this might be that the dictation of letters is not an integral

part of anaesthetic training. Anecdotally, anaesthetists tend to write only on their dedicated anaesthetic charts. Other health-care workers do not often read these charts.

Formal referral of the patient to the medical team is left to the surgeon who, often only vaguely aware of the reasons for cancellation, can only suggest the patient be assessed for general 'fitness'. Kleinman *et al.* found that only 3% of such referrals to the medical team specify what is required of the cardiologist. The rest ask only for an 'evaluation' or 'clearance' and, some, make no request at all.<sup>9</sup> Consequently, the positive yield of pre-operative cardiac consultations is extremely low and as few as 10% of patients referred have any change in medical treatment or investigations before surgery.<sup>10</sup>

### The perspective of the cardiology team

If a patient attends cardiac clinic with only the vague request that s/he be assessed for 'fitness', the cardiologist may be faced with a number of problems. First, the cardiologist may not know the precise nature or implications of the planned surgery. For example: what does a trans-vaginal tension-free tape operation actually involve?; what are the physiological implications of a bimaxillary osteotomy as opposed to a repair of zygomatic fracture? Second, the cardiologist may not be familiar with the details of all anaesthetic techniques: how should the blood pressure best be managed during laparoscopic adrenalectomy?; what are the indications or contra-indications for a combined spinal-epidural technique? Thus, apart from some exceptional circumstances, it is impossible for a cardiologist to make any useful comment on the practical conduct of surgery or anaesthesia. Advice such as "the heart rate should be monitored during surgery", or "low blood pressure should be avoided during surgery", are clearly of limited relevance to the anaesthetic team.

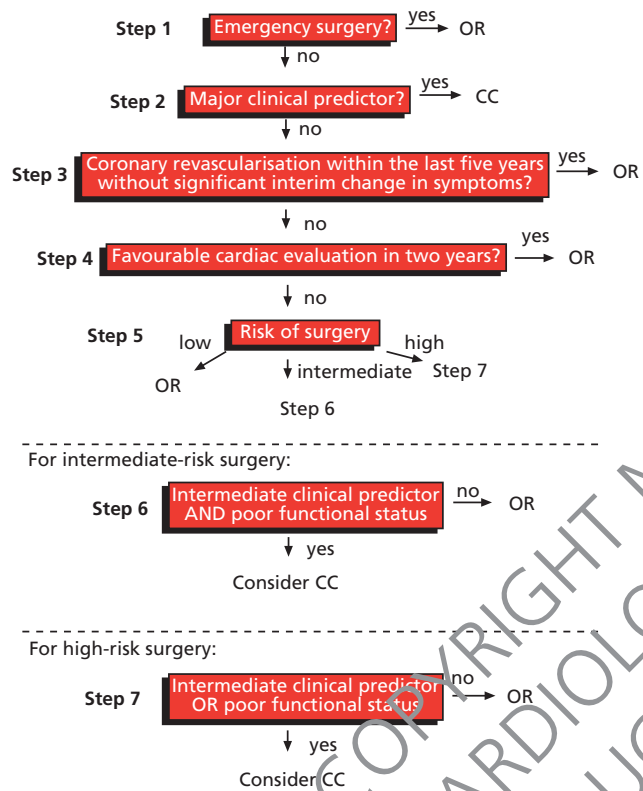
The outcome of the cardiac consultation can only be as useful as what is asked of it: if the referring anaesthetist/surgeon were to ask a more precise question of the cardiologist, then a more precise answer should result. What then should be the proper aims of a pre-operative cardiac consultation?

### Proper aims of pre-operative consultation

It is generally agreed that there are at least three important aims of the pre-operative evaluation.<sup>10,11</sup>

- A possibly inadequately-treated condition (e.g. angina or heart failure) should be optimised. The cardiac consultation may conclude that the condition is already optimally treated and no further intervention is warranted. Even if this is the case, this is valuable input to the anaesthetic/surgical plan.
- An undiagnosed condition (e.g. new onset atrial fibrillation or a heart murmur) should be investigated. Again, it is possible that once diagnosed, this condition may not need any treatment. Alternatively (though perhaps less commonly), cardiac investigation reveals an abnormality which not only needs attention but is judged to need attention before the surgery which resulted in the referral.
- Objective data should be provided to help guide anaesthetic management or provide an index of risk (e.g. a specific

**Figure 1.** Modification of the ACC-AHA guidelines to highlight indications for cardiology consultation. The clinical predictors, high-risk and intermediate-risk surgery, and poor functional status are defined in the text. CC may be indicated for patients with a major clinical predictor for patients undergoing an intermediate-risk surgery who have poor functional status and an intermediate clinical predictor, and for patients undergoing a high-risk surgery who have poor functional status or an intermediate clinical predictor



**Key:** ACC = American College of Cardiology; AHA = American Heart Association; OR = operating room; CC = cardiology consultation

Adapted from Park KW<sup>11</sup>

request for left ventricular ejection fraction or ischaemic threshold of tachycardia on exercise test). In this context, the cardiologist is (to some extent) simply providing only a support service to the anaesthetic/surgical team. The final decision as to whether to proceed with surgery and, if so, in what manner (e.g. extent of invasive monitoring to be used, or the need for elective post-operative intensive care admission) must rest with the anaesthetic/surgical team, based upon data provided by the cardiologist.<sup>3</sup>

**Guidelines for referral to the cardiology team**

If we accept that risk reduction in elective patients is important, and that referrals should be made explicit, and the proper aims of the cardiac consultation as outlined above are also accepted,

**Table 2.** Cardiac risk stratification for non-cardiac surgery. Risk refers to combined risk of cardiac death or myocardial infarction

**High cardiac risk (> 5%)**

- major operations, especially in the elderly
- aortic and other vascular surgery
- prolonged surgical procedures associated with large fluid shifts or blood loss

**Intermediate cardiac risk (< 5%)**

- carotid endarterectomy
- head and neck surgery
- orthopaedic surgery
- prostate surgery

**Low cardiac risk (< 1%)**

- endoscopic procedures
- body surface surgery
- cataract surgery
- breast surgery

Adapted from: Park KW<sup>11</sup>

it is then important to consider the proper criteria for referring the patient to a cardiologist. Recently, the American College of Cardiology (ACC) and the American Heart Association (AHA) suggested guidelines for referral for elective, non-cardiac surgical patients,<sup>12</sup> which were also published in a slightly modified form.<sup>11, 8</sup> These guidelines help both the referring anaesthetist and the cardiologist receiving the referral.

First, the guidelines make a distinction between elective surgery and emergency surgery: urgent life-saving surgery must never be delayed simply to obtain a cardiac opinion.

Second, for elective surgery, the guidelines contain elaborate flow charts and definitions of 'major, intermediate and minor clinical predictors' (figure 1) and definitions of 'high-, intermediate- and low-risk surgery' (table 2). This advice may be further summarised: referral to a cardiologist is generally indicated if the patient has any new, or under-optimised, or uninvestigated cardiac condition (e.g. coronary artery disease, heart failure, murmur, or arrhythmia) unless the patient has 'recently' (i.e. within approximately two years) seen a cardiologist for the same condition and the condition is stable. Communication is important: the referring physician (anaesthetist or surgeon) should specify (preferably in the form of an appropriately written letter) what information is being sought from the referral.

Third, the guidelines also offer some advice for the cardiologist receiving the referral. The general principle is that the indications for further cardiac investigation or treatment of the referred patient are the same as those in a non-operative setting. In other words, a patient who does not need an echocardiogram or coronary artery bypass surgery (CABG) does not suddenly need these, just because surgery is scheduled.<sup>14</sup> An exception to this is if the request is specifically to quantify a variable (e.g. left

ventricular ejection fraction) and it is made clear that this is necessary for the planning of anaesthesia or for risk assessment. While Lee *et al.* have suggested that risk assessment itself might generally be undertaken using a simplified clinical scoring system, rather than using expensive investigations,<sup>7</sup> it would be generally prudent to accept a specific request for more objective information.

These ACC/AHA guidelines are clearly constructive although it is important to highlight some of their limitations. The guidelines represent a consensus opinion and are not a statement of fact: the committee acknowledged that good quality evidence did not exist for all the guideline statements. The guideline algorithms concentrate only on cardiovascular evaluation: in reality many patients also have serious non-cardiac disease and this further modifies their overall operative risk. This is particularly true of obstructive pulmonary disease, which often accompanies cardiac disease. It is possible that while the main problem might not be strictly cardiac, the cardiologist is a reasonable first port of call to assist in general medical pre-operative optimisation. Furthermore, the categorisation of surgery into high, intermediate and low risk might not be sufficiently accurate (table 2). For example, 'head and neck surgery' (categorised as intermediate risk in the guidelines) actually encompasses a range of operations from major tumour resection with free flaps (high risk) to salivary gland removal (low risk). Also, while many planned surgical procedures might initially fall into a low-risk category, they may unexpectedly evolve during the course of surgery into more major and, therefore, high-risk undertakings. Finally, the details of some of the cardiac and anaesthetic advice might be more suited specifically to North American practice, since there were no European members of the committee.

I shall now look at three specific areas of interest by which risk reduction in the elective patient can be achieved.

### Peri-operative use of beta blockade

The cardiac risk to a patient with known coronary artery disease undergoing non-cardiac surgery can be reduced with peri-operative beta blockade.<sup>15-17</sup> Poldermans *et al.* have reported mortality of major vascular surgery being reduced from 17% to 3.4%. This protective effect appears to continue for two years after surgery.<sup>17</sup> Since the current mortality of CABG is itself approximately 3%,<sup>11</sup> this result is of great interest. For example, a patient with under-optimised angina might be referred for cardiac assessment. Currently, reasonable advice might be that CABG should be performed before any non-cardiac surgery. However, this decision exposes the patient to the 3% risk of CABG plus the risk of the subsequent non-cardiac surgery of approximately 1.7% in post-CABG patients (a total of about 4.7%).<sup>11</sup> In contrast, simply using beta blockers peri-operatively seems to reduce the overall risk of non-cardiac surgery to around 3%. This might influence the behaviour of both anaesthetists and cardiologists in future, who might opt to treat patients with beta blockade and proceed with non-cardiac surgery, rather than take the 'conventional' route to coronary revascularisation. This practice has not yet been adopted apart

from in a few centres. It is still not known whether all beta blockers are equally effective; for how long therapy should be continued for maximum benefit; and when or if revascularisation should be considered post-operatively.<sup>18</sup> The best management of patients with both coronary disease and obstructive lung disease remains unclear, especially since beta blockers are generally contra-indicated in this group of patients.

### Percutaneous transluminal coronary angioplasty (PTCA)

If the risk of CABG is higher than that of beta blockade plus non-cardiac surgery, might PTCA be a more suitable alternative to CABG for revascularisation in pre-operative elective surgical patients? The mortality and immediate success rate of PTCA depends on the severity of the coronary lesion and the urgency with which PTCA is performed. Reported success rates appear to be constantly improving.<sup>19</sup> Thus, PTCA may be a better route than surgery for some selected general surgical patients, but a delay in non-cardiac surgery of at least 30-40 days<sup>20</sup> (and, perhaps, more suitably over 90 days<sup>21</sup>) between PTCA and elective non-cardiac surgery is advisable. Aspirin/anticoagulation is stopped before some types of elective surgery (e.g. prostate, bladder) to minimise risk of bleeding but if this is done within 30 days of stenting, the risk of stent re-occlusion is prohibitively high.<sup>22</sup>

Kelion and Banning<sup>14</sup> have highlighted some problems posed by patients who are symptom-free but at high cardiac risk (> 5% based on the risk index of Lee *et al.*<sup>7</sup>). There is little hard evidence to support a policy of coronary angiography in these patients. There is also no evidence that CABG in symptom-free patients reduces the risk of non-cardiac surgery.<sup>14</sup> There may also be a sound pathophysiological reason why mechanical intervention (PTCA or CABG) may not benefit this group of patients. The cause of spontaneous myocardial infarction (plaque rupture) probably differs from peri-operative myocardial infarction (which curiously occurs on the second or third post-operative day, rather than during surgery when stress might be highest).<sup>23,24</sup> If this is indeed the case, then perhaps it is more rational to concentrate efforts on achieving a balance between myocardial oxygen delivery and demand in the peri-operative period (e.g. with aggressive management of risk factors and beta blockade), rather than on mechanical revascularisation.<sup>14</sup>

### The uninvestigated murmur

Traditionally, a heart murmur might not be 'innocent' if:

- there are associated cardiovascular symptoms such as chest pain, palpitations or breathlessness
- it is a diastolic murmur
- it is anything other than ejection systolic
- it occurs along with other positive cardiovascular signs in the clinical examination (such as a characteristic pulse or thrill)
- the ECG or chest X-ray are abnormal.<sup>25</sup>

Non-innocent murmurs require further investigation, usually with echocardiography. The main anaesthetic concern is that a murmur may indicate severe aortic stenosis (other valvular lesions are of relatively less concern). Aortic stenosis can be asympto-



## Key messages

- 'Fitness' for anaesthesia or surgery is a meaningless term and should be avoided by all medical practitioners involved in a patient's care. It is better to describe the patient as suitably 'optimised'
- The anaesthetist or surgeon who refers an elective surgical patient to the cardiologist (or general physician) should communicate explicitly what is sought from the consultation
- Cardiologists assessing elective surgical patients should concentrate upon optimising pre-existing cardiac and medical conditions, rather than on offering specific advice on anaesthetic or surgical management
- The need for elective surgery should of itself not influence the cardiologist in any decision to investigate or treat the patient
- If pre-operative optimisation is necessary, the cardiologist might be faced with certain dilemmas concerning the optimum modes of treatment (e.g. PTCA vs. CABG)
- There is probably not enough published evidence at present to use beta blockade 'routinely' in the absence of a cardiac opinion in elective surgical patients suspected of having cardiac pathology. However, for cases in which it is felt that delaying elective surgery itself might increase risk (e.g. cancer surgery), it would seem reasonable to use acute peri-operative beta blockade
- Current guidelines concerning asymptomatic systolic murmurs seem extremely cautious. In certain circumstances, it would seem reasonable to proceed with elective surgery in patients found to have a murmur which fulfils the criteria of being clinically 'innocent'

matic until very severe and may therefore masquerade as an 'innocent' murmur.

Highlighting this possibility, the National Confidential Enquiry into Peri-Operative Deaths (NCEPOD) has suggested that all elective patients found to have a murmur during routine pre-operative clinical examination should undergo echocardiography before any elective surgery.<sup>8</sup> If this advice were followed to the letter, it would clearly increase demand for echocardiography services, a fact which NCEPOD recognised, suggesting that anaesthetists and cardiologists jointly develop local protocols.<sup>8</sup> However, is the advice to perform echocardiography (and hence potentially delay elective surgery) itself reasonable?

Some studies suggest that patients with an aortic valve area of < 0.5 cm<sup>2</sup> and pressure gradient > 50 mmHg, in whom non-cardiac surgery was nonetheless undertaken had a peri-operative

mortality of approximately 3% with careful anaesthetic management.<sup>26,27</sup> This compares with a mortality for aortic valve repair of 3–4%.<sup>11</sup> Thus, in certain circumstances it might seem reasonable to proceed with non-cardiac surgery in the presence of an undiagnosed murmur since, even in the worst case (i.e. that of severe aortic stenosis), the risk of proceeding is similar to the risk of valve surgery itself. It is important to use a suitably careful anaesthetic plan (which might have other implications in terms of resources). Cardiac referral might be undertaken post-operatively rather than pre-operatively for patients in whom surgical delay itself increases overall risks. Recent recommendations suggest that exercise testing is the key investigation which should determine the need for valve surgery in patients with asymptomatic aortic stenosis.<sup>28</sup> It is unclear whether this advice will increase or reduce the overall rate of valve surgery in this group of patients.

## Conflict of interest

None declared.

## References

1. Audit Commission. Waiting for elective admission: review of national findings. London: CW Print Group, 2003.
2. Rai M, Pandit J. Day of surgery cancellations after nurse-led pre-assessment in an elective surgical centre: the first 2 years. *Anaesthesia* 2003; **58**:684-711.
3. *Pre-operative assessment: the role of the anaesthetist*. London: The Association of Anaesthetists of Great Britain and Ireland, November 2001.
4. *Risk Management*. The Association of Anaesthetists of Great Britain and Ireland, January 1998.
5. Prys-Roberts C, Meloche R, Foex P. Studies of anaesthesia in relation to hypertension. I: Cardiovascular responses of treated and untreated patients. *Br J Anaesth* 1971; **43**:122-37.
6. Stone JG, Foex P, Sear J *et al*. Risk of myocardial ischaemia during anaesthesia in treated and untreated hypertensive patients. *Br J Anaesth* 1988; **61**:675-9.
7. Lee TH, Marcantonio ER, Mangione CM *et al*. Derivation and prospective validation of a simple index for prediction of cardiac risk of major non-cardiac surgery. *Circulation* 1999; **100**:1043-9.
8. National Confidential Enquiry into Perioperative Deaths. Functioning as a Team? The 2002 Report of the National Confidential Enquiry into Perioperative Deaths. London: The Association of Anaesthetists of Great Britain and Ireland, November 2002.
9. Kleinman B, Czinn E, Shah K, Sobotka PA, Rao TK. The value to the anaesthesia-surgical care team of the preoperative cardiac consultation. *J Cardiothorac Anesth* 1989; **3**:682-7.
10. Katz RI, Barnhart JM, Ho G, Hersch D, Dayan SS, Keehn L. A survey on the intended purposes and perceived utility of preoperative cardiology consultations. *Anesth Analg* 1998; **87**:830-6.
11. Park KW. Preoperative cardiology consultation. *Anesthesiology* 2003; **98**:754-62.
12. Eagle KA, Berger PB, Calkins H *et al*. ACC/AHA Guideline Update for Perioperative Cardiovascular Evaluation for Noncardiac Surgery – Executive Summary: A report of the ACC/AHA task force on practice guidelines (Committee to Update the 1996 Guidelines on Perioperative Cardiovascular Evaluation for Noncardiac Surgery). *J Am Coll Cardiol* 2002; **39**:542-53.
13. Stinson DK. An abbreviation of the ACC/AHA algorithm for perioperative cardiovascular evaluation for noncardiac surgery. *Anesth Analg* 2003; **97**:295-6.
14. Kelion AD, Banning AP. Is simple clinical assessment adequate for cardiac risk stratification before elective non-cardiac surgery? *Lancet* 1999; **354**:1837-8.
15. Mangano DT, Layug EI, Wallace A, Tateo I. Multicenter Study of

- Perioperative Ischemia Research Group. Effect of atenolol on mortality and cardiovascular morbidity after noncardiac surgery. *N Engl J Med* 1996;**335**:1713-20.
16. Wallace A, Layug EI, Tateo I *et al*. Prophylactic atenolol reduces postoperative myocardial ischemia. *Anesthesiology* 1998;**88**:7-17.
  17. Poldermans D, Boersma E, Bax JJ *et al*. Dutch Echocardiographic Cardiac Risk Evaluation Applying Stress Echocardiography Study Group. Bisoprolol reduces cardiac death and myocardial infarction in high-risk patients as long as 2 years after successful major vascular surgery. *Eur Heart J* 2001;**22**:1353-825.
  18. Priebe H-J. Perioperative  $\beta$ -blocker therapy. *Anesth Analg* 2003;**96**:S60-S65.
  19. Krone RJ, Laskey WK, Johnson C *et al*. A simplified lesion classification for predicting success and complications of coronary angioplasty. *Am J Cardiol* 2000;**85**:1179-84.
  20. Kaluza GL, Joseph J, Lee JR, Raizner ME, Raizner AE. Catastrophic outcomes of noncardiac surgery after coronary stenting. *J Am Coll Cardiol* 2000;**35**:1288-94.
  21. Posner KL, van Norman GA, Chan V. Adverse cardiac outcomes after noncardiac surgery in patients with prior percutaneous transluminal coronary angioplasty. *Anesth Analg* 1999;**89**:553-60.
  22. Vicenzi MN, Ribitsch D, Luha O, Klein W, Metzler H. Coronary artery stenting before noncardiac surgery: more threat than safety? *Anesthesiology* 2001;**94**:367-8.
  23. Mangano DT, Browner WS, Hollenberg M *et al*. Association of perioperative myocardial ischemia with cardiac morbidity and mortality in men undergoing noncardiac surgery. *N Engl J Med* 1990;**323**:1781-8.
  24. Mangano DT, Wong MG, London MJ, Tubau JF, Rapp JA. Perioperative myocardial ischemia in patients undergoing noncardiac surgery – II: incidence and severity during the 1st week after surgery. *J Am Coll Cardiol* 1991;**17**:851-7.
  25. Davies JIT. *Postgraduate Medicine, 5th edition*. London: Chapman and Hall, 1991:14-17.
  26. Torsher LC, Shub C, Rettke SR, Brown DL. Risk of patients with severe aortic stenosis undergoing noncardiac surgery. *Am J Cardiol* 1998;**81**:448-52.
  27. Raymer K, Yang H. Patients with aortic stenosis: cardiac complications in noncardiac surgery. *Can J Anaesth* 1998;**45**:855-9.
  28. Hillis SW, McCann GP. Surgery in asymptomatic aortic stenosis. *BMJ* 2004;**328**:63-4.

COPYRIGHT MEDINEWS  
(CARDIOLOGY) LIMITED  
REPRODUCTION PROHIBITED