Pre-operative assessment of cardiac risk for non-cardiac surgery

Physicians are frequently asked by surgeons and anaesthetists to assess patients pre-operatively to determine their suitability for surgery. The level of cardiac risk has been quantified in observational studies but is not based on randomised prospective data.

Following myocardial infarction (MI), historical data suggest that the risk of reinfarction decreases the longer non-cardiac surgery is delayed; 27% of reinfarctions occur in patients having an operation within 3 months of a MI, 11% within 3–6 months and 4% thereafter, but it has been suggested that careful monitoring can reduce the risk to 5.7% within 3 months and 2.5% subsequently. There is therefore good reason to advocate a delay of at least three and possibly six months after MI before undertaking any non-cardiac surgery.

Attempts to identify clinical indicators of cardiac risk associated with non-cardiac surgery have not yielded any clear answers. In a 1977 study of 1001 patients, four clinical features were independently associated with a risk of cardiac death >10%: a third heart sound or raised jugular venous pressure (ie congestive cardiac failure), MI within the previous six months, clinically important aortic stenosis, and more than five ventricular ectopic beats per minute. The authors of that study proposed a new index of surgical risk that performed better than the Dripps American Surgical Association Index which was then in clinical use. Both indices attributed numerical scores to adverse features and then stratified the patients. By 1990 the new index was shown to be inadequate, and peri-operative monitoring was proposed as a method to define patients at particular risk. Such monitoring strategies aim to identify cardiac ischaemia at an early stage during non-cardiac surgery rather than seeking to avoid its occurrence by pre-operative investigation and treatment.

In 1996, the American Heart Association (AHA) and American College of Cardiology (ACC) published comprehensive guidelines on assessing patients undergoing non-cardiac surgery. These guidelines take a different approach by stratifying individual predictors of risk (rather than calculating a summative score) and also taking into account the patient's functional capacity (exercise tolerance) and the type of surgery planned. The main points are summarised below, with particular reference to ischaemic heart disease.

The AHA/ACC guidelines

In every individual patient the operative risk should be balanced against potential benefit from the proposed surgery; a large peri-operative risk may be justifiable if the benefit of surgery is considerable, eg colectomy for early colonic carcinoma. In addition, before embarking on cardiac investigation to determine if non-cardiac surgery is necessary, the prognosis of the non-cardiac condition, and also any co-morbid conditions, should be taken into account.

The goal of initial assessment is identification of ischaemic heart disease, valve disease, congestive cardiac failure (CCF) and definition of severity, stability and previous treatment of known heart disease. The patient's clinical history and examination, and resting electrocardiogram (ECG) are of utmost importance in making this assessment.

A stepwise approach (Table 1) is advised, based on an algorithm:

- Step 1 states that no investigation is appropriate if emergency surgery is necessary.
- Step 2 deals with patients who have undergone coronary revascularisation (coronary artery bypass grafts (CABG) or coronary angioplasty (PTCA)) in the five years preceding the assessment. If these patients have remained free of signs or symptoms of heart disease, their risk of adverse events is low and they need no further cardiac investigation.
- All other patients enter at Step 3 and are stratified according to the level of their clinical predictors (major, intermediate and minor), which determines the next step.

Major clinical predictors include unstable coronary syndromes (eg recent MI or unstable angina), decompensated CCF, significant arrhythmias (eg ventricular tachycardia, uncontrolled rapid atrial fibrillation) and severe valvular heart disease (particularly aortic stenosis). In these cases surgery should be postponed for cardiac investigation and appropriate management. Once treated for the cardiac problem, patients should be reassessed for the initially planned surgery.

Intermediate clinical predictors are stable angina, previous MI, compensated or prior CCF, and diabetes mellitus. Minor clinical predictors are advanced age, abnormal ECG, rhythm other than sinus, history of stroke, or uncontrolled systemic hypertension. In the presence of intermediate or minor predictors, account should be taken of functional capacity, an arbitrary level of 4 metabolic equivalents (METS) being considered satisfactory (climbing...
Table 1. Stepwise approach to assessing surgical risk. (Adapted from AHA/ACC guidelines)

| Step | Description |
|------|-------------|
| 1    | Emergency life-saving surgery – no pre-operative assessment appropriate |
| 2    | Coronary revascularisation within the last 5 years  
|      | - If no return of symptoms, no investigation needed  
|      | - If symptoms have returned, assess clinical predictors in Step 3 |
| 3    | Major clinical predictors present – postpone or cancel non-cardiac surgery  
|      | eg. uncontrolled congestive cardiac failure  
|      | unstable angina (angina at rest or on minimal exertion)  
|      | myocardial infarction within previous 6 months  
|      | post-myocardial infarction angina  
|      | significant aortic stenosis or severe mitral stenosis  
|      | ventricular tachycardia  
|      | uncontrolled rapid atrial fibrillation  
|      | or Intermediate or minor clinical predictors present – investigate as in Table 2 |

Elective surgery

- Step 2 Coronary revascularisation within the last 5 years
  - If no return of symptoms, no investigation needed
  - If symptoms have returned, assess clinical predictors in Step 3
- Step 3 Major clinical predictors present – postpone or cancel non-cardiac surgery
  - eg. uncontrolled congestive cardiac failure
  - unstable angina (angina at rest or on minimal exertion)
  - myocardial infarction within previous 6 months
  - post-myocardial infarction angina
  - significant aortic stenosis or severe mitral stenosis
  - ventricular tachycardia
  - uncontrolled rapid atrial fibrillation
  - or Intermediate or minor clinical predictors present – investigate as in Table 2

a flight of stairs, walking up a hill or steady walking on level ground at 4 mph). Patients with only minor or intermediate clinical predictors who can achieve this level of exertion need no further investigation unless high risk surgery is intended. This approach is summarised in Table 2.

For those patients for whom further cardiac investigation is indicated, exercise ECG is the investigation of choice. One study has shown that patients who, when they were assessed prior to abdominal aortic aneurysm repair, could reach 85% of predicted heart rate without ECG changes on treadmill exercise, supplemented with arm ergometry, had significantly fewer cardiac events (6%) than those who could not (24%); this finding has been confirmed in other studies. For patients unable to perform treadmill exercise, pharmacological stress (dobutamine/adenosine) myocardial perfusion scintigraphy (MPS) or echocardiography can both provide useful prognostic information. Coronary angiography may be considered for those with significant ST segment changes or anginal chest pain at exercise testing or for those with evidence of reversible ischaemia at MPS or stress echocardiography.

The AHA/ACC guidelines emphasise that relatively few patients will benefit from cardiac revascularisation before non-cardiac surgery. The risk of death or myocardial infarction complicating revascularisation has to be less than the anticipated reduction in these complications at the time of the non-cardiac surgery. A protocol similar to the AHA/ACC guidelines has recently been tested in a German centre, where 201 patients with abdominal aortic aneurysm or aorto-iliac occlusive disease underwent treadmill and questionnaire assessment of functional capacity: 41 (20%) required non-invasive testing (exercise ECG and myocardial perfusion scintigraphy), 7 (3.5%) had coronary angiography and 1 (0.5%) was revascularised by CABG prior to non-cardiac surgery. In this study the cardiac mortality was 1% and cardiac morbidity 12.4%. These data confirmed the anticipated low yield of patients for whom coronary revascularisation is indicated prior to non-cardiac surgery. In addition, it provided an estimate of the increased workload for nuclear medicine and echocardiography departments which would be expected if such a strategy were implemented.

The UK situation

In the UK few patients currently receive pre-operative cardiac investigation, so the implications of following the above guidelines could be considerable. Many patients with adverse clinical predictors or a poor functional capacity (<4 METS) would need clinical assessment and an exercise ECG. Patients unable to exercise (eg with peripheral vascular disease), or with an uninterpretable ECG, would need myocardial perfusion scintigraphy or echocardiography with pharmacological stress. Many hospitals in the UK where major surgery is performed have no facilities for either of these investigations.

In the absence of prospective data, the AHA/ACC guidelines make clear which recommendations are based on evidence from observational data and which are based on the views of the working group. There is good evidence that prediction of low and high risk groups can be identified by clinical and functional assessment (exercise ECG etc); the cost-effectiveness of non-invasive testing for reducing peri-operative cardiac complications, however, has not been reported. The low risk of post-operative cardiac complications among patients who have undergone CABG without

Table 2. Recommendation for non-invasive cardiac investigation depending on presence of intermediate or minor clinical predictors. (Adapted from AHA/ACC Guidelines).

| Surgery type | Clinical predictors | <4METS | >4METS | <4METS | >4METS |
|--------------|---------------------|--------|--------|--------|--------|
| **High risk** |                     | **test** | **test** | **test** | **OT** |
| Aortic and vascular surgery | Prolonged surgery with large blood loss or fluid shift | | | |
| **Intermediate** | Carotid endarterectomy | **test** | **OT** | **OT** | **OT** |
| Intraperitoneal/intrathoracic | Orthopaedic, prostate | | | |
| Head & neck | | | | |
| **Low risk** | Superficial procedures | **test** | **OT** | **OT** | **OT** |
| Endoscopy, breast, ophthalmic | | | | |

METS = metabolic equivalents

test = exercise test, myocardial perfusion scan or stress echocardiography

OT = fit for operating theatre


return of symptoms is well documented, but there is no published information to indicate whether prophylactic revascularisation (CABG or PTCA), or optimised medical therapy would improve overall outcome.

The AHA/ACC guidelines provide a framework to guide decision making but may be difficult to implement in the UK. We need a prospective study broadly applicable to UK and European practice, to define whether delaying non-urgent surgery for cardiac investigation, revascularisation or optimisation of medical therapy really benefits patients with pre-existing heart disease and to assess the cost-effectiveness of such strategies. Meanwhile, decisions about pre-operative assessment will have to be based on the limited data available and on guidelines such as those described.

Acknowledgement

We are grateful to our vascular surgical colleagues, Mr Simon Ashley, Mr Alasdair Walker and Mr Denis Wilkins for their helpful comments.

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