PREOPERATIVE CARE

Recommendations

The anaesthetist, or the anaesthetic department, should be notified of elective patients who have significant operative risks, preferably in advance of their admission.

National protocols should be formulated to identify which inpatients would benefit from a more detailed preoperative cardiovascular assessment, including echocardiography.

When a formal preoperative medical assessment is indicated, an experienced physician, preferably a consultant, must make it. It is the responsibility of that physician to fully understand the operative risks of the patient's medical condition.

There need to be national guidelines for clinical prescribing in hospitals in order to reduce the risk of drug error.

INTRODUCTION

This section of the report will concentrate on the preoperative assessment of patients for their final operation. It must be remembered that the patients reviewed by NCEPOD were mostly those that were of poor physical status and undergoing high-risk surgery, all of whom died within three days of their operation. Most patients reviewed were likely to die irrespective of excellent care. Nevertheless there were remedial factors that may have contributed to an adverse outcome in some patients and lessons to be learned that can improve future patient care.

PRE-ADMISSION PROCEDURES

Pre-admission assessment clinics

88% of hospitals now run pre-admission assessment clinics for one or more surgical specialties.

Pre-admission assessment clinics allow the clinical history and examination of patients to be documented before their admission, enable appropriate routine investigations to be arranged and identify those patients that may need further investigations or treatment before an elective or scheduled operation. They can reduce the period of hospital inpatient stay and reduce the number of operations cancelled at short notice, therefore improving the hospital throughput of surgical patients and helping to reduce the waiting times for operations. A questionnaire on hospital facilities that was circulated to all trusts/hospitals enquired whether the hospital ran pre-admission assessment clinics. 88% (430/487) of hospitals reported that preoperative assessment clinics were being run in their hospital and 10% (51/487) had no pre-admission assessment clinics. It is desirable that all patients for whom it would be appropriate are seen in a pre-admission assessment clinic. A breakdown of the health professionals who run these clinics is presented in Table 3.1 and, if the assessor is a nurse, the health professional that examines those patients who need a more detailed clinical assessment is presented in Table 3.2.

Table 3.1	The health professionals that run the pre-admission assessment clinics
Nurses	266 (62%)
Nurses & doctors	121 (28%)
Doctors	36 (8%)
Not answered	7 (2%)
Total	**430**

Table 3.2	When a nurse makes the assessment, the health professional who makes a more detailed assessment of the cardiac or respiratory system, when indicated
Doctors	106
Nurses	85
Nurses & doctors	59
Not answered	16
Total	**266**

In most cases, when nursing staff undertake the initial assessment and problems are detected, the patient is referred for a second opinion. It is of concern that in 85 hospitals where nurses ran the clinics there appeared little recourse to a medical opinion. However, it is possible that those who were completing the questionnaire may not have fully understood the protocols of their clinics.

Pre-admission assessment of patients

34% of elective admissions did not attend a pre-admission assessment clinic.

From the surgical questionnaires, 17% (356/2114) of patients were admitted either as a day case or an elective admission. The rest were either urgent or emergency admissions and were therefore unlikely to have had a pre-admission assessment. 234 patients (i.e. 66% of the elective admissions) were assessed in a pre-admission assessment clinic. The health professionals that ran those clinics are presented in Table 3.3.

Table 3.3	Health professional who assessed patients before admission *(answers may be multiple n=234)*
Nurse/nurse practitioner	129 (55%)
Preregistration HO	77 (33%)
Surgical SHO	72 (31%)
Anaesthetic consultant	31 (13%)
Surgical consultant	9 (4%)
Anaesthetic SHO	6 (3%)
Surgical NCCG	5 (2%)
Anaesthetic NCCG	5 (2%)
Medical SHO	4 (2%)
Medical NCCG	3 (1%)
Medical consultant	1 (<1%)

There should be comprehensive training of pre-admission assessment staff in preoperative clinical assessment skills.

A nurse or preregistration house officer performed the majority of pre-admission assessments for these patients. It is appropriate for nurses and junior doctors to assess patients before admission providing they are fully trained in clinical assessment skills to identify those patients at risk, and are properly supported. Although some of the pre-admission assessment staff may lack experience they are not the sole preoperative assessor but are part of a chain of operative care. Only 15% (34/234) of patients were reported to have had preoperative therapeutic manoeuvres initiated as a result of their pre-admission assessment; at least seven of these interventions could be considered routine (Table 3.4).

Table 3.4	Therapeutic manoeuvres initiated from pre-admission assessment clinic
Cardiology review/ echocardiogram	10
Routine screening tests*	4
Anticoagulation arranged**	4
Preoperative blood transfusion	2
Correction of low serum K^+	2
Hypertension control	1
ICU bed booked	1
Radiological malignancy staging	1
Haemodialysis	1
Postoperative epidural	1
Sliding scale insulin regimen arranged	1
Carotid endarterectomy before TKR	1
Visit by stoma nurse	1
Stabilise blood sugar and thyroid function	1
Skin swab MRSA treated	1
Not specified	2
Total	**34**

*These included clinical history, haematology and biochemistry investigations, ECG and CXR.

**These included routine perioperative thromboprophylaxis in three patients.

The most common single intervention was referral to a cardiologist for investigation and review of treatment. This included echocardiography in at least four cases and coronary angiography in one.

The following case studies of patients that were assessed at a pre-admission assessment clinic are presented, not to criticise the assessment but to illustrate the place of the pre-admission assessment in the chain of patient care. NCEPOD has tried to illustrate both good and poor practice, and show that assumptions made at the pre-admission assessment may influence subsequent management.

Case Study 1

A 73-year-old, ASA 4 male was admitted for a scheduled transverse colectomy. He had previously undergone repair of an abdominal aortic aneurysm and his medical history included ischaemic heart disease, angina, CCF and TIAs. He was assessed in a pre-admission clinic that was run by nurses and preregistration house officers, and was referred from there for an echocardiogram and review by a cardiologist. A consultant anaesthetist provided general anaesthesia supplemented by epidural analgesia. Postoperatively he was nursed on a HDU, where he developed CCF and died there on the second postoperative day. An autopsy revealed a myocardial infarction.

Case Study 2

An 83-year-old, ASA 2 male was admitted for an elective completion colectomy two years after a left hemicolectomy. A preregistration house officer assessed him at a pre-admission clinic and noted an ejection systolic murmur that had not previously been detected; no action was taken. On admission one week later, a consultant anaesthetist again noted the systolic murmur, but as the patient had no cardiac history or symptoms, no further investigations were deemed necessary. (Results of his CXR and ECG were not forwarded to NCEPOD.) General anaesthesia was supplemented by epidural analgesia using 30 ml of 0.25% bupivacaine. No invasive monitoring was used. The patient's preoperative blood pressure was 150/80 mmHg and for three hours during the operation his systolic blood pressure was between 90-110 mmHg. He had persistent hypotension postoperatively, BP < 90/60 mmHg, and his urine output was low. He had received 4940 ml of fluid intravenously (about 500 ml/hour) and had produced 176 ml of urine by the time of his fatal cardiac arrest 10 hours postoperatively. An autopsy revealed severe aortic stenosis, mitral stenosis, severe cardiomegaly, left ventricular hypertrophy and subendocardial ischaemia.

Case Study 3

A 73-year-old female, ASA 2 patient weighing 45 kg was admitted for a total hip replacement. A nurse and preregistration house officer assessed her at a pre-admission clinic. At that clinic an asymptomatic ejection systolic murmur radiating to the neck, which was thought to be aortic stenosis, was noted for the first time. The ECG was reported as showing LVH and anterolateral ischaemia. No action was taken. A consultant anaesthetist provided a general anaesthetic, supplemented by spinal analgesia. The patient's preoperative blood pressure was 125/70 mmHg and during the operation 2500 ml of fluid (56 ml.kg^{-1}) and ephedrine 18 mg IV were used to attain a target systolic blood pressure of 80-90 mmHg. The operation finished at midday. Postoperatively the patient remained hypotensive until 04.30 the following morning, at which time she was reviewed. From an ECG taken at that time (and despite the changes on the preoperative ECG) a medical SHO diagnosed an acute anterior MI. Two hours later she suffered a fatal VF arrest. The cause of death was assumed MI, so no autopsy was performed.

Case Study 4

An 82-year-old, ASA 2 female was admitted to a limited surgical specialty hospital without critical care facilities for wide local excision of breast carcinoma and axillary node sampling. She had a history of IHD and was on diuretics; her exercise tolerance was limited by arthritis but she denied shortness of breath. Preoperative assessment was in a pre-admission clinic that was run by nurses and NCCG surgeons. She was admitted at 13.00 on the day before her operation, but was in the anaesthetic room when first seen by an SHO anaesthetist, who had been in that grade for more than two years but had no anaesthetic qualifications. Postoperatively, whilst in recovery, she developed fulminating pulmonary oedema and required tracheal intubation and ventilation to the lungs. She was transferred to another hospital for ICU care.

Case Study 5

A 62-year-old, ASA 3 female patient was admitted for a scheduled diagnostic removal of a submandibular gland. She had undergone CABG seven years earlier, had paroxysmal SVT and NIDDM. She was assessed at a pre-admission clinic by a SHO surgeon. Routine haematology and serum biochemistry investigations were normal. The ECG (that was sent to NCEPOD) suggested acute ischaemia in addition to a previous Q wave infarction. There were Q waves in leads III, AVF and V1-V4, a raised ST segment in lead III and flattened or inverted T waves in lead III, AVF and all chest leads. She did not have an echocardiogram or medical referral. The SpR anaesthetist (year 3/4) who assessed her on admission commented that the ECG was unchanged since 1990, three years before her CABG. After induction of general anaesthesia she developed severe hypotension and her blood pressure was not recordable for 20 min. Postoperatively whilst in the recovery area she developed VT with LVF and died. An autopsy revealed severe coronary artery disease and cardiac sarcoid, which may have precipitated the arrhythmia; there was no evidence of myocardial infarction.

Would appropriate investigation instigated from the preadmission clinic have alerted the anaesthetist to these patients poor cardiac status and have modified the anaesthetic care that they received?

Protocols for preoperative assessment and referral of patients by the pre-admission assessment clinic need to be explicit.

Anaesthetists should be involved in the development of pre-admission assessment guidelines.

Many patients reviewed at a pre-admission assessment clinic are well and require no or only basic investigation. It cannot be assumed their well-being is indefinite. There needs to be an accepted limit on the time between the pre-admission assessment and the date for operation.

One of the roles of staff in a pre-admission assessment clinic is to detect patients who are at an increased operative risk and, if necessary, refer them for further assessment or investigation. In the main, the staff that run the clinics are doctors in the early stages of their training, or nurses. These staff should have a written protocol for pre-admission assessment and training in its application. Guidelines as to which patients have operative risks and which need to be referred should be explicit. Referral must be to clinicians of appropriate experience. Anaesthetists should be involved in the development of pre-admission assessment clinic protocols and guidelines.

In this sample, few patients were referred for a further medical opinion, and it was usually a referral to a cardiologist or their general practitioner. None

was reported as being referred to an anaesthetist. Policies setting out which patients should be referred, and to whom, vary greatly between hospitals. It is essential that pre-admission assessment personnel have access to an anaesthetist [18].

The involvement of consultant anaesthetists in pre-assessment admission clinics has implications for consultant workload, which must be recognised in anaesthetic staffing reviews and job plans.

General practitioners and experienced surgeons review patients before they attend pre-admission assessment clinics. It should be possible to identify patients with operative risks in advance of these clinics. Perhaps the primary care physician, or consulting surgeon, could identify those patients with operative risk at the time of surgical referral, or when the decision to operate is made. The organisation of the preoperative assessment process should ensure that physicians and/or anaesthetists review those patients who require it, preferably before admission. The anaesthetist, or the anaesthetic department, should be notified of all patients who have severe operative risks in advance of their admission in order for an appropriate care plan to be formulated.

The pre-admission assessment should not be the final preoperative assessment; it does not obviate an anaesthetic assessment. An anaesthetist should see all patients before they undergo an operation that requires the services of an anaesthetist [18] and the anaesthetic room is not the appropriate place for this. Is there an assumption that once the patient is admitted for surgery the anaesthetist should accept the findings of the pre-admission assessment? The findings of the pre-admission assessment need to be reviewed by an anaesthetist preoperatively, and any further investigations deemed necessary instigated before the patient's operation. Ultimately, the anaesthetist is responsible for deciding whether a patient is fit for anaesthesia [18].

The findings of morbidity/mortality reviews should be considered when the pre-admission assessment clinic protocols are being evaluated and modified.

The cases in this sample illustrate that unanticipated adverse outcomes can occur during elective surgery. Hospitals should conduct morbidity/mortality review of patients that are assessed at the pre-admission clinics. Findings of such reviews should be considered when the pre-admission assessment clinic protocols are being re-evaluated and modified, which should be on a regular basis.

There is a much ongoing investigation into preoperative assessment. The Association of Anaesthetists of Great Britain and Ireland has produced guidelines [18]. Guidelines by NICE and the Modernisation Agency are in preparation at the time of writing.

ADMISSION

Some patients are admitted into an inappropriate area of the hospital because of the pressure on beds.

The area to which the patient was admitted for their final operation is presented in Table 3.5.

Table 3.5	The area to which the patient was admitted for their final operation
Surgical specialty ward	722 (34%)
General surgical ward	491 (23%)
A&E ward	223 (11%)
Medical ward	218 (10%)
Admission ward	99 (5%)
ICU	88 (4%)
Direct to theatre	85 (4%)
Elderly medicine ward	43 (2%)
Coronary care unit	33 (2%)
HDU	32 (2%)
Gynaecology/Obstetric ward	25 (1%)
Not answered	25 (1%)
Day unit	20 (<1%)
Private bed	8 (<1%)
Recovery	2 (<1%)
Total	**2114**

In 4% (91/2114) of cases this area was considered by the surgeon to be inappropriate. 43 patients were admitted to a medical ward, mostly because a diagnosis of acute abdomen was missed and so these could be considered inappropriate only with the benefit of hindsight. 42 patients were admitted to a surgical ward that the surgeon considered inappropriate for a variety of reasons, but often due to lack of beds on the appropriate ward or a missed diagnosis. Patients who are admitted into an inappropriate area of the hospital because of the pressure on beds are likely to suffer from delays in their diagnosis or treatment. In 10 cases the surgeon thought that the patient should have been admitted to a critical care facility and of these two were not because the unit was full, and two because there was no HDU in their hospital.

Preoperative transfer of care

It is essential that when the care of a patient is transferred, those referring the patient give the receiving team all the necessary relevant clinical information.

14% (295/2114) of patients were transferred from another hospital to that of their final operation, mainly either for specialised surgical care or a critical care facility, and 31% (660/2114) were referred to the final surgical team from another specialty/team within the hospital.

Case Study 6

A 65-year-old male was admitted to a district general hospital with a history of collapse, onset of slurred speech and ataxia. The GCS on admission was 14, but overnight deteriorated to 6. A CT scan demonstrated a cerebellar haemorrhage and hydrocephalus. Mannitol and dexamethasone were administered, the lungs ventilated and the patient was transferred to a neurosurgery unit. On arrival at the neurosurgical unit, the patient had decreased movement of the right hemithorax and a blood pressure of 80/40 mmHg. There was no mention of any attempt to insert a subclavian CVP line in the transfer note, however, there were signs of recent attempted venepuncture in the right subclavian region. The patient went to the operating theatre for insertion of a ventricular drain where a tension pneumothorax was diagnosed by an "on the table CXR" and a chest drain was inserted.

A tension pneumothorax that develops while a patient is receiving intermittent positive pressure ventilation can be difficult to diagnose. This case illustrates that it is vitally important that all interventions should be recorded in the medical notes and, when a patient is transferred, they should be communicated to the receiving medical team.

Delays after admission

NCEPOD is concerned by delays in assessment, diagnosis and referral of patients following their admission into secondary or tertiary care.

Case Study 7

A 24-year-old, ASA 4 female was admitted to a cardiology ward as an emergency with a two-day history of nausea and vomiting. She was known to have severe aortic stenosis and mixed mitral valve disease and her operation to replace these valves had already been delayed for several months (from "Spring" to December) following a pregnancy that resulted in a miscarriage. On admission she complained of shortness of breath and palpitations, and was noted to have right heart failure with an enlarged pulsatile liver. A diagnosis of helicobacter pylori was considered, but apparently was not excluded until 13 days later. Her nausea and vomiting persisted and she was scheduled for aortic and mitral valve replacement three weeks after her admission. She started menstruating three days before the planned operation. The consultant surgeon was unaware of this and because of it cancelled the case in the anaesthetic room. The operation was booked again for two weeks later. The following day she went into fast AF and circulatory collapse followed by cardiac arrest. Salvage surgery was attempted but she died in the operating theatre.

Case Study 8

A 78-year-old, ASA4 male was admitted with a fractured hip. He suffered from recurrent chest infections, had suffered a previous CVA and was in AF and on warfarin therapy. He was referred to a haematologist who advised that he should be given two units of fresh frozen plasma to reduce his INR, and his operation was scheduled for two days after admission. Despite treatment, at this time his INR was still too high so the operation was postponed for another three days. Again his INR was high and he finally underwent his operation eight days after admission. After the initial two units of FFP he received no treatment to correct his INR. Possibly as a result of his prolonged bed rest, by the time of his operation he had developed another of his recurrent chest infections. He died of bronchopneumonia on the second postoperative day.

Case Study 9

A 71-year-old female with no previous medical problems was admitted at 03.00 with an acute abdomen. At this time a HO assessed her and noted that she was shocked. The results of her serum biochemistry investigation were urea 24.4 m mol/l, creatinine 471 micromol/l and metabolic acidosis with a base excess of -11.8 m mol/l. At 07.40, over four hours after admission, she was reviewed by a surgical SHO who confirmed the admission findings. At 09.30 she was referred to a surgical registrar and consultant. At 11.30 she was reviewed by a consultant anaesthetist who agreed to take her to the ICU for resuscitation and a bed was available there at 14.00 (11 hours after admission). A three-hour laparotomy with limited right hemicolectomy, small bowel resection and Hartmann's procedure was started at 16.50. After her operation she returned to the ICU where she died of multiple organ failure on the second postoperative day.

Case Study 10

A seven-year-old fit child fell from a bicycle at 11.30. The child was admitted to a DGH at 12.15 with vomiting, headache and a GCS 15/15. X-ray showed a temporal skull fracture. At 16.00 the GCS had decreased to 13/15. No further neurological observations were done until 19.00, by which time the level of consciousness had deteriorated and the left pupil was dilated. A CT scan at that time showed an extradural haematoma. The child was then referred to the regional neurosurgical centre and arrived there at 22.00 six hours after the first signs of deterioration, with bilateral fixed dilated pupils. The child was taken to theatre immediately and the extradural haematoma was removed at 22.35. Although there was some immediate improvement in the neurological signs, tragically neurogenic pulmonary oedema developed, which was followed by multiple organ failure, and the child died on the second postoperative day.

These case studies illustrate that delays can and do occur after admission to secondary or tertiary care, and they may adversely affect outcome. Mainly the impression conveyed by the sequence of events was that after admission hospital staff assumed that patients were in a safe environment and the necessity for urgency had passed. This was not so. It is difficult for NCEPOD to assess delays because it has no in-depth knowledge of the individual circumstances; particularly it does not currently enquire into events on the medical wards. Nevertheless, these and other cases cause disquiet. Moreover, the prevalence of delays is difficult to quantify as NCEPOD reviews only those patients who suffer adverse outcome, which is more likely following delays in treatment. The case of the patient with a head injury is more clear-cut. There are guidelines for the management of patients with a head injury and these were not followed [19,20].

Only 5% of all head injuries are managed in neurosurgical units; medical and nursing staff without specialised neurosurgical experience manage the rest [21] and only 48% of consultant general surgeons and 40% of consultant orthopaedic

surgeons have been trained in the management of head injury patients [20].

All wards admitting head injury patients need a clear management protocol to identify which patients require neurosurgical referral, and to ensure any referral is timely.

An assessment of the process of patient care and delays preoperatively should be part of mortality/morbidity review, and organisational changes should ensure that any such delays are eliminated.

PREOPERATIVE INVESTIGATIONS

Preoperative investigations of the patients in this sample are presented in Table 3.6. These are compared with the report of 1994/95 which also reviewed deaths on or before the third postoperative day.

Table 3.6	Preoperative investigations *(answers may be multiple n=1911)*	
	2000/01	1994/95
None	23 (1%)	1%
Haemoglobin	1835 (96%)	96%
White cell count	1782 (93%)	90%
Platelets*	1753 (92%)	
Coagulation screen	997 (52%)	31%
Serum electrolytes	1779 (93%)	93%
Serum urea	1703 (89%)	88%
Creatinine	1731 (91%)	81%
Bilirubin (total)	885 (46%)	35%
Glucose	982 (51%)	51%
Serum albumin	927 (49%)	40%
Amylase	370 (19%)	16%
Blood gas analysis	591 (31%)	24%
Chest X-ray	1183 (62%)	70%
ECG	1540 (81%)	84%
Respiratory function tests	69 (4%)	5%
Special cardiac investigations (e.g. ECHO, angiography)	273 (14%)	8%
CT scan/ultrasound/ MRI/NMR*	310 (16%)	
Others relevant to anaesthesia**	52 (3%)	7%

* Not collected in 1994/95.

**Others included thyroid function tests, 5; calcium, 4; cardiac enzymes, 2; cardiac output studies, 2; phosphate, 1 and magnesium, 1. Most others were not specified.

A high percentage of patients had haemoglobin, blood count, urea and electrolytes measured preoperatively, and this was expected in this sample as many patients were of a poor physiological status. There was evidence of increased preoperative investigation of coagulation, renal (creatinine), hepatic (bilirubin) and respiratory (blood gas) disorders in this sample, when compared with 1994/95. It was a concern that in 12% (70/591) of the analyses of blood gases there was no record of the inspired oxygen concentration, limiting the value of the investigation. The proportion of patients who had a preoperative chest X-ray examination has decreased, and this is probably due to the guidelines

of the Royal College of Radiologists [22]. These state that chest X-ray is not indicated routinely except before cardiopulmonary surgery, likely admission to ITU, suspected malignancy or possible TB. It may also be indicated in dyspnoeic patients, those with known cardiac disease and the very elderly. A Health Technology Assessment report that investigated the value of routine preoperative chest X-rays concluded that they are of value in less than 9% of patients but that a chest X-ray is more likely to be abnormal in those patients who are elderly and of poor physical status [23].

When analysed further, only 70% of urgent, scheduled or elective operations on patients of ASA 3, 4 and 5 had a chest X-ray. It was surprising that only 51% of patients had their blood glucose measured in the sample where 87% of patients were ASA 3 or poorer.

Preoperative investigations are important. They may influence the patient's management or allow fuller information to be provided on the risks and benefits of the proposed operation.

The operations of patients that had no preoperative investigations are presented in Table 3.7.

Table 3.7	Number of patients who had no preoperative investigations
Leaking abdominal aneurysm repair	9
Thoracotomy for thoracic trauma	4
Cataract operation	3
Internal fixation of fracture	2
Others*	5
Total	**23**

*The others were reduction of a dislocated prosthetic hip, removal of an external fixator, oesophagoscopy with oesophageal stenting, biopsy of a brain tumour and insertion of a ventricular drain.

Most patients that had no preoperative investigations were admitted as an emergency and were undergoing resuscitation at the time of their operation. Of note are the three patients who had cataract operations. Eye surgery is recognised as being low risk. However, no operation is free of stress, and stress may have an impact on patients with cardiovascular disease. There are guidelines on local anaesthesia for intraocular surgery[17] which state that for the patient with no history of significant systemic disease and no abnormal findings on examination at the nurse-led assessment, no special investigations are indicated. The three patients that underwent cataract operations were all female. These were a 91-year-old, ASA 2 patient who suffered from dizzy spells and who died from a CVA, an 87-year-old, ASA 2 patient with COPD who died from an AAA and a 62-year-old, ASA 3 patient with a history of MI and CVA, who had angina and who died from a myocardial infarction. According to these guidelines, all three patients should have had some preoperative investigations.

Further investigation of cardiovascular disease

Specific cardiac investigations, echocardiography and/or angiography were performed in 14% of patients, but this included those undergoing heart operations. Only 9% of patients undergoing non-cardiac operations had any specific cardiac investigations other than an ECG, and this despite 76% of the sample having some cardiovascular disorder.

Case Study 11

A 71-year-old, ASA 2 male was admitted for a left-sided petrosectomy, parotidectomy, neck dissection and reconstruction with latissimus dorsi flap and skin graft from the thigh. He had asbestosis and IHD with stable angina. He was not assessed in a pre-admission assessment clinic. However, preoperative echocardiography was performed in order to assess his left ventricular function, which was described as mildly impaired. Operative monitoring included CVP and direct arterial pressure. His operation lasted for 9 hours 30 minutes after which he went to the HDU. He died of a myocardial infarction on the second postoperative day.

Case Study 12

An 82-year-old female was admitted to a medical ward for investigation of nausea, vomiting, weight loss and renal impairment. She had undergone a nephrectomy in 1963 and suffered a MI with LVF in 1987. The day after admission her heart rate was 120-130 beats/min, her blood pressure was 105/40 mmHg, and she had pain in her right shoulder and a reversible ST elevation. A diagnosis of MI was considered but not confirmed. She remained in hospital and four weeks later she underwent an EUA cystoscopy, at which time her preoperative anaesthetic assessment recorded mild CCF. Operative findings were of a lengthy ureteric stricture that could not be crossed or stented. On the first postoperative night she developed acute LVF. Ten days later she underwent an unsuccessful attempt at

nephrostomy insertion and a CT scan demonstrated a large stone in the renal pelvis. The next day she was admitted to HDU for CVP line insertion before an operation to explore her right kidney, at which time she was noted to be breathless and in "gross pulmonary oedema" with a CVP of 4 mmHg. Later that day she underwent an exploration of the right kidney, biopsy of the renal pelvis and pyelolithotomy. She was nursed on an ICU postoperatively, where she died two days later.

Case Study 13

An 87-year-old, 60 kg, ASA4 male was admitted with a fractured neck of femur. He had COPD and was on domiciliary oxygen. On admission an apical systolic murmur was detected and a presumed diagnosis of mitral regurgitation, pulmonary regurgitation and tricuspid regurgitation was noted (presumably, as regurgitation of the right heart valves was thought likely, pulmonary hypertension of cardiac or respiratory origin was considered). An ECG showed changes consistent with right axis deviation and anterolateral ischaemia. His serum creatinine was 239 micromol/l. No medical referral or echocardiogram was obtained. His preoperative blood pressure was 120/60 mmHg. Spinal anaesthesia resulted in a blood pressure between 80/50 mmHg and 90/50 mmHg during the operation that lasted for 1 hour 20 minutes. Postoperatively he returned to the ward where despite intravenous inotropic drugs his systolic arterial pressure was between 110-65 mmHg for three days until his death.

Case Study 14

An 82-year-old, 55 kg, ASA 3 man was admitted with a fractured neck of femur. He had COPD with an acute chest infection, severe IHD with angina and CCF, hypertension, PVD, NIDDM and had suffered a previous CVA. Chest X-ray revealed cardiomegaly and upper lobe blood diversion. The ECG showed AF (that was misdiagnosed as sinus rhythm by the ECG machine) and bifascicular block. The patient was reviewed by one of the specialist orthopaedic medical team (grade unknown), and deemed fit for surgery. No echocardiogram was obtained. During a hemiarthroplasty the patient suffered a cement reaction at which time his systolic blood pressure decreased to 60 mmHg and heart rate decreased to 60 beats/min, which responded to intravenous atropine and vasoconstrictors. He returned to the ward and suffered a fatal cardiac arrest the following day.

Case Study 15

A 63-year-old male was known to have type II diabetes mellitus and hypertension. One week before the final operation he was admitted with right-sided abdominal pain, vomiting and abdominal distension. The clinical diagnosis was biliary colic. Initial investigations were unremarkable with a raised WCC 17.9 x 10^9/l and creatinine 160 micromol/l as the only abnormalities; serum amylase was normal at 20 iu/l. Four hours after admission he developed "heartburn", tightness in his chest and shortness of breath. He was found to be clammy with a pulse rate of 116 beats/min. At this time a history of chest pain on walking 20 yards was elicited. ECG showed atrial premature beats, left axis deviation, poor R wave progression and an inverted T wave in AVL. The findings were discussed with the medical registrar, who did not see the patient but advised that troponin I should be checked in eight hours time. The following day a CT scan revealed cardiomegaly and an inflammatory mass in the RIF. The medical registrar, who was again asked to review the patient, commented that structural heart disease was likely and that a laparotomy should await the results of troponin I measurement and the heart should be further investigated. The surgeons continued to plan for surgery. At preoperative assessment the SHO anaesthetist noted angina, CCF, SOB on walking and bending, orthopnoea, bilateral basal crepitations and rapid respiratory rate and commented that ICU would be required postoperatively. Following a normal troponin I level a laparotomy was undertaken. No abnormality was found. The patient was critically ill postoperatively with low cardiac output and despite full cardiovascular and respiratory support he died two days later. An autopsy revealed that he had been in congestive cardiac failure for some time and had a cardiomyopathy of unknown aetiology.

The patients in these case studies all had known severe cardiac disease, some with decompensation, as well as other serious comorbidity. The first patient was a scheduled admission who received a well-considered preoperative workup. Although the other five patients were urgent admissions, there was time for a consultant cardiological opinion and further investigation before their operation. Such action may have affected their preoperative preparation or anaesthetic management and in the last case the diagnostic confusion, between acute abdominal pathology and liver engorgement from cardiac failure, may not have occurred.

There is plenty of interest in developing pre-admission and preoperative assessment protocols. However, most of the patients reviewed by NCEPOD

are urgent or emergency admissions so they bypass the established pre-admission protocols, even though often they are sicker than most elective admissions. Inpatient preoperative assessment guidelines should be established. Following an urgent admission there is heterogeneity of urgency for the operation, and that makes guidelines more difficult; nevertheless it is possible. Multidisciplinary teams manage some patients, particularly those admitted following trauma and it would be appropriate to establish guidelines for their preoperative investigation. The American College of Cardiology/American Heart Association have reviewed the evidence and produced updated guidelines on cardiovascular evaluation for non-cardiac surgery [24]. This is valuable reading for anaesthetists, as well as those cardiologists or physicians involved in preoperative assessment of patients. The guidelines are mainly applicable to non-emergency surgery, and there is a useful algorithm for assessment before urgent or elective operations. However, a high proportion of cases that NCEPOD reviews are of an urgency that precludes following this pathway and it must be recognised that some patients need to be investigated and managed in a more pragmatic way.

Lee and co-workers [25] identified predictors of cardiac risk of major non-emergency, non-cardiac surgery (see Table 3.8).

Table 3.8	Revised cardiac risk index
Risk factor	**Definition**
High risk type of surgery	Intraperitoneal, intrathoracic, suprainguinal vascular
Ischaemic heart disease	History of MI, positive exercise test, angina, use of nitrates, evidence of Q wave infarct
History of congestive heart failure	History of CHF, pulmonary oedema, PND, bilateral rales or S3 gallop, upper lobe blood diversion
History of cerebrovascular disease	History of transient ischaemic attack(s) or stroke
Insulin therapy for diabetes	
Preoperative serum creatinine >177 micromol/l	

Other recognised risk factors include severe valvular heart disease, unstable angina, high-grade atrioventricular block, symptomatic ventricular arrhythmias in the presence of underlying heart disease, supraventricular arrhythmia with uncontrolled ventricular rate, emergency or urgent major operations particularly in the elderly, and prolonged surgical procedures associated with large fluid shifts and/or blood loss [24].

Echocardiography is a simple, rapid and useful assessment that can be made at the bedside, and it is being used increasingly as part of patient preoperative assessment. Trained non-medical staff now perform echocardiography examinations, and the cost of transthoracic echocardiography equipment is decreasing. The results of echocardiography can influence the choice of the anaesthetic, operative monitoring and the requirement for postoperative critical care. Currently there is little evidence, and few guidelines, as to which patients should have an echocardiogram as part of their preoperative assessment. An asymptomatic cardiac murmur, particularly in the aortic area, may indicate significant cardiac disease and should be investigated appropriately [2]. Patients with heart failure or previous Q wave myocardial infarction also have an indication for some assessment of left ventricular function, especially before intermediate or major surgery, and that may include echocardiography [24]. Agreed national and local protocols as to which patients would benefit from a more detailed preoperative cardiovascular assessment, including echocardiography, should be formulated jointly by anaesthetists and cardiologists.

There is no benefit to be gained by performing any preoperative investigation if an abnormal result is disregarded.

Case Study 16

A 76-year-old, 68 kg female was admitted following a fractured neck of femur. Ten years previously she had episodes of sinus tachycardia, accompanied by angina, and a diagnosis of aortic stenosis was made. She was started on atenolol, which controlled her symptoms and underwent yearly cardiology review. An echocardiogram one month before admission showed severe aortic stenosis with an estimated aortic valve gradient of 95 mmHg and a LV ejection fraction of 71%. She was assessed preoperatively by a trust anaesthetist who discussed the case with an associate specialist before providing anaesthesia for her operation one day after admission. There was no cardiology referral. Her preoperative haemoglobin was 10.8 gm/dl. She received a general anaesthetic without invasive monitoring. During the operation, that lasted for one hour, her systolic arterial pressure was recorded as between 90-110 mmHg and she received 3000 ml of fluid intravenously (44 ml/kg); the blood loss was not recorded. Postoperatively, whilst in the recovery

area, her haemoglobin was 4.6 gm/dl (was that due to excess clear fluid or blood loss?). No ICU or HDU bed was available, so she returned to the ward where she received a blood transfusion. Whilst on the ward she developed LVF, tachycardia and hypotension that did not respond to epinephrine. Twelve hours later she was admitted to the HDU, where she died after two hours.

Preoperative investigations are usually organised by the surgical team. However, the decision on whether the patient has been investigated adequately rests with the anaesthetist.

PREOPERATIVE MEDICAL REFERRAL

Care was undertaken on a formal shared basis in 21% (449/2114) of cases. NCEPOD did not ask whether care was shared before, or not until after the operation. The specialties involved in shared care are presented in Table 3.9.

Table 3.9	Specialties involved in formal shared care *(answers may be multiple n=449)*
General medicine	146
Other medical specialty	107
Other surgical specialty	102
Care of the elderly	84
Paediatric	21
Other	21

Care was shared with a medical specialty in 17% (358/2114) of cases. This was a surprisingly low percentage of shared medical care for a sample with such a high incidence of serious medical disorders. In the case of some medical referrals the physicians involved were of an inappropriate grade and many did not appear to fully understand the operative risks associated with the patient's medical condition.

Case Study 17

A 71-year-old, ASA 4 female was admitted following a fractured neck of femur. She was recognised as having a high operative risk. She had severe IHD and had suffered two myocardial infarctions, eight and ten years previously. Three weeks before admission she had suffered a third myocardial infarction complicated by a VF cardiac arrest. She had a history of multiple pulmonary emboli and had suffered an episode of LVF after a previous anaesthetic. She was a non-insulin dependent diabetic. The consultant anaesthetist who assessed her noted that she had a two-day history of shortness of breath at rest, orthopnoea and PND. Her chest X-ray revealed bilateral pleural effusions that were thought to be secondary to cardiac failure. Her ECG showed evidence of old inferior and anterolateral infarction, there was first degree heart block and low voltage complexes throughout all leads. The anaesthetist requested that she had an echocardiogram and a medical review. The echocardiogram showed that there was moderate mitral regurgitation, mild tricuspid regurgitation, poor LV function (ejection fraction of <30%), poor RV function and dilatation of both ventricles. The opinion of the medical SHO

who reviewed her two days after referral was that she was now in optimal condition. Nine days after her admission she underwent an operation for insertion of a DHS. She had central venous and arterial cannulae inserted before receiving a cautious incremental epidural anaesthesia. The first recorded CVP measurement was 19 mmHg. She was nursed on the ICU postoperatively, before discharge to the ward on the following morning. There was no further entry in the notes until her death 48 hours later.

Case Study 18

A 73-year-old, ASA 4 female was admitted with abdominal pain and peritonism. She had ischaemic heart disease with atrial fibrillation and peripheral vascular disease. Regular drug treatment included digoxin, warfarin and large doses of diuretics. On admission she had an acute chest infection and her heart rate was poorly controlled at a rate of 130 beats/min. A medical SHO reviewed her antiarrhythmia treatment on the day of admission, a medical registrar provided telephone advice one day after admission and a consultant cardiologist reviewed her three days after admission; she had a heart rate of between 130-150 beats/min throughout. She was ASA 5 and her heart rate was still 150 beats/min when she went for a laparotomy at 03.00, four days after admission.

Medical SHOs, who apparently failed to recognise the risk or improve the patient's medical condition, reviewed both these patients at some time.
If a preoperative medical assessment is indicated an experienced physician should make it, preferably a consultant. It is inappropriate for a preoperative medical assessment to be made by a medical SHO or inexperienced SpR (year 1/2). If necessity dictates the initial medical assessment is by an experienced trainee (SpR Ó year 3) or NCCG doctor, the medical consultant should review the patient at the earliest opportunity. It is the responsibility of the physician to fully understand the operative risks of the patient's medical condition. Referral is a process of consultation and there must be clear communication between the surgeon anaesthetist and physician on the aims of the referral to enable them to better understand each other's concerns [26].

PREOPERATIVE DRUG TREATMENT

Many patients do not receive essential regular medication preoperatively.

In this sample NCEPOD asked about maintenance drug treatment for medical conditions, and whether they were given on the day of operation. Table 3.10 shows how many patients were on specified treatments and the percentage of cases where the drugs were not given on the day of operation. The fourth column indicates the percentage of cases where drugs were not given on the day of operation for urgent, scheduled and elective operations. This assumes that for emergency cases, an omission of maintenance drugs may be unavoidable, however most of the urgent, and all scheduled and elective patients should be able to take their maintenance drugs on the morning of operation.

Table 3.10 The number of patients on specified drug groups and percentage not given on the day of operation

Drug class	No. of patients	Not given - all patients	Not given- urgent/ scheduled/ elective operations
Anti-anginal	393	27%	22%
Anti-arrhythmics	326	25%	20%
Anti-hypertensive	660	34%	23%
Thyroid/anti-thyroid	121	43%	31%
Bronchodilators	261	16%	15%
Steroids	180	19%	17%

It is interesting that giving thyroid-related medication on the day of operation appears to be a low priority. Of concern is the information on antianginal, bronchodilator and steroid treatment. These drugs should be given throughout the operative period and when the patient cannot take their oral drugs, there are simple topical, inhaled or parenteral replacement formulations readily available. Some of the drug charts returned to the NCEPOD office show clearly that the reason given for the patient not receiving the drug is because they were classified as "nil by mouth" for the preoperative period. Doctors and nurses need to understand the difference between preoperative oral medication and the full English breakfast.

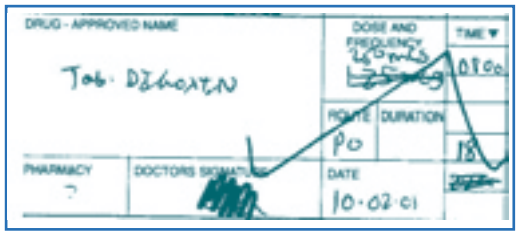
Drug prescribing errors

Legal responsibility for prescribing rests with the doctor who writes or alters the prescription.

NCEPOD did not request the prescription charts for this sample. Nevertheless, from the ones that were sent, NCEPOD could see that dose alteration was not uncommon, and often it was impossible to know the date or time the alteration was made, or by whom.

Case Study 19

A 78-year-old, 82 kg, male was admitted for a total hip replacement. He had undergone CABG two years earlier specifically to enable this operation. He had angina, AF, NIDDM, hypertension and bilateral 80% carotid artery stenosis. He was on maintenance doses of warfarin 3.5 mg od, digoxin 125 micrograms bd, ramipril 10 mg od, glipizide 5 mg tds and metformin 850 mg bd. He was assessed by a surgical SHO two days before admission, who liaised with a haematologist about the anticoagulation control and documented clear advice, but did not notify the anaesthetic department of his high-risk patient. The patient's drugs and their doses were recorded in the pre-admission notes. The patient was admitted three days before his operation. At this time his drugs were initially prescribed as follows; warfarin was discontinued, digoxin, ramipril and metformin were prescribed as above and the glipizide dose was increased to 10 mg bd. For some reason the digoxin 125 micrograms was crossed through and 250 micrograms written above it, although the instruction for it to be given twice a day was left unchanged. The patient received digoxin 500 micrograms per day, given according to an altered prescription, for the three days until his operation. A staff grade anaesthetist who assessed him at 08.00, half an hour before induction of anaesthesia commented that he was "very unfit" and ASA 3, but failed to notice the drug error. Systolic blood pressures, which had been recorded between 160-180 mmHg before, were between 70-80 mmHg for one hour during the operation. One day after his operation the patient was noted to be drowsy and a medical registrar reviewed him. The patient had a bradycardia (heart rate 35 beats/min), metabolic acidosis, hyperkalaemia (7.7 mmol/l), creatinine of 266 micromol/l (136 micromol/l previously), glucose 21 mmol/l, and a digoxin level 5 nmol/l (therapeutic limits 1-2.6 nmol/l). He was treated with digoxin-specific antibody fragment (Fab) and his blood sugar was controlled. Nevertheless he became increasingly drowsy and acidotic, and died on the second postoperative day. The coroner's autopsy reported non-haemorrhagic brain infarct and ischaemic heart disease. In the report there was no mention of an examination of the stenosed carotid arteries, or of his diabetes or digoxin toxicity.



This case illustrates a drug error as a consequence of poor practice. If a completely new dated and signed prescription is required when a change in drug dose is made, the sequence of prescribing events can be clarified and errors reduced. At present there are no national guidelines for prescription writing in hospitals. The guidelines in the British National Formulary relate more to prescribing by general practitioners. The amount of training in writing clinical prescriptions given to medical students varies between medical schools. The amount of training in writing clinical prescriptions given to postgraduate doctors during their induction to a new appointment varies between hospitals, and hospitals have different local practices. Increasingly, hospital pharmacists are monitoring drug prescriptions and they are qualified to determine the clinical suitability of a prescribed medicine [27]. Experienced nursing staff should be encouraged to, and often do, question prescriptions if they have concerns. Ultimately, the legal responsibility for prescribing lies with the doctor who writes, or alters the prescription.