Perioperative patient management

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Modern perioperative care is complex and involves a large number of staff from multiple disciplines. Patient outcomes depend on well-designed processes, consistent clinical practice, and effective communication. Perioperative care should be a unified process of multiple coordinated steps. There should be a hospital-based multidisciplinary service to manage and plan this process. Early assessment of the patient’s comorbidities is essential to plan patient preparation. Ideally, patients should be fully prepared before the day of surgery, and only admitted to hospital shortly before surgery. For many common clinical challenges, there is a range of accepted management regimes. Institutionally consistent clinical practice is necessary to optimise patient outcome. Postoperative management should be based on standardised observations and care protocols, prevention strategies targeted at common problems, and rapid response by high-level teams to early physiological signs of complications.

Key words: preoperative care; perioperative care; postoperative care.

The traditional model of surgical patient care based on an omniscient and omnipresent surgeon managing all aspects of patient care is no longer sustainable. Patient care is now delivered by multidisciplinary teams made up of a large number of staff, many of whom will have only transient contact with the patient. In the modern hospital, patient outcomes depend on well-designed clinical processes, consistency of clinical practice, and effective communication to ensure all practitioners in the multidisciplinary team are working synergistically to achieve the same goals. Hence, all members of the perioperative team must have a general understanding of all aspects of perioperative care, and have the personal ability to function within the team to contribute their specialised skills and knowledge.

For any particular clinical challenge, 'best' practice may vary between institutions—but these differences are of little significance if the practice within each institution is consistent. There are various examples in this chapter where it is impossible to choose between a wide variety of possible methods for dealing with a particular clinical challenge.
challenge. For this reason, specific details of management regimes are not suggested. The appropriate patient management is to follow locally developed practices consistently—or, if these have not been developed, to develop such practices using an institution-wide, multidisciplinary team approach.

THE PERIOPERATIVE PROCESS

Perioperative care begins when the decision is made to perform an operation. It ends when the physiological changes related to surgery and convalescence have resolved. The perioperative process can be outlined as shown in Table 1.

ORGANISATIONAL ASPECTS OF PREOPERATIVE ASSESSMENT AND PREPARATION

The complexity of surgical patient care is increasing. Surgery is more technically challenging, patients have more comorbidities, the hospital system involves more staff and more information, and care is delivered under greater time pressures. This increasing complexity emphasises the need to appropriately assess and prepare the patient, to plan the patient’s care in advance, and to ensure effective communication about the patient’s planned care to all care providers. This can be achieved by individual effort, but in many hospitals has led to the establishment of a multidisciplinary clinical service whose role is to coordinate the assessment, planning and preparation of elective surgical patients.1

**Decision to operate**

The decision to operate is made by the surgeon and patient. This decision requires careful consideration of the expected benefits and risks associated with the planned operation. For some patients, further risk assessment by a consulting anaesthetist or subspecialty physician will be required.

**Legal consent**

The process for obtaining and documenting consent by the patient for a procedure varies between legal jurisdictions and will generally be defined by the institution taking the medicolegal risk. The logical basis for legal advice on this issue is difficult to define and is outside of the expertise of this author.

**Patient education – shaping expectations**

Both patient preference and legal requirements mandate an adequate explanation of the planned procedure, the reason for performing it, the expected benefits and risks, and the events of the planned perioperative process. Clinical pathway booklets or other educational material can be used to shape patient expectations. Making the patient an active partner in the perioperative process can improve patient outcome, improve functional recovery, and reduce length of stay postoperatively.2
### Table 1. The perioperative process.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Steps</th>
<th>Staff involved</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative</td>
<td>Decision to operate</td>
<td>Surgeon and Patient</td>
<td>May require risk assessment and advice from anaesthetist or others</td>
</tr>
<tr>
<td></td>
<td>Assemble existing patient information</td>
<td>Preoperative Service</td>
<td>Existing information may reduce need for repeated investigations</td>
</tr>
<tr>
<td></td>
<td>Preoperative clinical assessment</td>
<td>‘Junior’ Surgical Team, Preoperative nurses and/or Clinic Anaesthetist</td>
<td>Requirement for clinic visit should be selective and can be reduced by well-functioning preoperative service</td>
</tr>
<tr>
<td></td>
<td>Additional investigations</td>
<td>Preoperative clinic</td>
<td>Avoid unnecessary tests results of investigations must be followed up before day of surgery</td>
</tr>
<tr>
<td></td>
<td>Optimisation of Health Status</td>
<td>Preoperative Clinic; GP; Consultant Physicians; Allied Health Professionals</td>
<td>Must be coordinated by surgeon, anaesthetist or Preoperative Service</td>
</tr>
<tr>
<td></td>
<td>Preoperative preparation plan formulated</td>
<td>Surgeon, Clinic Anaesthetist</td>
<td>Capacity of patient and system to cope with complex preparation must be considered</td>
</tr>
<tr>
<td></td>
<td>Preoperative preparation</td>
<td>Patient (as instructed)</td>
<td>Quality of preoperative service may determine complexity of preparation before admission</td>
</tr>
<tr>
<td>Day of procedure</td>
<td>Final preoperative checks</td>
<td>Nurses, procedural anaesthetist, surgeon</td>
<td>Cancellation at this point should be uncommon, and may indicate failure of preoperative process</td>
</tr>
<tr>
<td></td>
<td>Preoperative medication</td>
<td>Procedural anaesthetist surgical team ward nurses</td>
<td>Anxiolysis, DVT prophylaxis, antibiotics, etc.</td>
</tr>
<tr>
<td></td>
<td>Anaesthetic and intraoperative care</td>
<td>Procedural anaesthetist</td>
<td>Shared understanding of the planned procedure, and effective teamwork, is crucial to efficient and high-quality patient care</td>
</tr>
<tr>
<td></td>
<td>Operative procedure</td>
<td>Surgeon, Recovery nurses and procedural anaesthetian</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Postoperative recovery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Postoperative</td>
<td>Early postoperative phase</td>
<td>Ward nurses, surgeon, acute pain team</td>
<td>Special-care teams (ICU, HDU) might be involved</td>
</tr>
<tr>
<td></td>
<td>Functional recovery</td>
<td>Surgeon, nurses, allied health, patient</td>
<td>Care plans can enable ‘fast-tracking’</td>
</tr>
<tr>
<td></td>
<td>Convalescence</td>
<td>Patient, family, GP, surgeon</td>
<td>Patient expectations and motivation are crucial determinants of progress</td>
</tr>
</tbody>
</table>
Fitness for anaesthesia

This oft-used term is deprecated by anaesthetists. For the majority of patients, the perioperative risk is justified if the surgery itself is clinically justified. Anaesthetic assessment then focuses on identifying any possible interventions to reduce perioperative risks, or requirements to modify the anaesthetic plan due to pre-existing comorbidities.

Gathering patient information for ‘booked’ surgery

It is inappropriate to start gathering patient information shortly before surgery; an information-gathering process should be commenced at the time of patient booking. This should be coordinated by a hospital-based service using appropriate staff (including clerical staff) with senior clinical supervision and support. The information obtained can be used to select patients who should attend a preoperative clinic for ‘face-to-face’ assessment. Existing information about the patient should be reviewed before meeting the patient. ‘Customer satisfaction’ studies consistently report high levels of patient dissatisfaction associated with being asked the same clinical questions repeatedly.

Preoperative tests

The high cost of unnecessary preoperative testing has been extensively reviewed. Institutional guidelines for ordering of preoperative tests should be used. Unnecessary tests can also be avoided by reviewing existing test results. Any tests that are performed must be checked before surgery. In the UK, the National Institute of Health and Clinical Excellence (NICE) has produced a clinical guideline on appropriate preoperative tests. This is available at: http://www.nice.org.uk.

PREOPERATIVE ASSESSMENT OF COMORBIDITIES

The general health of every patient having surgery must be assessed to identify any comorbidity that might be affected by, or have effect on, the physiological and psychological changes associated with the operation and postoperative recovery. Some common and important issues are discussed below.

Ideally, the treatment of any pre-existing comorbidity should be optimised preoperatively. This is the ideal, and might need to be modified based on patient factors and urgency of surgery. Complications associated with the chronic disease must be identified and perioperative management adjusted accordingly. With few exceptions, chronic drug therapy should be continued throughout the perioperative period. Communication within the perioperative team about any finding or matter of uncertainty is crucial to achieve optimal patient outcome.

Cardiovascular disease

Cardiovascular diseases are common. This includes hypertension, ischaemic heart disease, congestive cardiac failure, arrhythmias and valvular heart disease. The usual management of most patients with these conditions should be within the competence of the perioperative team. Pacemakers and implantable defibrillators are undergoing
rapid technological change and should be managed in consultation with the cardiologist managing these devices. Patients with recent coronary artery stents are also complex and advice should be sought.

Most cardiovascular drugs must be continued perioperatively. There is uncertainty about ‘best’ management of patients using aspirin and antiplatelet agents. The risks of cessation must be balanced against the risks of surgery in the presence of these agents. Alternative therapy might be needed.

Cardiac failure and cardiac reserve

The ability of the cardiovascular system to cope with the physiological demands of the perioperative period is a key determinant of the patient’s risk. The postoperative period might require a sustained rise in cardiac output, particularly if there are septic or other complications. Assessment of cardiovascular reserve is thus a key part of preoperative assessment. A patient with uncompensated cardiac failure due to any cause has a markedly increased perioperative risk. Exercise tolerance (such as walking up stairs) is the best clinical marker of cardiac reserve. Echocardiography, stress testing, or other cardiological investigations can assist this assessment. Assessment might be difficult in patients with respiratory disease or musculoskeletal limitation. There is increasing interest in the use of formal cardiopulmonary exercise testing (CPX) including measurement of anaerobic threshold, as a means to objectify this assessment. Cardiological review to identify if there is any capacity to improve the treatment of existing cardiac failure might be necessary.

Ischaemic heart disease

Ischaemic heart disease is common and hence perioperative ischaemia and infarction are also common. Many episodes of postoperative ischaemia and infarction (as many as 60%) are silent, and can present as respiratory complications, or postoperative confusion in the elderly.

The perioperative period is associated with increased myocardial oxygen demand and–sometimes–with reduced myocardial oxygen supply. Haemorheological changes (such as platelet stickiness) can increase myocardial ischaemic episodes. Coronary artery plaque rupture might be precipitated by perioperative events. Despite intense scientific study, there remains much uncertainty and controversy about the pathogenesis and prevention of perioperative infarction.

There are multiple reviews and guidelines regarding preoperative cardiovascular testing. Assessment must begin by considering clinical risk factors, exercise capacity, and the cardiovascular impact of the surgical procedure. This can be used to guide decision making regarding further preoperative cardiovascular investigations. The ACC/AHA guidelines are widely regarded as authoritative. Although controversial, the general consensus is that the investigation and management of a patient’s ischaemic heart disease should be optimised regardless of the planned surgery. If this has been achieved, further investigation or intervention is unlikely to be justified.

If a patient is optimally treated, or if surgery must proceed before optimisation by surgery or angioplasty, there is limited scope to modify perioperative patient management. Patients may benefit from intensive peri- and postoperative monitoring, avoidance of hypothermia, optimisation of ‘routine’ care, oxygenation, and pain relief. The use of short-term perioperative beta-blockade has been shown to reduce perioperative infarction in high-risk patients, but it is questionable whether it is
appropriate to use beta-blockade in moderate-risk patients who are not normally on this treatment.\textsuperscript{8}

The risk of surgery after a myocardial infarction (MI), and appropriateness of delay after such an infarct, is also controversial. Patients with a past history of MI are 5–10 times more likely to suffer a perioperative MI, which has higher mortality than a ‘usual’ MI. Decision making must consider the urgency and extent of surgery, and the degree of myocardial damage. Surgery within 6 weeks of an MI must be regarded as high risk, as this time is associated with ongoing plaque instability and unstable myocardial scarring. From 6 to 12 weeks the risk can be described as intermediate. Delay of elective surgery beyond 3 months is probably of minor benefit only.\textsuperscript{7}

Valvular heart disease

Newly identified cardiac murmurs must be investigated further. Prophylactic antibiotics for valvular heart disease should be administered in accordance with institutional guidelines.\textsuperscript{9} Antibiotics should be given intravenously shortly before the procedure.

Respiratory disease

Patients with pre-existing respiratory disease are at increased risk of postoperative pulmonary complications such as atelectasis, infection, and respiratory failure. Assessment is based on history, clinical examination, exercise capacity, spirometry, and oximetry. ‘Traditional’ ordering of preoperative chest X-rays has often resulted in unnecessary tests with little impact on management. Pulmonary function tests are of limited value, and unlikely to be of value in patients who do not require review by a respiratory physician.\textsuperscript{10}

Perioperative pulmonary complications are reduced by preoperative optimisation of respiratory status, education and preparation for postoperative physiotherapy, and the use of regional anaesthesia and analgesia (e.g. spinal or epidural) for suitable surgery. High-risk patients require increased postoperative monitoring and therapy, including possible admission to a high-dependency unit.

Patients with bronchiectasis (including cystic fibrosis) will benefit from preoperative chest physiotherapy, including postural drainage. For patients with significant daily sputum production, ‘routine’ chest physiotherapy may be inadequate in technique, intensity and duration to be effective.

Diabetes

There are various accepted regimes for the perioperative management of diabetes. Management of an individual patient’s comorbidities associated with diabetes is more important than the technique used for managing the diabetes itself.

The objectives of perioperative management of diabetes are to avoid major disturbance to glucose homeostasis (hypoglycaemia, hyperglycaemia, ketoacidosis) and to avoid complications arising from the technique used for managing diabetes. Hence, the technique used will need to be tailored both to the patient and to the treatment setting—the equipment, skills, experience, and usual practice in the hospital. The wide variety of accepted techniques reflects the lack of superiority of any particular regime, and emphasises the need to be consistent with usual institutional practice.\textsuperscript{11}
Cerebrovascular disease

Residual effects of a previous stroke or previous transient ischaemic attacks (TIAs) must be assessed for perioperative significance. Residual immobility may increase the risk of pressure areas, thromboembolic complications and nursing-care requirements. Impaired cough, swallowing, or airway protection may increase the risk of pulmonary complications. Drug therapy may include antiplatelet agents or anticoagulants, and the risk/benefit of ceasing these drugs must be considered. The risk of postoperative confusion is increased, and the patient and family may have anxieties in this regard.

Elective surgery should be postponed for at least 6 weeks after a stroke due to neurovascular instability. A patient having current TIAs is at risk of major perioperative events and requires neurological consultation.12

Other neurological conditions

Patients with stable and treated epilepsy must have their medication continued (orally or parenterally) throughout the perioperative period.

Parkinson’s disease also requires careful medication maintenance, can present nursing challenges postoperatively, and increases the risk of pulmonary complications.

Existing dementia can be exacerbated perioperatively. This may indicate a need for additional postoperative care and discharge support planning.

Psychiatric illness

Assessment of patients with psychiatric illness should identify the likelihood of perioperative decompensation and the need for liaison psychiatric support in the perioperative period. Medication must be completely and correctly documented because drug interactions are common. Comorbidities are common due to lifestyle factors, suboptimal treatment of other medical illnesses and compliance issues. Social issues at discharge need to be planned for.

Patients with substance abuse issues may present complex management problems, including dealing with (or preventing) drug withdrawal, drug interactions, pain management, manipulative behaviour, and poor compliance. Early involvement of specialised substance abuse services is advisable.

Haematology and transfusion medicine

The cause of anaemia that is found preoperatively must be identified. Preoperative treatment with iron and/or erythropoietin should be considered. Recent evidence-based reviews suggest that transfusion should be considered, but is not mandatory, when haemoglobin is between 70 and 100 g/L.13

The cause of thrombocytopenia should be identified. Some myelodysplastic syndromes are also associated with abnormally poor platelet function. Generally, surgery can proceed normally if platelet count is above 100,000, and may still be possible with a platelet count above 50,000 and good function. Advice from a haematologist should be sought.

Haematological consultation is necessary to guide the management of patients with bleeding disorders or thrombophilias. Local policy should guide screening for sickle-cell trait.
Changes in surgical techniques and transfusion practice have virtually eliminated blood transfusion in many elective operations. For patients without haematological risks, in settings with reasonable access to emergency blood supply, it might be unnecessary to perform ‘group and screen’ prior to many operations where this has traditionally been required. This includes hysterectomy (by any route) other than for widespread malignancy.

The use of autologous or donor-directed transfusion is an area of controversy and varying clinical practice. Autologous transfusion carries equal risk of clerical/system error, is logistically difficult and costly, and might increase overall transfusion rates and hence total risk. The advantage of reduced transmission of blood-borne illness is much less than popularly imagined. Counselling patients desiring this management in hospitals where it is not locally supported practice can be complex. Involvement of senior haematologists might be necessary.

The ethical and legal issues pertaining to Jehovah’s Witnesses are clearly defined but can be professionally and personally challenging when dealing with individual patients. Senior clinicians who will be involved in treating these patients should be warned in advance.

**Other medical conditions**

The cause and stability of renal impairment should be identified preoperatively, and associated comorbidities assessed. Prevention of perioperative renal deterioration includes adequate hydration and avoidance of nephrotoxic drugs, including some radiological contrast media. Intravenous access should consider future vascular access requirements. Dialysis patients will need timing of surgery and dialysis planned together.

Major hepatic dysfunction may be a complex perioperative management challenge. Early involvement of gastroenterologists and anaesthetists/intensivists in planning care is appropriate.

Symptomatic reflux may indicate a need for preoperative acid suppression therapy, and modification of airway management by the anaesthetist.

Rheumatoid arthritis has multisystem complications, many of which have perioperative implications. Drug treatments include steroids and various drugs with immunosuppressive and antiplatelet effects. Many drugs have important toxicities and interactions, which must be anticipated. Airway management may be compromised by cervical spine changes and atlantoaxial instability. Stiffness, joint deformity, and trophic skin changes may have implications for regional anaesthetics, patient positioning intraoperatively and postoperative pressure area care.

Oncology patients may have current or recent treatment with a variety of chemotherapeutic agents with significant side effects and interactions. It might take some effort to clarify which drugs have been used and the implications these could have on planned surgery. Venous access might be difficult.

Morbidly obese patients have widespread physiological changes and are technically challenging for the surgeon, the anaesthetist, and for nursing care. They present organisational challenges with regard to patient equipment, manual handling, and so on, so wards and operating theatres should be warned in advance. Operating time (including ‘turnover’ time) must be expected to be prolonged.
**Warfarin**

There are varied approaches to the management of de-warfarinisation and alternative anticoagulation. The requirement for completeness of reversal will vary with surgery. Omitting four or five doses of warfarin will generally provide sufficient reversal, but this will need to be checked on day of surgery. The patient’s risk of complications while de-warfarinised will vary. Low-risk patients may not need alternative anticoagulation. Medium-risk patients may be treated with once daily enoxaparin, 40–60 mg SCI; high-risk patients require twice daily dosing. Local guidelines or consultation should be sought.14

**Miscellaneous issues**

Oestrogen-containing oral contraceptives (OCP) increase the risk of deep vein thromboses (DVTs). This was a particular issue with early-generation higher-dose OCPs. Cessation of OCPs 4 weeks before major or lower-limb surgery might be prudent with regard to thromboembolism but will increase the risk of perioperative pregnancy. The patient should be involved in this decision. Continuing OCP use is a minor modifier when assessing perioperative DVT risk. Fertile patients should be assessed for possible pregnancy before anaesthesia.

Smoking is associated with increased cardiovascular and respiratory complications, which are at least partly reduced by preoperative cessation. The increased motivation to modify health behaviour may also be used to achieve longer-term smoking cessation. Patients who smoke should be encouraged to quit preoperatively. Nicotine replacement therapy should be used to assist quitting, and to assist patient tolerance of the smoke-free hospital environment.15

The patient’s anaesthetic history may identify relevant issues including airway problems, malignant hyperthermia risk, severe postoperative nausea and vomiting, or requests for, or objections to, regional anaesthesia. These should be notified to the procedural anaesthetist.

Use of non-prescription (‘herbal’) medication is common. Some have significant side effects and interactions, including antiplatelet effects. General advice to cease for 1 week preoperatively is simple and broadly appropriate. More tailored advice can be given if the patient requests this.16

Reported allergies should be clarified to establish why the patient is considered to be allergic. Latex allergic patients require special management in the operating theatre, which must be planned for.

**PATIENT MANAGEMENT FOR DAY-ONLY PROCEDURES**

**Patient selection**

Procedures for managing patients having day-only procedures are well established. Patient selection depends on three factors: (1) the patient’s medical status must be appropriate and stable; (2) the planned procedure must be appropriate with regard to postoperative pain, emesis, mobility, function, and possible complications; and (3) social factors, including comprehension of instructions, transport, communication, and
responsible adult supervision postoperatively should be appropriate. There will be some local variation in policy, but application of these criteria should be consistent.

**Postoperative care**

Effective analgesia and prevention of postoperative nausea and vomiting (PONV) are keystones of patient satisfaction. Multimodal analgesia should be used including regular oral analgesics, NSAIDs and local anaesthesia. Patients should be instructed to use analgesia to prevent pain, rather than to relieve it. Good intravenous hydration, avoiding early oral fluids, helps to prevent PONV. Combination therapy for PONV includes antiserotonergics (e.g. ondansetron), droperidol and dexamethasone.

**Discharge**

Patients should be discharged on the basis of local criteria addressing surgical complications, vital signs, analgesia, nausea, alertness, and mobility. Patients should be discharged with an escort, overnight supervision, and verbal and written postoperative instructions. It is safe to drive on the day following general anaesthesia if feeling well and not using strong pain medication.

**MANAGEMENT ON DAY OF PROCEDURE (ALL PATIENTS)**

Wherever possible, patients should be admitted to hospital 1–2 hours before their procedure, through specifically established and staffed preoperative area. This is preferred by patients and has been shown to reduce adverse outcomes, including surgical infections, compared to traditional admission the day before surgery through a surgical ward.\(^\text{17}\)

Tests on the day of procedure should only be those that could not have been done earlier (e.g. check of coagulation status after de-warfarinisation, group and screen when pregnant or after recent transfusion).

Preoperative anxiolysis is assisted by reduced in-hospital waiting time, a pleasant and warm environment, maintenance of street clothing for as long as possible, and well-explained, efficient clinical processes conducted by competent staff. Patients dislike being asked the same questions repeatedly: information should be gained from accurate clinical records rather than repeatedly from the patient. Anxiolysis may be supplemented pharmacologically, e.g. temazepam 10–30 mg.

Patients may have light food until 6 hours preoperatively, and clear fluids (not including milk) until 2 hours preoperatively. This is a change from ‘traditional’ fasting guidelines (6 hours for food and water) and remains an area of confusion for some staff. A small amount of water to take oral medication may be allowed within 2 hours preoperatively. Patients who have not fasted appropriately should not be cancelled until discussion with the procedural anaesthetist.

Patients with symptomatic reflux may be given acid suppression therapy and gastric prokinetics (ranitidine, sodium citrate, metoclopramide). Pre-emptive analgesia using opiates, paracetamol or NSAIDS may be given. Prophylactic antiemetics may be indicated based on risk assessment, but there is no advantage gained by preoperative administration. Preoperative carbohydrate loading has recently been advocated but has not become widespread.\(^\text{18}\) Antibiotic prophylaxis for surgical infection, valvular heart disease, or implanted devices should be given intravenously shortly before surgery.
Prophylaxis against venous thromboembolic disease should be given based on established guidelines. \(^{19}\) Regional anaesthesia/analgesia may be contraindicated after DVT prophylaxis using heparins. In patients likely to have these techniques, DVT prophylaxis should be withheld preoperatively, but then given after regional procedures are completed.

The patient's family should be given clear expectations as to when the procedure will be finished. Contact details for communication at the completion of the procedure should be recorded.

**POSTOPERATIVE PATIENT MANAGEMENT**

Postoperative management includes those general tasks, issues, and complications encountered in any patient having surgery, and specific tasks or complications pertaining to individual operations or procedures. These specific issues are appropriately considered with the specific operation, and not dealt with here.

Postoperative care is based on regular observations of physiological vital signs (pulse, respiration, blood pressure, temperature), general observations of the patient's condition, and specific observations related to the surgical procedure. Integration of vital signs with assessments including urine output and peripheral vasoconstriction indicates adequacy of cardiac output and tissue perfusion, the fundamental determinant of the patient's well-being. Pain has been proposed as the 'fifth vital sign', and must be considered in all patient observations. Technological advances are providing 'routine' availability of other signs, in particular haemoglobin saturation by pulse oximetry. In addition to regular observations, the established routines of surgical patient care (such as pressure area care) prevent, or facilitate the early detection of, postoperative complications.

The traditional medical model of care has been based on using regular observations to detect early signs of possible complications. These observations trigger a process that aims to diagnose the cause of the problem by history, examination, and investigation. Having made a diagnosis, a therapeutic approach is then formulated. This approach is satisfactory for early problems and minor complications, but may lead to inappropriate delays in treating patients with acute severe illness. Audits of unplanned ICU admissions and high-risk surgical patients have demonstrated that many patients suffer as result of inadequate response to early physiological indicators of acute illness. \(^{20,21}\)

Various early-response strategies, such as the Medical Emergency Team or Critical Care Outreach Team, have been proposed as a possible solution to this problem. \(^{22}\) Ward nurses can be empowered to summon senior clinical assistance directly, based on defined physiological criteria. Medical staff can be trained to use algorithm-based responses to physiological disturbances, with stabilisation and initial treatment commencing simultaneously with the diagnostic process, rather than sequentially. The Royal College of Surgeons’ CCrISP programme is an example of the latter approach. The best solution remains controversial but the importance of rapid, aggressive response to early signs of physiological decompensation cannot be overstated.

**Fluids and electrolytes**

Postoperative fluid therapy is needed for the following requirements: (1) normal maintenance; (2) blood or fluid loss e.g. wounds, drains, induced diuresis etc; (3) ‘third
space losses’—fluid sequestration in tissue oedema or ileus; and (4) increased systemic requirements due to fever and hypermetabolic state. Fluid therapy should be tailored to match these requirements. Daily normal maintenance requirements include approximately 30 mL/kg water, 1.5 mEq/kg sodium and 1 mEq/kg potassium. Fluid losses should be considered as plasma and replaced with a balanced solution such as lactated Ringer’s fluid. Potassium replacement can be omitted in the short term because tissue destruction due to surgery, and the aldosterone response, increases potassium in circulation. The third postoperative day may be associated with a ‘rebound’ hypokalemia that can contribute to cardiac arrhythmias in at-risk patients.

Analysis of the above will show that 1000 mL of normal saline or lactated Ringer’s supplies daily sodium requirements, and that common clinical practice tends to provide excessive salt (and water). This may reflect traditional invasive surgery associated with considerable ‘third-space’ losses, but is less appropriate with current, less invasive, surgery. The homeostatic capability of a normal (renally intact) body is considerable, and wide variation in fluid therapy is tolerated by most patients. Elderly patients, particularly those with cardiorespiratory disease, must be treated more cautiously. Some recent work suggests that excessive postoperative salt and water may increase adverse outcomes after colorectal surgery.23 Conversely, recovery on the first day of surgery is improved by ‘liberal’ intravenous fluids (e.g. 40 mL/kg lactated Ringers).24

**Venous thromboembolic disease**

Thromboembolic disease is one of the major causes of readily preventable death and morbidity in hospital patients.19 The need for thromboprophylaxis is clearly established, but application of evidence-based therapy remains suboptimal. Patients can be classified as low, medium or high risk depending on patient factors, type of surgery, and comorbidities. Prophylaxis based on established guidelines must be continued through the postoperative phase. This will continue for some weeks after discharge for high-risk patients.

**Chronic medication**

With few exceptions, chronic medication should be maintained perioperatively, even when ‘nil by mouth’. Alternative routes of administration should be considered for critical drugs such as antiarrhythmics (including beta-blockers), anticonvulsants, and antiparkinsonian drugs. Advice from the hospital pharmacist should be sought.

**Pain management**

Postoperative pain management is based on a number of principles. Pain is both unpleasant and associated with complications such as chest infections, thromboembolism, and delayed recovery. Pain prevention is preferable to, and more efficacious than, treatment of established pain. Multimodal approaches reduce side-effects, and enable ‘fast-tracking’ of the patient’s functional recovery.2

The safe and effective use of modern pain-management techniques depends on a hospital-based pain team providing regular training, supervision, and audit of pain management. This facilitates the safe use of complex techniques such as epidurals and multimodal analgesia. The pain team should be consulted if postoperative analgesia is inadequate or problematical.
Mild or even moderate pain can be appropriately managed using strong oral analgesics in a multimodal strategy. This includes attention to all aspects of patient comfort.

**Patient-controlled analgesia**

Patient-controlled analgesia (PCA) is the standard technique for the management of moderate or severe postoperative pain. A small dose of opiate (e.g. 1 mg morphine) is given intravenously at patient request, with a lockout period (e.g. 5 minutes) to prevent overdosing. Patient control and titration is important for both safety and patient satisfaction. The incremental dose can be adjusted for tolerant or sensitive patients. The lockout period is rarely changed. There is little evidence that a background infusion improves analgesia. Fentanyl may be used as an alternative opiate; other opiates have no clear advantages. Neuroexcitatory metabolites of pethidine may accumulate, particularly in renal failure. Regular paracetamol and NSAIDs can be used simultaneously. Supplementary oxygen should be considered, particularly on the first and second postoperative nights.

**Epidural analgesia**

Epidural analgesia provides excellent pain management after major surgery. It is only safe to use on wards with trained staff under pain service supervision. Usually, a combined local anaesthetic and opiate infusion is used. These drugs act synergistically, but can be given separately. The level and density of block must be regularly assessed. Ideally, the local anaesthetic will provide blockade of small nerve fibres (pain and temperature) but maintain fine sensation and motor power. The opiate augments the analgesic effect at a spinal level.

Epidural analgesia may require repeated interventions to achieve the correct level and density of block. Side effects of epidural opiates include pruritus, nausea and vomiting, and respiratory depression. Continuous supplementary oxygen should be used. Urinary retention is common. Pain service protocols should guide the management of these side effects. The insertion site must be inspected regularly, and possible infection treated promptly. Any suggestion of neurological deficit should be promptly assessed for possible epidural haematoma or infection, and investigated (e.g. magnetic resonance imaging) urgently. Removal of epidural catheters may need to be timed to match a therapeutic trough after prophylactic heparin or low molecular weight heparin (LMWH) is given.

The sympathetic blockade associated with local anaesthetics can result in vasodilation and subsequent hypotension. Blockade of cardiac sympathetics might prevent an associated tachycardia. This can be particularly confusing. Hypovolaemia should be excluded by assessment, including urine output and fluid resuscitation. If the patient is not normally hypertensive, and appears otherwise well and well-perfused, it might be appropriate to accept a low-normal blood pressure. It may, however, be difficult to exclude inappropriate vasodilation or early sepsis. The advice of the pain team may assist decision making, including modifying or abandoning the epidural analgesic technique.

**Other pain-management techniques**

This includes the use of non-opiate drugs such as clonidine or tramadol, continuous nerve blocks, and novel drugs used epidurally. The management of a surgical patient
with coexisting substance abuse issues or chronic pain problems of any cause, is complex and requires the early involvement of a pain medicine specialist.

**POSTOPERATIVE COMPLICATIONS**

**Respiratory complications**

There are multifactorial causes for postoperative changes in pulmonary function, which may result in pulmonary complications. These include decreased vital capacity and functional residual capacity (FRC), changed breathing pattern (shallow breaths), pulmonary oedema, dry and thickened airway secretions and impaired sputum clearance. The reduction in FRC and loss of normal periodic maximal inflation leads to alveolar collapse and atelectasis. This can then cause hypoxaemia, increased work of breathing, pulmonary infection and respiratory failure.

Complications are more likely after operations involving upper abdominal/thoracic incisions, nasogastric tubes, prolonged bed rest, and prolonged or severe pain. Patients who have pre-existing lung disease, smokers, the obese and elderly are at particular risk.

The prevention of postoperative pulmonary complications is based on prevention of atelectasis by deep breathing, sitting up, effective pain relief, and early mobilisation. Patients at risk should use incentive spirometry to ensure periodic deep inspiration. Preoperative instruction in technique assists the effectiveness of this treatment.

‘Early’ respiratory failure is primarily due to impaired respiratory mechanics. Initial treatment is based on oxygenation, reversing atelectasis and re-establishing effective ventilation by physiotherapy etc. ‘Late’ respiratory failure (> 48 hours postoperation) might indicate another cause, such as pulmonary or other infection, cardiac failure, early sepsis, or pulmonary embolus. Tachypnoea (> 25 breaths/minute) is an early and sensitive indicator of physiological decompensation. Late respiratory failure must be investigated and treated aggressively.

**Cardiovascular complications**

Cardiovascular changes leading to disturbances of heart rate, blood pressure, and oxygenation are common. High-risk patients should be monitored closely in a special-care area. Management of cardiovascular complications should be based on rapid initial assessment with simultaneous stabilisation, followed by identification of cause and treatment as indicated.

Dysrhythmias (including atrial fibrillation) may be related to increased sympathetic activation, fluid and electrolyte disturbance, omission of normal drug therapy, early sepsis, or myocardial ischaemia/infarction. Treatment includes beta-blockade, amiodarone, or cardioversion if the patient is haemodynamically unstable due to atrial fibrillation/flutter.

Acute postoperative left ventricular failure (LVF) and pulmonary oedema might reflect fluid overload but is more likely to be cardiogenic, such as myocardial ischaemia causing decreased ventricular compliance and contractility, tachyarrhythmias, or myocardial infarction. Except in mild cases, patients should be treated as a medical emergency. Initial treatment will include oxygenation including mask continuous
positive airways pressure (CPAP), nitrates, diuretics, morphine, and other therapy based on findings and initial response.

Postoperative myocardial ischaemia or infarction is common in high-risk patients having major surgery. Early diagnosis is difficult as about 50% are ‘silent’. The mortality associated with postoperative infarction is reported to be higher than ‘usual’ infarcts. Treatment is based on treatment in the non-operative setting (aspirin, nitrates, beta-blockade, anticoagulation when feasible, investigation, angioplasty, etc.) but must be modified due to the contraindications to thrombolysis.

Other complications

Postoperative confusion, cognitive changes and delirium

These complications are common after major surgery and in the elderly. The cause can be multifactorial and early assessment should aim to identify acute or reversible causes including infection (chest, urinary, wound, systemic), drug effects and interactions, cardiorespiratory decompensation, anaemia, metabolic derangements, drug or alcohol withdrawal, or cerebrovascular accidents. Reorientation and reassurance must be given. Pharmacological sedation may be appropriate after assessment but established delirium or psychosis is a medical emergency and psychiatric involvement should be sought.

Renal function

This must be monitored by measuring urine output, serum urea and creatinine in patients at risk. Deterioration in renal function that does not respond to treatment for obstruction or hypovolaemia might be multifactorial, including drug interactions, and must be investigated more thoroughly by a nephrologist.

Infection

Infection can be either local (including surgical wound, urinary tract, chest, phlebitis) or systemic. It can present insidiously and should be considered as the cause of any postoperative decompensation.

Gastrointestinal issues

Postoperative nausea and vomiting associated with anaesthesia and pain relief, should be treated with a serotonin antagonist (‘-setrons’) alone or in combination with other antiemetics. Nasogastric tubes are associated with increased atelectasis, pneumonia, and patient discomfort. After surgery not involving the gastrointestinal tract, patients should be allowed postoperative fluids and a light diet as desired.

DISCHARGE AND CONVALESCENCE

The patient should have been given clear expectations for the postoperative period as part of education before surgery. This should include preparation for discharge from hospital. Clear instructions for the convalescent period after leaving hospital should
also be given. Earlier discharge, better functional recovery, and (presumably) less morbidity are the results of optimal planning for postoperative care.

### Practice points

- Institutional consistency is more important than the choice between accepted methods for managing many clinical issues.
- Patient preparation should begin at the time of booking for surgery.
- Preoperative tests should be based on patient risk factors, not ordered ‘routinely’.
- Optimisation of existing comorbidities improves patient outcomes.
- If a patient requires cardiac drug optimisation, angioplasty or surgical intervention (regardless of considerations of forthcoming surgery), this should be performed before surgery if possible.
- There is no justification for angioplasty or bypass surgery in anticipation of non-cardiac surgery, if this is not otherwise indicated.
- It is unclear if beta-blockers are of benefit preoperatively in a patient who does not normally need them.
- Surgery after MI should be delayed for at least 6, and preferably 12, weeks if possible.
- There is little evidence to justify cardiac or other interventions that could not be justified independently of the planned surgery.
- All diabetic patients will need regular perioperative monitoring of blood glucose.
- Oral hypoglycaemics are omitted on the day of surgery and some up to 48 hours beforehand.
- Insulin management may involve maintaining long-acting insulin and omitting short-acting doses, giving a reduced dose (e.g. half) of normal premixed insulin, or using an insulin infusion, starting pre- or intraoperatively.
- Glucose infusion will be needed depending on the duration of fasting.
- It may be advantageous to place a diabetic patient early on a list but this ‘requirement’ has often been overstated.
- There remains ongoing controversy about the benefit of ‘tight’ perioperative glycaemic control in otherwise well-treated patients.
- Non-insulin-dependent patients may require insulin postoperatively after major surgery.
- Most chronic medication should be continued throughout the perioperative period. Alternative routes of administration should be considered for critical drugs such as antiarrhythmics (including beta-blockers), anticonvulsants and antiparkinsonian drugs.
- Conventional fluid regimes may give excessive salt and water after the first postoperative day.
- Prophylaxis against venous thromboembolism remains underutilised.
- Postoperative patients (especially the elderly) are at high risk of significant adverse events. A system to facilitate rapid ‘aggressive’ response to early signs of deterioration should be used.
• respiratory complications are common, but can be minimised by the prevention and early treatment of atelectasis
• left ventricular failure and pulmonary oedema may be a result of myocardial ischaemia rather than simple fluid overload
• confusion or delirium may be an early sign of drug interactions or infective complications, and should be assessed carefully

REFERENCES

