

# **An Introduction to Postoperative Complications**

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## Introduction

Many people have complications after surgery; some transient, others serious, but all are important to patients. The likelihood of postoperative complications is influenced by the type of surgery, the patients pre-existing comorbid state and perioperative management. Postoperative complications can be general or specific to particular operations and can also be classed according to their time of onset: immediate, early and late. Although not exhaustive this article will outline a range of postoperative complications.

## Background

Post-operative complications cause death and suffering, longer hospital stays and increase costs. Patients who have complications are more likely to die, *even 5 years after surgery*. About 20,000 to 25,000 deaths occur every year in UK hospitals following surgery, of which about 80% occur in a small group of “high risk patients”. These patients account for 10% of surgical inpatients and are at increased risk of mortality and morbidity (table 1). True rates of post-operative complications have been difficult to quantify due to the lack of universally agreed definitions, making comparisons between different hospitals and countries challenging. Complication rates may differ in the literature for various reasons, not least due to the various methods which can be used to detect a complication eg the use of an ultrasound to detect a deep vein thrombosis (DVT) compared with clinical examination.

Predictor of risk	
History of ischemic heart disease	
History of congestive heart failure	
History of cerebrovascular disease (stroke or transient ischemic attack)	
History of diabetes requiring preoperative insulin use	
Preoperative serum creatinine > 166 $\mu$ mol	
High-risk type of surgery	
Number of predictors	Risk of cardiovascular complications
0 predictors	0.4%
1 predictor	0.9%
2 predictors	6.6%
3 or more predictors	>11%

**Table 1: Lee's Revised Cardiac Risk Index** - a clinical prediction tool developed to estimate patients' risk of perioperative cardiac complications in patients undergoing elective non-cardiac surgery. Recently there has been a general trend to try to involve patients more and more in decisions about their care. Although there are lots of gaps in our knowledge anaesthetists and surgeons assess the chance of complications and communicate that risk to patients as part of the consent process, helping them decide whether or not to proceed with surgery.

Presently, no one cause of postoperative complications has been identified, but several associated risk factors have been used to develop scoring systems to assist with pre-operative risk stratification (Table 1). Some researchers think that some patients immune systems are in a 'primed' susceptible state before surgery that make them more likely to subsequently have complications. Other areas of research have focussed on the gastrointestinal tract being a source of inflammation- causing endotoxin from bacteria to leak systemically or have highlighted a lowered ability of patients that develop complications to increase their cardiovascular performance, leaving tissues at risk of underperfusion and hypoxia.

## Preventing Perioperative Complications

Ideally, no-one would have a complication after surgery. Some complications may be avoidable whilst others inevitable in some circumstances. In some circumstances patients may choose not to proceed with their surgery once they

At all stages of the patients perioperative 'journey' there are techniques and strategies that health care professionals can use to help stop postoperative complications (table 2). Some of these are generally accepted (eg timely antibiotics) whilst others are gaining increasing prominence such as the concept of a 'perioperative physician'.

<b>Preoperative</b>	Preassessment Clinic Fitness and Risk assessment Correct diagnosis and treatment of comorbidities Continue/ stop relevant drugs
<b>Theatre Suite</b>	Correct and timely antibiotics 'Cardiovascular Optimisation' Specific Drugs (eg anti emetics)
<b>Postoperative</b>	'Enhanced recovery' programmes Good analgesia Early mobilisation Postoperative Intensive care / HDU / PACU Regular Postoperative ward rounds Perioperative Physician Local postoperative outcome data collection

**Table 2** Examples of strategies designed to prevent perioperative complications. HDU: High Dependency unit; PACU: Post Anaesthetic Care Unit.

## Anaesthesia

Anaesthesia can cause many complications, but in general we can think of them as centred on the airway, respiratory or circulatory systems. For some there is debate about where 'anaesthesia' complications end and 'surgical' complications start. For example, postoperative pneumonia may be caused by the abnormal ventilation that occurs under anaesthesia as well as the positioning for surgery and the surgical incision that makes breathing and coughing painful, shallow and ineffective. Modern anaesthetic practice is aimed at being safe and avoiding complications.

Specific	Causes
Painful throat	Airway related trauma
Malignant hyperthermia	Ryanodine receptor defect
Suxamethonium apnoea	Inheritance of defective cholinesterase gene
Abnormal reaction to anaesthetic drugs	Anaphylaxis, acute porphyria
Associated	Causes
Ventilation/perfusion mismatch	Increased dead space, shunt, atelectasis
Hypoventilation	Inadequate pain relief, opioid overdose
Pneumonia	Poor cough & clearance of secretions, aspiration, immobility
DVT/Pulmonary embolus (PE)	Immobility, hyper-coagulable state post-operatively
Pressure sores	Immobility, poor tissue perfusion & wound healing

**Table 2** : Examples of specific and associated complications of Anaesthesia

## Haemorrhage

Haemorrhage can be classified as:

- *'Primary'*: occurring when a vessel is cut during surgery.
- *'Reactionary'*: occurring when rises in blood pressure at the end of the operation cause vessels that had previously not been bleeding to start to do so.
- *'Secondary'*: normally due to infection which causes damage to a vessel days after surgery.

The increased risk of haemorrhage may be multi-factorial in origin (see table 3). The management of haemorrhage depends on the cause but may include fluid and blood product resuscitation, reversal of anti-coagulant effect and surgical intervention. Some drugs and techniques may play a part in reducing blood loss and the need for blood transfusion.

Risk factor	Cause
Drugs	Heparin, warfarin, non-steroidal anti-inflammatory agents, anti-platelet drugs
Congenital bleeding disorder	Haemophilia, von Willebrand disease
Acquired bleeding disorder	Sepsis, liver disease, disseminated intravascular coagulation

**Table 3** : Risk factors for perioperative haemorrhage.

## Damage to Adjacent Structures

Damage to adjacent structures may occur intra-operatively and if unrecognised, may result in leaks (eg bile, gastrointestinal contents), haemorrhage, abscess formation or sepsis. The clinical presentation varies depending on the structure affected and the extent of the damage.

## Atelectasis

Atelectasis is the collapse of areas of the lungs and may result in post-operative pulmonary complications such as hypoxia. Clinical examination may show reduced basal air entry with reduced lung volumes on chest x-ray. Prevention and treatment includes humidified oxygen, good quality analgesia to allow deep respiration, coughing and sitting up, early mobilisation, chest physiotherapy and continuous positive airway pressure (CPAP).

## Pain

Post-operative pain should be assessed and managed according to the WHO pain ladder. When prescribing an analgesic regimen, the expectations and fears of the patient, the nature of surgery, contraindications to certain analgesics and suitability for a regional anaesthetic block should be considered. Pre-existing chronic pain problems (eg being on analgesics before surgery) can make post-operative pain management more difficult. Surgical complications (e.g. bleeding or perforation) should be considered when pain is disproportionate to the clinical situation or new in onset. Additionally, chronic pain syndromes may develop as a complication of acute post-operative pain.

## Nausea and Vomiting

Post-operative nausea and vomiting (PONV) may cause an unplanned hospital admission. The risk factors are multifactorial (table 4). Strategies to prevent PONV include considering regional anaesthesia, reducing the use of opioids, adequate hydration and a combination of anti-emetic drugs. Classes of anti-emetics include anti-histamines (cyclizine), 5HT3 antagonists (ondansetron), anticholinergics (hyoscine hydrobromide), steroids (dexamethasone) and D2 antagonists (metoclopramide). They act on receptors that have sensory afferents to either the vomiting centre (in the medulla) or the chemoreceptor trigger zone outside the blood brain barrier.

Risk factors for PONV	Reason
History	Previous PONV, motion sickness
Sex	Females
Type of surgery	Gynaecological, emergency, middle ear, eyes
Drugs	Opioids

**Table 4:** Risk factors for postoperative nausea and vomiting

## Oliguria

We think of oliguria- low urine output (<0.5ml/kg/hour) – as having pre renal, intrarenal or postrenal causes (Table 5). Initial examination of oliguric patients should assess whether the cause is likely to be pre- or post-renal. Fluid balance charts should be checked to determine whether fluid intake has been adequate or losses excessive. A fluid status examination and measurement of blood pressure may elicit evidence of hypovolemia or hypotension. Initially a fluid challenge may be appropriate with strict assessment of whether the urine output increases. Post-renal causes are likely if abdominal examination or ultrasound demonstrates discomfort and a distended bladder: the patient should have a urethral catheter inserted. If pre- and post-renal failure has been excluded, intrinsic renal disease should be considered.

Investigations of oliguria may include urine dipstick, serum electrolytes (particularly potassium), renal ultrasound and an immunology screen with nephrology referral. All patients should be assessed before surgery for their risk of renal dysfunction according to the 'RIFLE' criteria.

<p><b>Pre-renal</b> <i>Renal hypoperfusion</i></p> <ul style="list-style-type: none"> <li>• Hypotension (e.g. sepsis)</li> <li>• Hypovolemia (e.g. haemorrhage)</li> <li>• Reduced cardiac output</li> <li>• Drugs that influence renal perfusion (e.g. non-steroidal anti-inflammatory drugs, ACE inhibitors, angiotensin II receptor antagonists.)</li> </ul> <p><b>Renal</b> <i>Intrinsic renal disease</i></p> <ul style="list-style-type: none"> <li>• Ischaemia from hypoperfusion</li> <li>• Nephrotoxins (e.g. aminoglycosides)</li> <li>• Glomerular disease</li> </ul> <p><b>Post-renal</b> <i>Outflow obstruction</i></p> <ul style="list-style-type: none"> <li>• Benign prostatic hypertrophy</li> <li>• Blocked Urinary Catheter</li> <li>• Inadequate urge to void (eg after spinal Anaesthesia)</li> <li>• Renal calculi</li> </ul>
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**Table 5:** Examples of Causes of Oliguria Adapted from Calvert and Shaw (2012)

## Post-operative Pyrexia

Post-operative pyrexia is common. Often inflammatory mediators released as the response to surgery will cause low-grade pyrexia within 24 hours of an operation and of course, any pre-existing pyrexia can leave some residual fever post-operatively. Other common causes of pyrexia can be remembered as the “seven Cs” below. Each of these causes should be sought and treated appropriately:

- **Cut** (*Wound Infection*)
- **Collection** (*Pelvic or Subphrenic Abscess*)
- **Chest** (*Infection or Pulmonary Embolism*)
- **Cannula** (*Infection*)
- **Central venous catheter** (*Infection*)
- **Catheter** (*Urinary Tract Infection*)
- **Calves** (*Deep Vein Thrombosis*)

## Infections

Post-operative infections can be classified by both site and cause. Discussed below are some of the most common causes.

### Surgical Site Infection (SSI):

SSIs can complicate recovery in 5% of patients; risk factors include intra-operative exposure to endogenous organisms (e.g. during bowel surgery), prolonged surgery and impaired immunity (e.g. diabetes, immunosuppression) (NICE, 2008). Management may require antibiotics, suture removal and debridement with open wound care (NICE, 2008).

### Central Venous Catheter Infection:

Infection of central venous catheters (CVC) may lead to catheter related blood stream infections (CRBSI) that can have a 25% mortality (Fletcher, 2005). CVCs should be reviewed daily and CRBSI should be suspected when there is a CVC and signs of bacteraemia; a positive blood culture and growth of the same organism from the CVC would support the diagnosis. CVC's should always be removed as soon as they are not needed. Inflammation around the CVC insertion is relatively uncommon and its absence does not rule out CRBSI. Treatment usually requires antibiotics and removal of the line. All CVS's should be inserted with meticulous aseptic technique: gown, mask, gloves, skin preparation, antibacterial dressing.

### Urinary tract infection:

Urinary catheters are inserted perioperatively to facilitate surgery or to aid fluid balance management. They do, however, predispose patients to urinary tract infections that may need antibiotic treatment.

### Abdominal Collections:

Abdominal collections are more likely if there is leak of bowel contents. They may present with nausea, malaise, pain, swinging fever, localised peritonitis or tenderness and altered bowel function and the onset of symptoms is determined by abscess location: pelvic abscesses tend to occur 4-10

days after surgery whilst subphrenic abscesses occur 7-21 days after surgery. Collections are typically investigated by ultrasound, CT or MRI scans and may subsequently require drainage under radiological guidance or possibly surgical intervention.

Cannula:

Peripheral cannulae should be reviewed daily, and removed if there is evidence of redness or pain around the insertion site.

Pneumonia:

Risk factors for a post-operative chest infection include pre-existing co-morbidity, obesity, prolonged surgery, immobility and prior treatment with antibiotics (Nicholls and Wilson, 2000). Patients may complain of shortness of breath, malaise, a cough or even pleuritic chest pain and present with tachycardia, pyrexia, tachypnoea and hypotension (Nicholls and Wilson, 2000). Treatment options include oxygen therapy, chest physiotherapy, antibiotics and intravenous fluids to treat any hypotension.

**Deep Vein Thrombosis (DVT) and Pulmonary Embolism (PE)**

Any change to Virchow’s triad (flow, endothelial integrity and constituents of blood) promotes venous stasis and thrombus formation; potentially leading to a DVT. When there is a suspicion of a DVT and a Wells score  $\geq 2$ , a Doppler ultrasound scan of the proximal leg veins should be performed (Table 6). PE may complicate DVT and present with chest pain, shortness of breath, haemoptysis, hypoxia and pyrexia. If untreated, a PE may cause pulmonary infarction, right heart strain and even death. CT pulmonary angiography may be undertaken to confirm the diagnosis. Anticoagulation with heparin is necessary and occasionally surgical intervention may be indicated.

Clinical feature	Points
Active cancer	1
Paralysis/paresis/recent immobilisation of leg	1
Bedridden for $\geq 3$ days or major surgery within 12 weeks	1
Tenderness along distribution of deep venous system	1
Swelling of entire leg	1
Calf swelling $\geq 3$ cm larger than asymptomatic calf	1
Pitting oedema of symptomatic leg only	1
Collateral non-varicose superficial veins	1
Previous DVT	1
Alternative diagnosis at least as likely as DVT	-2
Clinical probability	
DVT <i>likely</i>	2 points or more
DVT <i>unlikely</i>	1 point or less

**Table 6:** A summary of the two-level DVT Wells score. Adapted from NICE Clinical Guidelines (2012)



## Cardiovascular Disease

Postoperative cardiovascular complications include acute dysrhythmias (e.g. atrial fibrillation), ischaemic injury, infarction, and left ventricular failure (with associated pulmonary oedema). The Vascular Events In Non-cardiac Surgery Patients Cohort Evaluation (VISION) Study in 2012 found that patients with troponin T levels of 0.02 ng/mL or greater had an elevated risk of death post-operatively. As such any new cardiovascular change including chest pain, should be appropriately investigated and specialist opinion sought.

## Reduced Bowel Function

Constipation may occur post-operatively due to opioids or anti-cholinergics. Management involves adequate hydration, appropriate nutrition and laxatives. Post-operative ileus may be caused by intra-operative bowel manipulation, pain, immobility, hypokalaemia and opioids. Features of ileus include reduced bowel function, abdominal distension, discomfort, nausea, vomiting and a reduced absorption of oral drugs. Ileus usually resolves within 24-36 hours and management involves insertion of a naso-gastric tube, analgesia and reduced oral intake.

## Delirium

An acute confusional state may occur post-operatively in any patient. Some of the risk factors are shown in Table 7. Unfamiliar surroundings may cause confusion so efforts should be made to reassure and orientate the patient. Occasionally, it may be necessary to prescribe sedation eg haloperidol, lorazepam to reduce distress and prevent harm to the patient, this should only be done under senior advice as sedation can mask important causes.

Cognitive impairment
Age
Dementia
Comorbid diseases (such as renal failure)
Depression
Type of surgery
Infection/inflammation
Medication
Metabolite disturbances
Sleep disruption
Pain

**Table 7:** Examples of risk factors for postoperative delirium

## Pressure sores

Pressure sores are serious and range from a discolouration of the skin to destruction of deeper tissue layers. They are caused by direct pressure, shear forces and friction. Prevention of pressure sores involve risk assessment, frequent turning, measures to promote early mobilisation eg physiotherapy, adequate pain relief and the use of suitable mattresses and cushions.

**Key points**

- Post-operative complications are an important cause of morbidity, mortality, extended hospital stay and increased costs.
- Complications can be general or specific to particular operations.
- There are many strategies to prevent postoperative complications
- Assessment of surgical complications should include a focussed history with particular attention to risk factors.

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