



INTRODUCTION

A surgeon takes on an enormous responsibility whenever performing an operation. There is little more devastating in medicine than an elective operation followed by death or significant morbidity. It is therefore basic surgical practice to evaluate the risks of each procedure, and consider them against the proposed benefits. The prevention of complications, as well as their early recognition and treatment play a major role in the management of a patient during the perioperative period.

All operations may have complications. These range from the trivial to the life threatening, or even death. **General complications** are those which may follow any operation, irrespective of the site. **Specific complications** are the direct consequence of the procedure in question, and vary depending on the type of surgery. The aim of this chapter is to highlight the common and most serious post-operative complications, as well as provide practical guidelines for use in clinical context.

A number of variables will influence the post-operative recovery. These include:

- **patient factors** (ie young vs old, fit vs medically ill, thin vs obese)
- **precipitating pathology** (ie clean vs contaminated)
- **surgical strategy** (elective vs emergency, conservative vs radical surgery)
- type of **anaesthesia** (local vs regional vs general).

For practical purposes this chapter will focus primarily on complications encountered after a standard abdominal operation such as a laparotomy, in the knowledge that the

majority of the principles discussed will apply to other areas of surgery.

RESPIRATORY COMPLICATIONS

Aetiology

Respiratory problems may arise denovo in the post-operative period, or represent deterioration of a pre-existing pulmonary disease.

<i>Common</i>	<i>Less common</i>
atelectasis	aspiration
pneumonia	ARDS
	pneumothorax
	pleural effusion
	pulmonary embolus

Pathogenesis

Multiple factors play a role in the development of atelectasis. Foremost amongst these is the effect of intraoperative mechanical ventilation, during which some areas of lung are invariably inadequately ventilated. Other factors involved are: respiratory depression from anaesthesia, narcotics and sedatives; suppressed cough reflex from sedation; increased absorption of alveolar gas due to high inspired oxygen tension during anaesthesia. Early in the post-operative period inadequate pain control and inability to cough or breathe freely are major factors.

Management

The majority of respiratory problems can be limited by careful perioperative management. High risk patients must be identified before surgery by thorough clinical assessment. A careful history with a specific emphasis on effort tolerance, and other respiratory symptoms is important. A chest X-ray, pulmonary

function tests, and arterial blood gas analysis should be performed in selected cases. Prior to surgery the patient's condition should be optimised, smoking should be stopped, physiotherapy performed and medications reviewed. A short period of antibiotics, bronchodilators or steroids may be beneficial. Intraoperative factors include optimal anaesthesia, and ventilation as well as efficient and appropriate surgery. During the post-operative period appropriate analgesia is paramount. Physiotherapy and early mobilisation are commonly practiced and important. Selected cases may require elective mechanical ventilation in the intensive care unit.

CARDIOVASCULAR COMPLICATIONS

Perioperative Myocardial Infarct

It is the major cause of perioperative death, and carries a mortality risk of 50%. It may occur at any time, but statistically it is commonest on the third post-operative day.

Pathophysiology

Surgical stimuli and anaesthesia, as well as the precipitating pathology, act as perioperative stressors. The most important of these are hypovolaemia, hyper- and hypotension, sepsis, and hypoxia. The end result is an increase in myocardial activity and oxygen requirement. Ischaemia and infarction occur when the need for oxygen is greater than it's supply.

Risk factors for perioperative MI

Patient factors	Operation factors
aortic stenosis	vascular surgery
recent MI	surgery >3 hrs
arrhythmia	
heart failure	
angina pectoris	

Treatment

Prevention is the most efficient strategy. Surgery should be avoided if at all possible in very high risk groups. These are recent myocardial infarct (surgery within 3 months of an MI carries a 37% risk of repeat MI, compared to 16% in the 3-6 month period; an asymptomatic man older than 50 has a risk of 0,5%), arrhythmia, congestive heart failure, symptomatic angina pectoris. The severity of ischaemic heart disease should be quantified and its treatment optimised before surgery. A thorough history and clinical examination together with a resting ECG and chest X-ray are usually sufficient. Occasionally a stress ECG, measurement of ejection fraction or coronary angiography may be required. These are best decided in consultation with the anaesthetist or a cardiologist. The operation and anaesthesia must be carefully tailored to the individual patient for optimal result.

HAEMORRHAGE

Post-operative haemorrhage is a life threatening event. It is relatively rare, and is prevented by accurate surgery and intraoperative haemostasis. Patients most at risk include those with a pre-existing coagulopathy, massive transfusion during surgery, such as a ruptured aortic aneurysm, polytrauma, or portal hypertension.

- **primary haemorrhage**- occurs during surgery and continues during the post-operative period.
- **reactionary haemorrhage**- within 24 hrs of surgery, usually 4-6 hours. May follow primary haemorrhage or result from slipping of a ligature.
- **secondary haemorrhage**- usually the result of infection and false aneurysm formation. Commonest 7 to 14 days post operatively.

Clinical features

Bleeding may be obvious if external (ie in the drain bottle, wound dressings) or occult if internal (peritoneal cavity, intrathoracic). Signs of haemodynamic instability, a drop in haemoglobin and shock become evident with ongoing bleeding.

Treatment

Initial management consists of aggressive fluid resuscitation through a large bore intravenous cannula. Urgent steps must be taken to ensure haemostasis. This may require repeat surgery or angiographic embolisation. Coagulation deficits must be corrected.

DEEP VENOUS THROMBOSIS

Deep venous thrombosis (DVT) is a common event, occurring in 20-30% of all general surgical procedures. The majority are asymptomatic and confined to the calf. A fatal pulmonary embolus may follow in 0,1-0,5% of all operations. The thrombus starts intra-operatively, precipitated by venous pooling which occurs due to paralysis and the absence of the calf muscle pump mechanism. The incidence may be affected by **patient** and **operative factors**.

Patient risk factors

High	Moderate
previous DVT	postpartum
malignancy	heart failure
hypercoagulable state	obesity
oral contraceptive	varicose veins
	pelvic fracture
	age >60 years

Operation risk factors

High	Moderate
hip replacement	Surgery >3hrs
knee replacement	pelvic surgery
	polytrauma
	laparoscopy >45min
	repeat surgery <1 month

Diagnosis

The gold standard remains venography. In limb DVT a hand held doppler or ultrasound can be diagnostic, but better sensitivity may be obtained with a colour duplex doppler.

Treatment

Prevention is important. Risk patients should be identified preoperatively and reversible factors optimised (loss of weight, withdrawal of oral contraceptive, etc). Intraoperatively a pneumatic leg compression device should be used for any operation lasting longer than 45 minutes, especially if the patient is in the lithotomy position. Low molecular weight heparin is administered prior to surgery and continued 12 hourly until the patient is fully ambulant.

With a proven DVT the aim of treatment is to stop thrombus extension and pulmonary embolus. All symptomatic DVT and asymptomatic DVT with extension above the calf should be treated with full anticoagulation for 3 to 6 months. Low molecular weight heparin may be an alternative to warfarin in the future.

GASTROINTESTINAL COMPLICATIONS

<i>common</i>	<i>less common</i>
ileus	stress gastritis
constipation	acute gastric dilatation
wound complications	jaundice
intra abdominal sepsis	pancreatitis
	acalculous cholecystitis
	enterocutaneous fistula
	enterocolitis

Ileus

An ileus implies a dysfunction of gastrointestinal motility or peristalsis leading to a functional bowel obstruction. It is very common after any type of intra-peritoneal surgery. Surgical manipulation or the inflammatory changes of peritonitis cause early adhesions which are responsible for the symptoms of incomplete bowel obstruction.

The extent of ileus may be limited by appropriate surgical technique such as minimal and gentle tissue handling, extraperitoneal surgical approaches, or laparoscopic surgery. Most cases resolve spontaneously within 2 to 5 days after surgery. Another complication is likely to be present if symptoms of obstruction persist for longer.

Anastomotic leaks

A leak from a gastrointestinal anastomosis is a life threatening event. It may lead to an intra-abdominal abscess, peritonitis, or an enterocutaneous fistula. Occasionally a small contained leak may follow a relatively subclinical course.

A number of factors affect whether an anastomosis is likely to leak or not.

Risk factors

<i>local</i>	<i>systemic</i>	<i>anatomic</i>
obstruction	hypoxia	oesophagus
sepsis	↓immunity	colorectal
ischaemia	malnutrition	pancreas
TB	delay	
Crohn's		
radiation		

Established sepsis, prolonged obstruction and bowel ischaemia are particularly hazardous. It is essential that all anastomoses are fashioned with adequately perfused bowel (both ends must be bleeding actively while doing the anastomosis), without any tissue tension, and using meticulous surgical technique. The actual materials or instruments used for of less importance. In high risk situations primary anastomoses should be avoided and diverting stomas created.

Intra-abdominal abscess/sepsis

Intra-abdominal sepsis is one of the most feared complications of abdominal surgery. Pus may be found diffusely throughout the peritoneal cavity, or loculated as an abscess. It is usually the result of inadequate drainage of sepsis at the initial operation, or follow ongoing contamination, as in an anastomotic leak. Other factors include retained foreign body (a lost swab!), infected haematoma, and patient immunocompromise.

Clinical features

The post-operative course will be characterised by a swinging pyrexia, persistent ileus, a raised white cell count, or purulent discharge from the drain. More severe cases will be accompanied by systemic signs of incipient multiple organ dysfunction, such as tachycardia, and hypotension, tachypnoea and hypoxia, poor urine output, coagulopathy and confusion. The elderly, immunocompromised, or

severely ill patients may present in more occult ways, making the diagnosis difficult.

Management

Treatment depends on the extent of infection, its anatomical site, and the patient's overall condition. The majority of patients will require **drainage**, either by means of a repeat laparotomy, or by percutaneous intervention under ultrasonographic guidance. Small, inaccessible collections may be treated conservatively with antibiotics alone.

WOUND COMPLICATIONS

Wound infection

See Chapter on Soft Tissue Infection

Wound dehiscence

This implies disruption or breakdown of the wound. It most commonly occurs during the second post-operative week. It is heralded by a dark red/brown ooze from the wound; and on removal of sutures a knuckle of bowel or omentum is visible. Treatment consists of urgent repair of the abdominal wall. Selected cases can be managed conservatively with moist dressings and eventual skin grafting of the open defect. The residual hernia will then be repaired at a later date.

Wound sinus

A sinus is a blind tract lined by granulation tissue opening onto the skin. In most cases it is the result of persistent infection related to inadequately drained abscess, residual necrotic tissue, or foreign material such as sutures. A common cause is a bulky knot of nylon suture in the subcutaneous tissue. This leads to persistent mucopurulent discharge from the wound, months to years after the original operation. Treatment

involves exploring the sinus, removing foreign material and granulation tissue, and adequately draining any residual sepsis.

Enterocutaneous fistula

A fistula is an abnormal communication between two epithelialised surfaces. The majority occur during the post-operative period. They usually follow an anastomotic breakdown, which leads to enteric contents discharging from the wound or drain site.

Causes of enterocutaneous fistulae

- Postoperative 80%
 - Crohn's disease
 - Adhesiolysis
 - Relook Laparotomy
 - Malignancy
 - TB
- Spontaneous 20%

Fistulae may be classified according to their anatomical position (gastrocutaneous, colocutaneous, etc.), precipitating pathology (iatrogenic, tuberculous, etc.), or volume of output (high output= more than 500 ml per day, low output less than 200 ml per day). Nutrition, volume, and electrolyte deficits are directly related to fistula output, and the greater the output the greater the morbidity and mortality. Malnutrition and sepsis are the principal causes of death, which will occur in between 15-30% of cases.

Management principles

- control of the output ⇒ *stoma therapy*
- adequate fluids ⇄
- correction of electrolytes ⇒ *doctor*
- management of sepsis ⇄
- aggressive nutrition ⇒ *dietician*

The management of complex enterocutaneous fistulae is

multidisciplinary, and requires close co-operation between the surgical team, stoma therapist, and dietician. Conservative treatment alone achieves closure in 60-75% of all fistulae, usually during the first 6 weeks. In cases not responding to conservative management surgical intervention is required. This is best delayed until the patient is free of sepsis and in an optimal nutritional state.

Characteristics of non-healing fistulae

<i>Patient factors</i>	<i>Anatomical factors</i>
<ul style="list-style-type: none"> • TB enteritis • Crohn's disease • Radiation enteritis • Carcinoma 	<ul style="list-style-type: none"> • intestinal discontinuity • distal obstruction • enteric defect > 1 cm² • fistula tract < 2cm long • large adjacent abscess

Practical Clinical Problems

Pyrexia

<i>cause</i>	<i>day post-op</i>
atalectasis	0-3
pneumonia	3-7
phlebitis	3-5
UTI	4-10
wound infection	4-10
DVT	5-10

A careful history and examination will reveal the diagnosis in the majority of cases. If doubt persists a chest X-ray, blood culture, white cell count and urine analysis are helpful initial investigations. A therapeutic course of antibiotics is indicated only when an infective cause has been demonstrated. This should be tailored to treat the likeliest pathogens responsible for the suspected clinical diagnosis.

Respiratory distress

<i>Respiratory</i>	<i>Other</i>
aspiration	pulmonary oedema
pneumonia	myocardial infarct
ARDS	IV fluid overload
pneumothorax	respiratory depression
pulmonary embolus	toxic gastroparesis

Severe respiratory distress, especially if accompanied by hypotension and confusion, is an ominous event. Patients with an impending respiratory arrest need immediate endotracheal intubation. In the majority of cases, however, respiratory support can be planned in a more controlled fashion.

The patient should be helped to sit upright, given face mask oxygen, an intravenous line should be secured, and if available, the oxygen saturation should be monitored. An urgent arterial blood gas, electrolytes, a chest X-ray and ECG are essential investigations. Persistent hypoxia despite 40% face mask oxygen (pO₂<8 kPa) or progressive hypercarbia (pCO₂>6,5kPa) are indications for further respiratory support, most commonly by means of endotracheal intubation and mechanical ventilation.

Progressive respiratory distress, hypotension and confusion are signs of an impending respiratory arrest

Inadequate urine output

<i>pre-renal</i>	<i>renal</i>	<i>post-renal</i>
septicaemia	drug injury	retention
hypovolaemia	ATN	faulty catheter

A urine output of less than 0,5 ml/hour is a defining criteria for acute renal failure. The commonest reason for this is poor renal perfusion due to insufficient circulating blood volume, related to either inadequate fluid administration or ongoing fluid and

blood losses. Patients who are uncooperative, confused, severely ill or where an obstructive cause is suspected should be catheterised.

Never give a surgical patient a diuretic without excluding a pre-renal cause of oliguria

Pre-renal failure is characterised by a dehydrated patient, with a high urine specific gravity, and a disproportionate rise in serum urea compared to creatinine. Treatment consists of replacing the fluid lost until an adequate urine output is achieved. Patients with established renal failure demonstrate a low urine specific gravity, and a rise in both serum urea and creatinine. Life threatening dangers in this setting are hypokalaemia and fluid overload. A CVP is invaluable in managing these cases. Fluids should be restricted, all fluid containing potassium stopped and further nephrotoxic insults avoided. Further management may entail a high dose of IV furosemide or dialysis. Obstructive causes are dealt with by urinary catheterisation.

Confusion/delirium

The causes of an altered sensorium during the post-operative period are many and potentially life threatening. It is essential to make an accurate diagnosis of the precipitating problem, and to resist the temptation to label difficult and restless behaviour as "psychiatric" or "just DT's".



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D	Drugs	opiates, benzodiazepine
	Drug withdrawal	alcohol, benzodiazepine
I	Infection	septicaemia UTI
	Ischaemia of CNS	stroke, TIA
M	Metabolic	hypo-/hyperglycaemia hypo-natraemia acute renal/liver failure
T	Trauma of CNS	subdural, extradural
	Temperature	hypothermia
O	Oxygen lack	hypoxia
P	Psychiatric illness	

When assessing a confused patient there is no substitute for a careful history and clinical examination. Collateral information from the nursing staff and the family is very valuable. The patient's drug chart and nursing notes should be carefully reviewed for changes in medication, fluid balance, blood pressure, heart rate and temperature.

Inappropriate sedation may precipitate a cardio-respiratory arrest

Arterial blood gas, and serum glucose and electrolytes levels are essential investigations. Once the cause of the confusion is ascertained, it must be treated. Occasional patients may be extremely difficult to control: under these circumstances it is permissible to use sedation. A patient should never receive sedation without the appropriate investigations having been done, and it is fundamental that hypoxia and hypoglycaemia are ruled out. Physical restraints, while still in use in many hospitals, are inhumane, dangerous, outmoded and possibly illegal.

Sudden onset of confusion in the post-operative period is due to a metabolic or organic derangement until proved otherwise