# POSTOPERATIVE COMPLICATIONS

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**TARGET: 4TH YEAR MEDICAL STUDENTS**
**DURATION: 50–60 MINUTES**

# POSTOPERATIVE COMPLICATIONS

Postoperative complications are an important cause of morbidity, mortality, extended hospital stay and increased costs.

Most patients at increased risk of developing postoperative complications can be identified prior to surgery at the preoperative assessment clinic using a variety of scoring systems (for example the American College of Surgeons National Surgical Quality Improvement Program surgical risk calculator for a patient's risk of postoperative complications

# Clavien–Dindo Classification of Post-Operative Complications

is a standardized way to **grade surgical complications based on the treatment required**, not on the complication itself.

**Grade I — Minor Deviation**

Any abnormal post-op event **not requiring** special drugs, procedures, or surgery.

•Allowed:

- Antiemetics
- Antipyretics
- Analgesics
- Electrolytes
- Physiotherapy

Example:

- Mild postoperative fever
- Nausea controlled with medication

**TABLE 24.1** Clavien–Dindo classification of postoperative complications.

| Grade | Definition |
|---|---|
| I | • Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic or radiological intervention<br>• Acceptable therapeutic regimens are: drugs as antiemetics, antipyretics, analgesics, diuretics and electrolytes and physiotherapy. This grade also includes wound infections opened at the bedside |
| II | Requiring pharmacological treatment with drugs other than such allowed for grade I complications. Blood transfusions and total parenteral nutrition are also included |
| III | Requiring surgical, endoscopic or radiological intervention |
| IIIa | Intervention not under general anaesthesia |
| IIIb | Intervention under general anaesthesia |
| IV | Life-threatening complication (including CNS complications, e.g. brain haemorrhage, but excluding TIAs) requiring ICU management |
| IVa | Single-organ dysfunction (including dialysis) |
| IVb | Multiorgan dysfunction |
| V | Death of a patient |

CNS, central nervous system; ICU, intensive care unit; TIA, transient ischaemic attack.

## Grade II — Pharmacologic Treatment Required

- Requires drugs **beyond** what's allowed in Grade I.
- Includes:
  - Antibiotics
  - Blood transfusion
  - Total parenteral nutrition
- Example:
  - Pneumonia treated with antibiotics
  - Post-op anemia requiring transfusion

## Grade III — Surgical / Endoscopic / Radiologic Intervention

### IIIa

- Intervention **without general anesthesia**
- Example:
  - Drain insertion under local anesthesia

### IIIb

- Intervention **under general anesthesia**
- Example:
  - Re-operation for bleeding

| | |
|---|---|
| **Grade IV — Life-Threatening (ICU Required)** | **IVa** |
| Single-organ dysfunction (e.g., respiratory failure needing ventilation) | **IVb** |
| Multi-organ dysfunction | |
| **Grade V — Death** | Death of the patient due to a postoperative complication. |

SYSTEM-SPECIFIC COMPLICATIONS

# Respiratory complications

Respiratory complications can occur either immediately or a few days later on the ward

Obesity, smoking, chronic lung disease, poor nutritional status and OSA predispose to a higher risk of respiratory complications

Early intervention and multidisciplinary involvement can prevent life-threatening respiratory complications

# Immediate respiratory complications on PACU

**Airway**

Upper airway obstruction is one of the commonest immediate postoperative complications and can be due to:

- laryngospasm
- persisting relaxation of airway muscles
- soft-tissue oedema
- hematoma
- vocal cord dysfunction
- foreign body.

Vigilance and early intervention are necessary to prevent harm to the patient. Most interventions are simple and involve manual support of the jaw or insertion of an oral or nasal airway.

**Hypoventilation** :The residual effects of anesthetic drugs (neuromuscular blockers, anesthetic agents, opioids) can contribute to :reduced or impaired adequacy of ventilation postoperatively.

- Continuous pulse oximetry and respiratory rate evaluation can identify respiratory compromise and consequent hypoxia early.
- Supplemental oxygen should be given to all patients on PACU until adequate respiration and oxygenation are restored.

**Hypoxemia** : This may occur, in addition to the situations already described above, as a consequence of acute pulmonary oedema (fuid overload, cardiac failure, post obstructive), bronchospasm, Hypoxemias develops most quickly in patients with obstructive sleep apnoea (OSA), lung disease and obesity; these patients should therefore be closely observed.

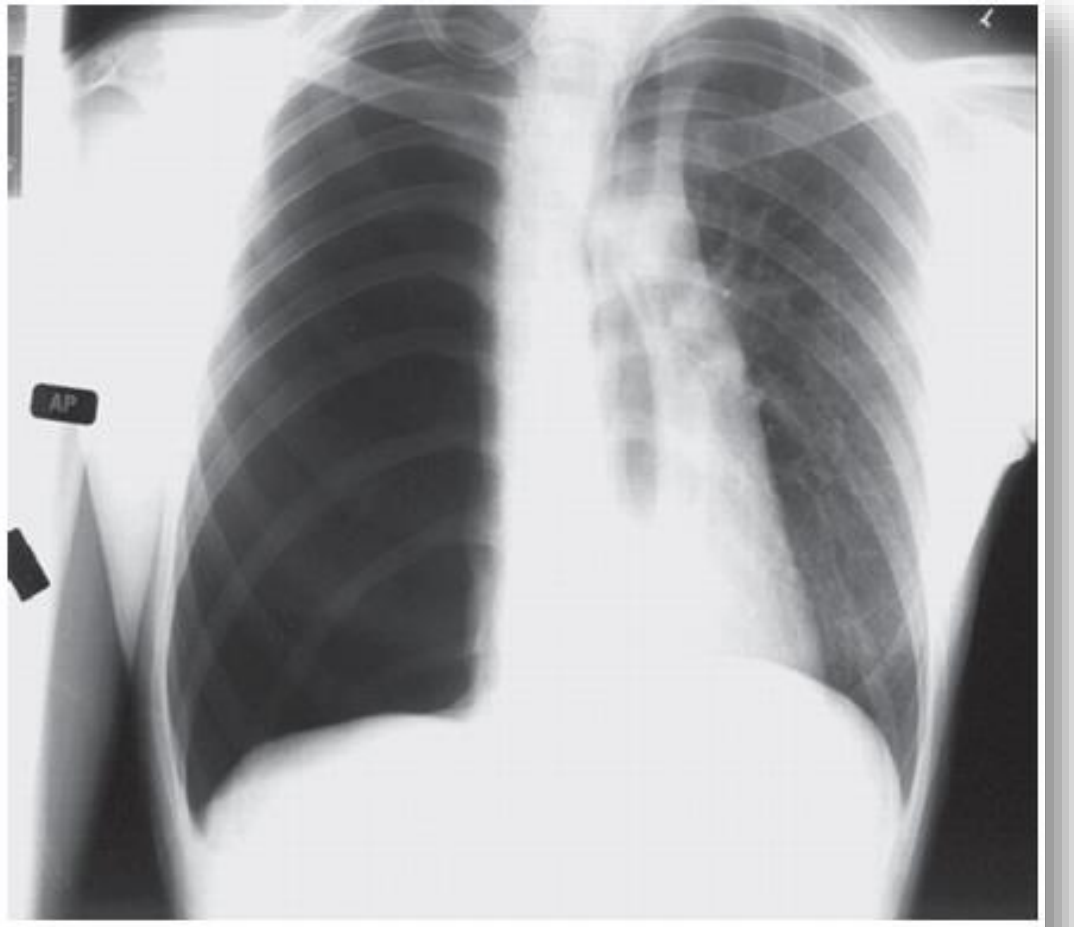



**Figure 24.4** Radiograph showing a right tension pneumothorax with tracheal deviation to the left (courtesy of Professor Stephen Eustace, Dublin, Ireland).

**Patients with hypoxemia should be treated urgently. If the patient is breathing spontaneously**

**oxygen should be administered at 15 L/min using a non-rebreathing mask.**

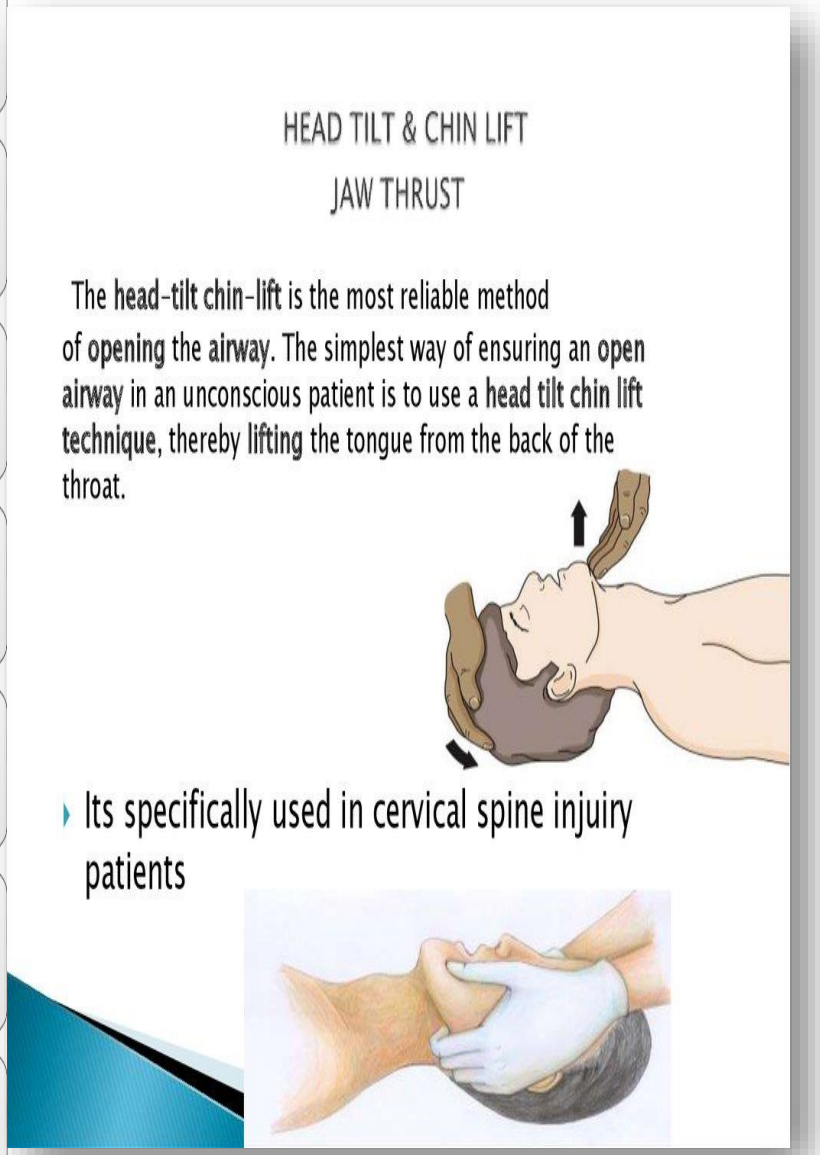
**A head tilt, chin lift or jaw thrust should relieve obstruction related to reduced muscle tone.**

**Suctioning of any blood or secretions**

**Insertion of an oropharyngeal airway may be needed.**

**Early anesthetic intervention may be required.**

**Vocal cord palsy (as a consequence of recurrent laryngeal nerve injury), neck hematoma and post-tonsillectomy bleeding are recognized as life-threatening complications of head and neck surgery, which need immediate medical attention for safe resolution.**



Respiratory complications after discharge from PACU Postoperative pulmonary complications are a significant cause of postoperative morbidity and mortality vary between 5% and 70%). Complications include

- fever (due to microatelectasis), cough, dyspnoea, bronchospasm, hypercapnia, atelectasis
- pneumonia
- pleural efusion,
- pneumothorax and respiratory failure.

The risk of each varies with the patient and the type of surgery being performed. Thoracic or abdominal surgery carries the highest risk. The majority of patients at risk (obese, smokers, chronic lung disease, OSA, poor nutritional status)

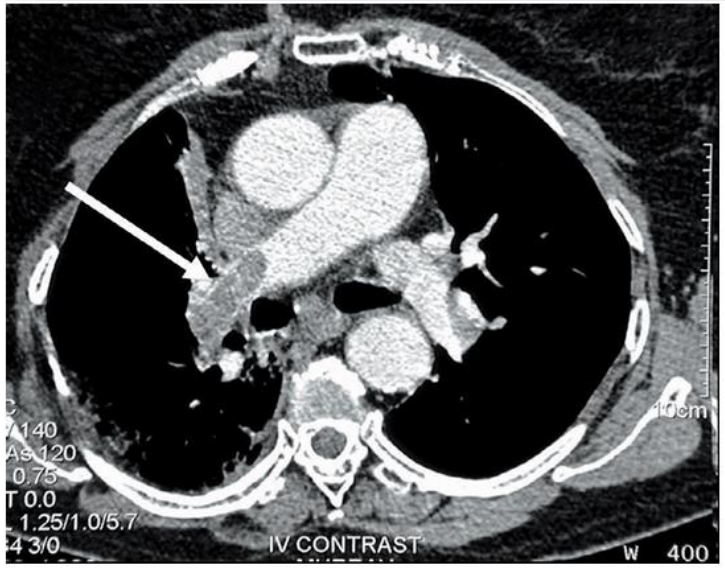



**Figure 24.5** Computed tomography scan showing a pulmonary artery blood embolism (arrow) (courtesy of Professor Stephen Eustace, Dublin).

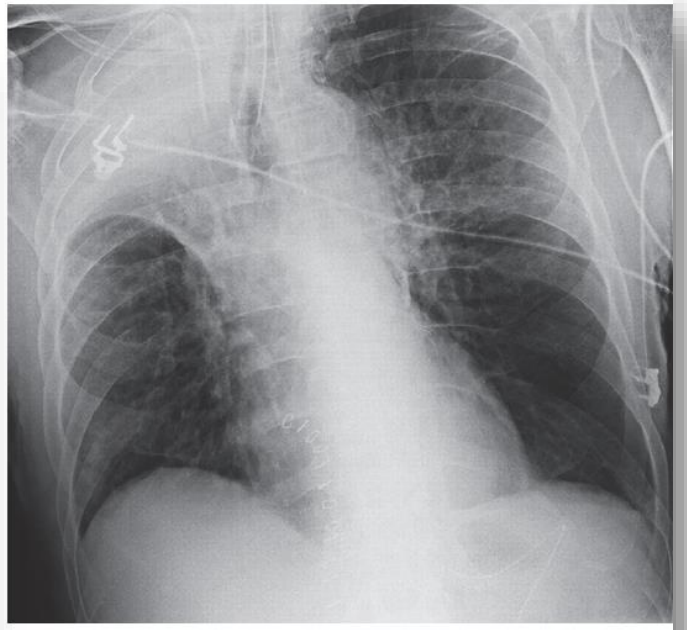


**Figure 24.6** Radiograph showing right upper lobe atelectasis (courtesy of Professor Stephen Eustace, Dublin, Ireland).

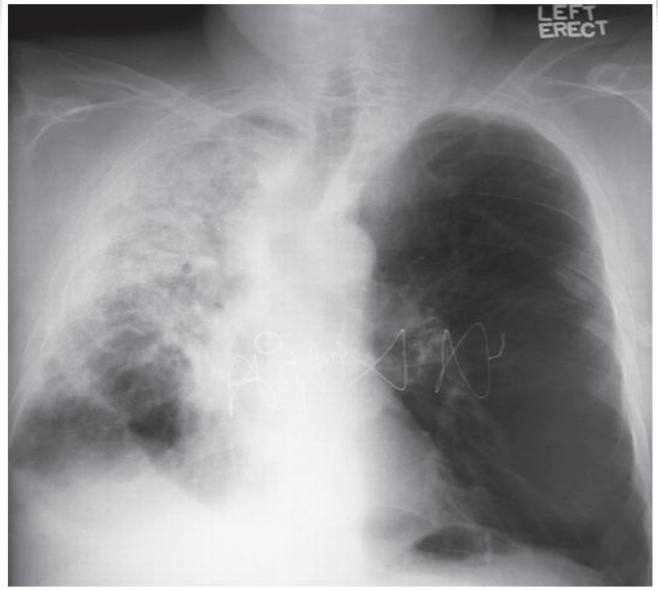



**Figure 24.7** Radiograph showing classical Staphylococcus aureus pneumonia (courtesy of Professor Stephen Eustace, Dublin, Ireland).

# Cardiovascular system

Thirty per cent of patients undergoing non-cardiac surgery will have at least one cardiovascular risk factor. In this group 30-day mortality is 0.5–2% as a result of cardiac complications.

Routine pulse, blood pressure and electrocardiogram (ECG) monitoring will detect cardiovascular complications, reduce adverse outcomes and should be recorded during emergence from, and recovery after, anesthesia.

## Hypotension

## Hypertension

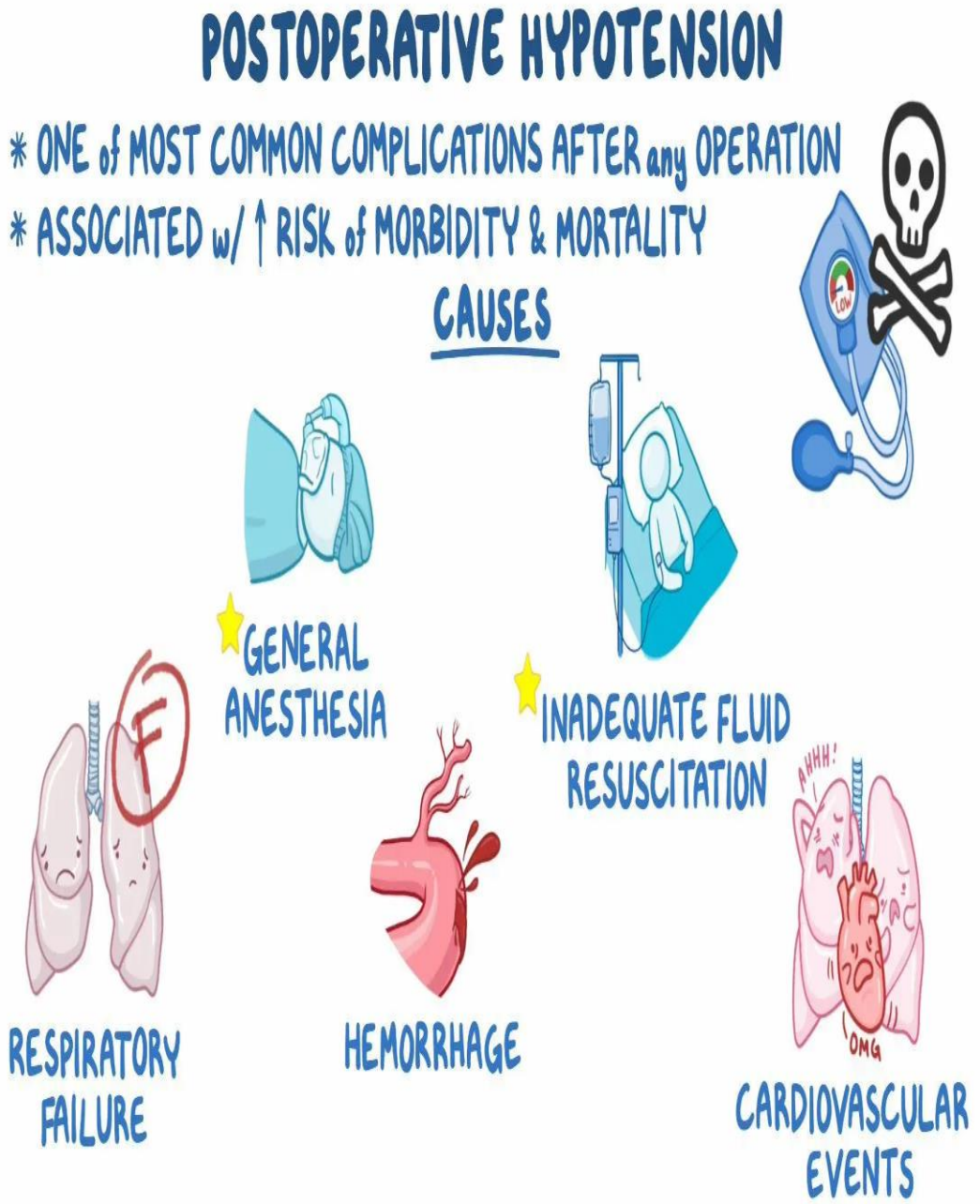
## Myocardial ischaemia

## Arrhythmias

# Hypotension

## Hypotension may be due to :

- hypovolemia,
- myocardial impairment
- vasodilatation from subarachnoid and epidural anesthesia.
- surgical bleeding
- sepsis
- arrhythmias,
- tension pneumothorax,
- PE
- pericardial tamponade
- anaphylaxis should also be considered in the differential diagnosis.



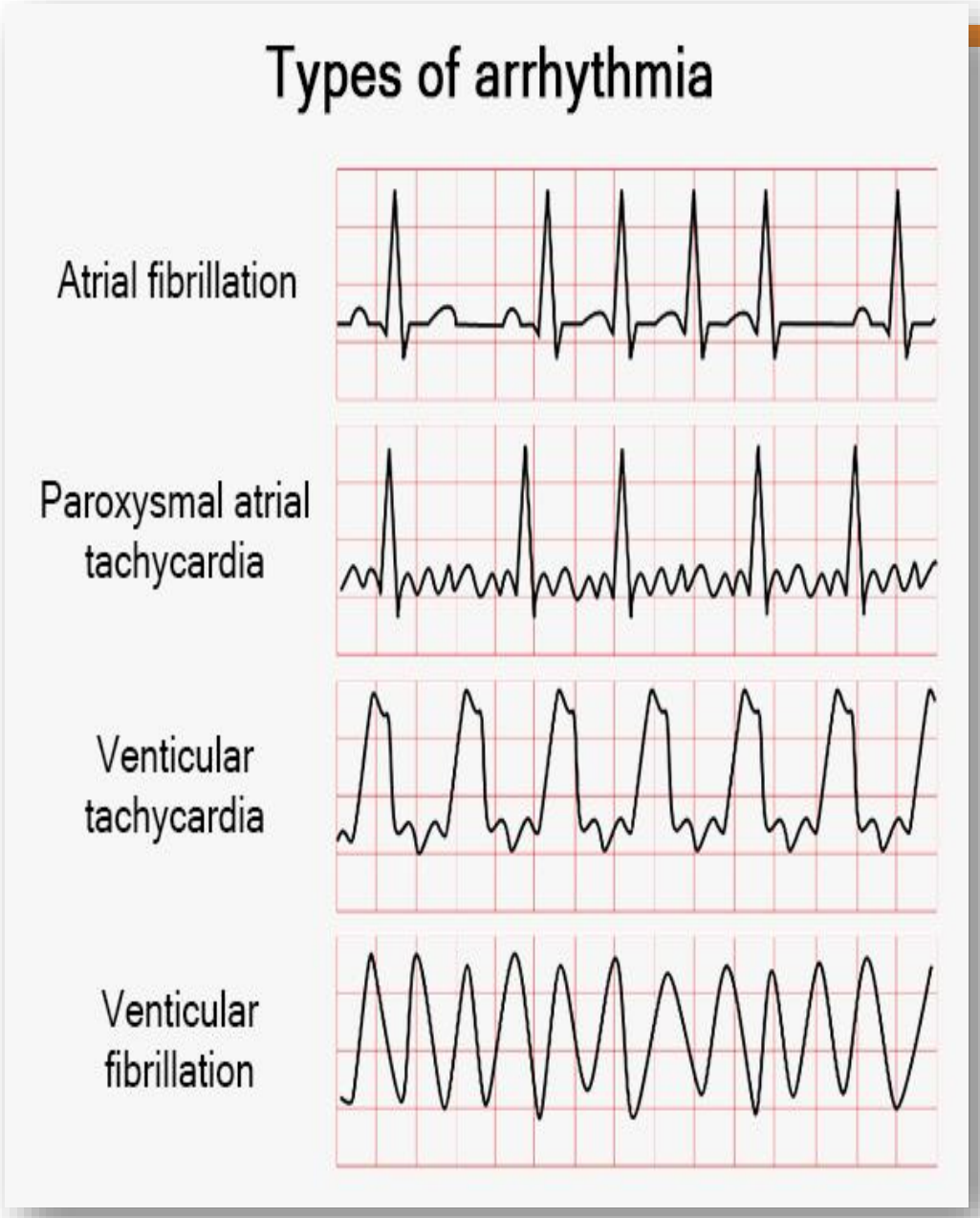
## Hypertension

- Hypertension is also common. It may be due to
- pain,
- agitation,
- anxiety,
- bladder spasm secondary to urinary catheterization
- pre-existing poorly controlled hypertension.

The consequences include bleeding from vascular suture lines, cerebrovascular hemorrhage and myocardial ischemia or infarction.

## Myocardial ischemia

- Patients with a history of cardiovascular disease or with known cardiac risk factors undergoing major surgery are at risk of major adverse cardiac events .
- Symptoms can include retrosternal pain radiating into the neck, jaw or arms, nausea, dyspnea or syncope, but many events in the perioperative period are silent.
- ECG changes can include ST elevation in two continuous leads, new left bundle branch block or an arrhythmia.
- rise in serial troponin levels will clarify the diagnosis.
- Cardiologists should be involved early and may start coronary reperfusion therapy in the form of primary percutaneous coronary intervention or thrombolysis.




# Arrhythmia

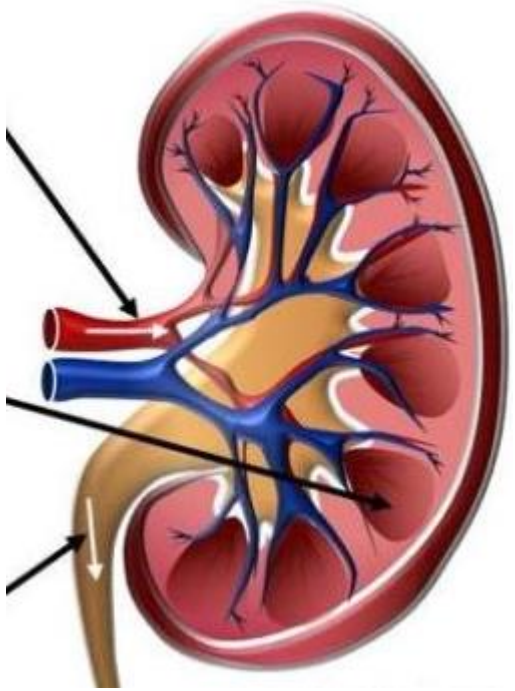
Tachycardia (sinus or supraventricular, including atrial fibrillation) may occur as a result of anxiety, pain, myocardial ischemia or infarction, hypovolemia, sepsis, electrolyte imbalance or hypoxia in the postoperative period.

correction of the underlying causes and the rate controlled with β-blockers, amiodarone or cardioversion, depending on the state of the patient

Sinus bradycardia may be normal in athletes, but it may also be associated with hypoxia, preoperative β-blockers, digoxin and increased intracranial pressure.

A prolonged QT interval may be seen in the perioperative period. It is multifactorial in origin with most patients having predisposing risk factors, such as long QT syndrome or electrolyte abnormalities.

# Renal and urinary system
# Acute kidney injury



- Renal failure occurring during the perioperative period is associated with considerable mortality and morbidity
- About one-quarter of cases of hospital-acquired renal failure occur in the perioperative period and are associated with high mortality, especially after cardiac and major vascular surgery.
- Several definitions of acute kidney injury have been proposed that use changes in serum creatinine and urine output to stage kidney injury. One of the more recent examples is KDIGO (Kidney Disease: Improving Global Outcomes),

# Causes of perioperative acute kidney injury

| | |
|---|---|
| Prerenal | Hypovolemia due to third space losses and bleeding<br>Sepsis<br>Cardiac failure<br>Low cardiac output due to anesthesia cardiopulmonary bypass<br>Increased intra-abdominal pressure<br>Cirrhosis, hepatorenal syndrome<br>Aortic cross-clamp |
| Renal | Inflammation and sepsis<br>Chronic kidney disease and comorbidities, e.g. diabetes, obesity<br>Endogenous (e.g. myoglobin) and exogenous (e.g. radiocontrast dyes) toxins<br>Blood transfusions<br>Chloride-rich solution and hydroxyethyl starch |
| Post renal | Surgery<br>Tumor<br>Benign prostatic hypertrophy |

**TABLE 24.3** KDIGO: Kidney Disease: Improving Global Outcomes.

| | |
|---|---|
| Stage 1 | Increased sCr x 1.5–1.9 of baseline that is known or presumed to have occurred within the preceding 7 days or sCr increase ≥0.3 mg/dL within 48 hours<br>or<br>Urine output <0.5 mL/kg/h for 6–12 hours |
| Stage 2 | Increased sCr x 2–2.9 of baseline<br>or<br>Urine output <0.5 mL/kg/h for ≥12 hours |
| Stage 3 | Increased sCr x 3 of baseline<br>or sCr ≥4 mg/dL<br>or initiation of RRT<br>or GFR decrease to <35 mL/min/1.73 $m^2$<br>in patients <18 years old<br>or<br>Urine output <0.3 mL/kg/h for ≥24 hours or anuria for ≥12 hours |

GFR, glomerular filtration rate; RRT, renal replacement therapy; sCr, serum creatinine.

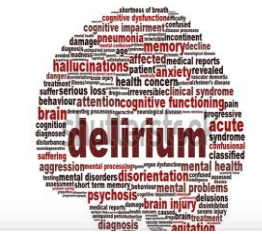
## Urinary retention

- Inability to void after surgery is common after anesthesia and surgery with the incidence ranging from 5% to 70%.
- Risk factors include age >50 years, male sex, certain surgeries such as hernia, anorectal and pelvic surgery, a history of benign prostatic hypertrophy and neurological disease. Neuraxial
- anesthesia and certain drugs given during anesthesia such as anticholinergic medications, α-/ β-blockers, sedatives and fuids increase the risk.
- The diagnosis of retention may be confirmed by clinical examination and by using ultrasound imaging. Urinary retention needs treatment as it can cause not only discomfort but also long-term bladder dysfunction.
- Catheterization should be performed prophylactically when an operation is expected to last 3 hours or longer, or when large volumes of fluid are administered.

## Urinary infection

- Urinary infection is one of the most commonly acquired infections in the postoperative period. Patients may present with dysuria and/or pyrexia.
- Immunocompromised patients, patients with diabetes and those with a history of urinary retention are known to be at higher risk. Treatment involves adequate hydration, proper bladder drainage and antibiotics depending on the sensitivity of the microorganisms.

# Central nervous system
# Postoperative delirium and postoperative cognitive dysfunction




- Postoperative delirium (POD) is characterized by a reduced awareness of the environment and a disturbance in attention accompanied by either hallucinations or disorientation or temporary memory loss.
- Postoperative cognitive dysfunction (POCD) refers to deterioration in cognition temporally associated with surgery.

POD can occur during recovery from anesthesia or a few days after surgery. The overall incidence of POD is 5–50%. It occurs more frequently in elderly orthopedic patients and those undergoing emergency surgical procedures.

Delirium is associated with increased all-cause morbidity, mortality and discharge to a nursing home. There are two types of delirium: hyperactive (restlessness, incoherent speech, agitation, hallucinations) and hypoactive (withdrawn, poorly responsive to the environment, depressed).

- Precipitating factors include surgery, intraoperative administration of narcotics and benzodiazepines, change of medications, electrolyte and fluid abnormalities, constipation, catheterization and an unfamiliar environment
- Correcting any reversible cause, involving relatives or friends whom the patient knows and pain control can all con tribute to reducing the impact and duration of delirium. As a last option, haloperidol may be given in titrated doses according to local protocols.

**TABLE 24.5** Causes of delirium.

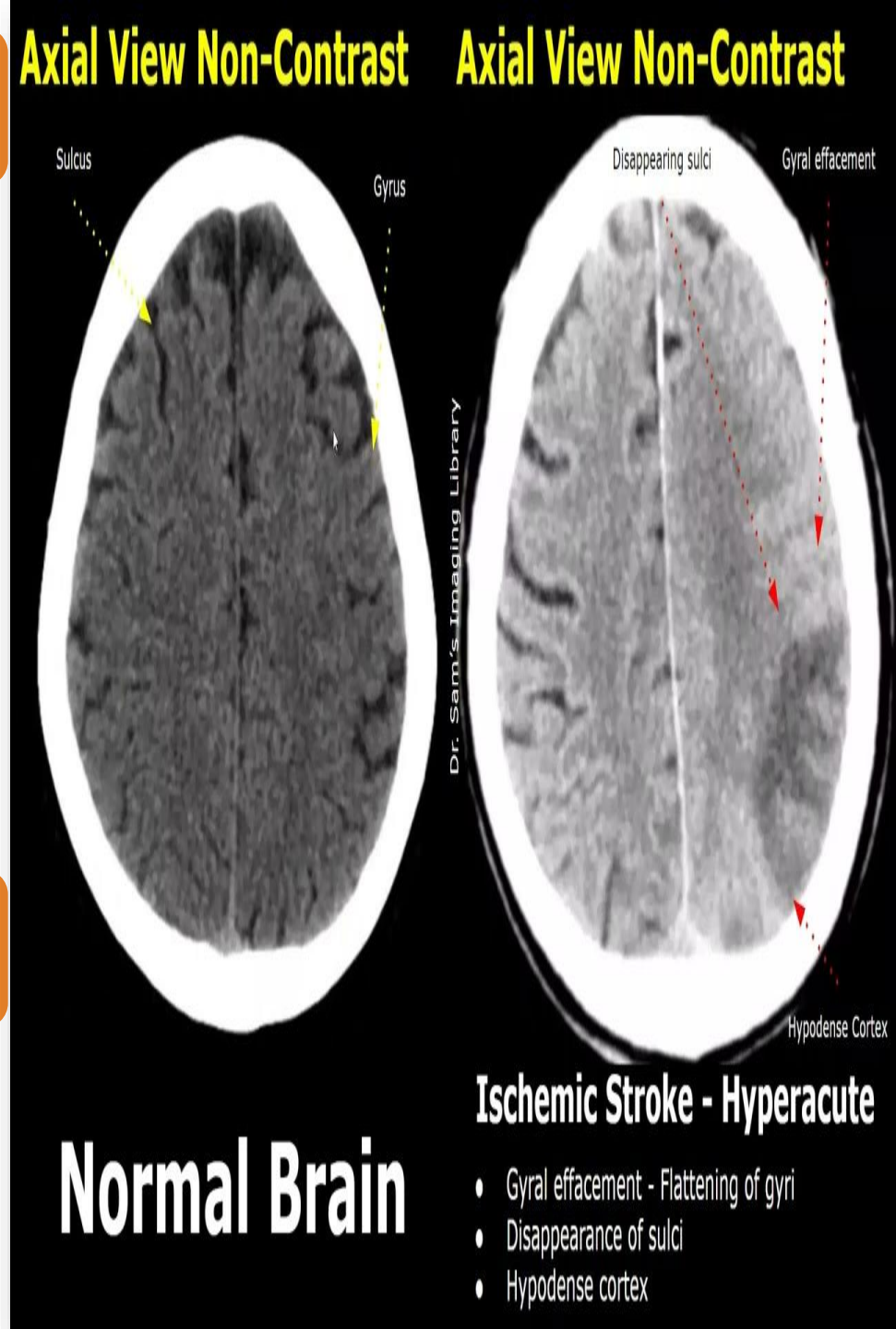
| | |
|---|---|
| Renal | • Renal failure/uraemia<br>• Hyponatraemia and electrolyte disorders<br>• Urinary tract infection<br>• Urinary retention |
| Respiratory | • Hypoxia, e.g. chest infection<br>• Atelectasis |
| Cardiovascular | • Pulmonary embolism<br>• Dehydration<br>• Septic shock<br>• Myocardial infarction<br>• Chronic heart failure<br>• Arrhythmia |
| Drugs | • Opiates including heroin<br>• Hypnotics<br>• Cocaine<br>• Alcohol withdrawal<br>• Hypoglycaemia |
| Neurological | • Epilepsy<br>• Encephalopathy<br>• Head injury<br>• Cerebrovascular accident |
| Idiopathic (rare) | • Hypothyroidism<br>• Hyperthyroidism<br>• Addison's disease |

## Stroke

- Stroke is a recognized complication of carotid endarterectomy surgery both early (secondary to emboli) and later (secondary to cerebral hyper perfusion syndrome). It is also a recognized consequence of both hypotension and hypertension. Thrombolysis may be indicated but the neurology and surgical teams must discuss together the risks and benefit's of such a treatment plan.

## Seizures

- These are uncommon except in those patients with known poorly controlled epilepsy. They may occur as a complication of neurosurgery.



# GENERAL POSTOPERATIVE COMPLICATIONS

- Bleeding
- Deep vein thrombosis
- Pulmonary embolus
- Fever
- Wound dehiscence
- Pressure sores

# Bleeding

**What Is Post-Operative Bleeding?** Bleeding after surgery that is **more than expected** and may cause:

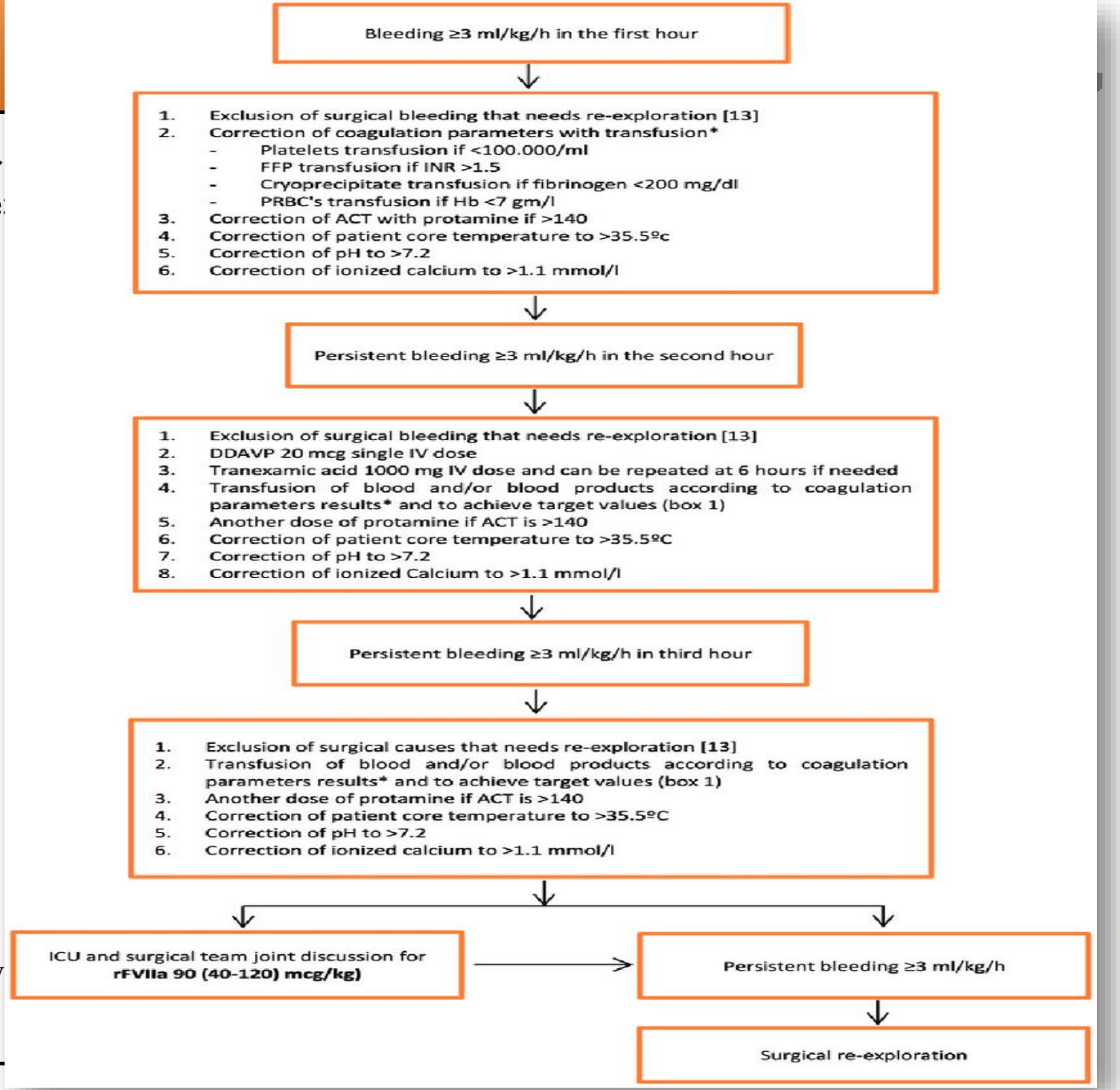
- Drop in blood pressure
- Fast heart rate
- Low urine output
- Falling hemoglobin
- Excessive drain output
- Swollen wound or hematoma

**Estimate the Bleeding**

- Look for: Drain or chest tube output, Blood on dressings, Swelling around wound, Abdominal distension, Drop in Hb

⚠ **Concerning signs:** Persistent heavy drainage, Hypotension, Tachycardia, Confusion

Decision to transfuse should be based on the clinical condition of the patient with acceptance of higher thresholds in individual cases. If the Hb level is below 7g/dL transfusion is usually indicated



# Deep vein thrombosis (DVT

a well-known and, when complicated by pulmonary embolus, potentially fatal complication of surgery .All hospitals must have a process for screening all surgical patients to identify those at risk and for implementing prophylactic measures to avoid this dreaded complication. use of compression stockings, calf pumps and pharmacological agents, such as low-molecular-weight heparin.

The symptoms and signs of DVT include calf pain, swelling, warmth, redness and engorged veins. However, most will show no physical signs. On palpation the muscle may be tender and there may be a positive Homans' sign (calf pain on dorsifexion of the foot), but this test is neither sensitive norspecific.

**TABLE 24.6** Stratification of surgical procedure and the associated risk of deep vein thrombosis.

Low
- Maxillofacial surgery
- Neurosurgery
- Cardiothoracic surgery

Medium
- Inguinal hernia repair
- Abdominal surgery
- Gynaecological surgery
- Urological surgery

High
- Pelvic elective and trauma surgery
- Total knee and hip replacement

**TABLE 24.7** Two-level deep vein thrombosis (DVT) Wells score.

| Clinical features | Points |
|---|---|
| Active cancer (treatment ongoing, within 6 months or palliative) | 1 |
| Paralysis, paresis or recent plaster immobilisation of the lower extremities | 1 |
| Recently bedridden for 3 days or more, or major surgery within 12 weeks requiring general or regional anaesthesia | 1 |
| Localised tenderness along the distribution of the deep venous system | 1 |
| Entire leg swollen | 1 |
| Calf swelling at least 3 cm larger than asymptomatic side | 1 |
| Pitting oedema confined to the symptomatic leg | 1 |
| Collateral superficial veins (non-varicose) | 1 |
| Previously documented DVT | 1 |
| An alternative diagnosis is at least as likely as DVT | –2 |
| **Clinical probability simplified score** | **Points** |
| DVT likely | 2 points or more |
| DVT unlikely | 1 point or less |

🧪 How Is Post-Op DVT Diagnosed?First-line:Compression Doppler ultrasound of the legLabs:D-dimer (limited value post-op—often elevated anyway)If PE suspected:CT pulmonary angiography

Management of Confirmed Post-Operative DVT

Anticoagulation (unless contraindicated)Low-molecular-weight heparin (LMWH)Or unfractionated heparin infusion (high bleeding risk / renal failure)

Transition to oral anticoagulant later (DOAC or warfarin)

⏳ Usual duration: at least 3 months.

# Pulmonary embolus PE

is not usually an immediate complication but can present in the early postoperative period. Thrombus can arise from DVT in the legs/pelvis, venae cavae or the right atrium. Signs and symptoms depend on the size of the embolus and may range from dyspnoea, cough and pleuritic chest pain to sudden cardiovascular collapse. Diagnosis of PE begins with the history (including risk factors and recent surgery) and a physical examination (which may include signs of DVT). The two-level Wells PE score can be used to determine the probability of PE. Depending on the presentation, investigations may include ECG, chest radiograph, blood tests (arterial blood gas and d-dimer) and radiological tests (usually CT pulmonary angiography).

**TABLE 24.8** Two-level pulmonary embolism (PE) Wells score.

| Clinical features | Points |
|---|---|
| Clinical signs and symptoms of DVT (minimum of leg swelling and pain with palpation of the deep veins) | 3 |
| An alternative diagnosis is less likely than PE | 3 |
| Heart rate more than 100 beats per minute | 1.5 |
| Immobilisation for more than 3 days or surgery in the previous 4 weeks | 1.5 |
| Previous DVT/PE | 1.5 |
| Haemoptysis | 1 |
| Malignancy (on treatment, treated in the last 6 months or palliative) | 1 |
| **Clinical probability simplified score** | **Points** |
| PE likely | More than 4 points |
| PE unlikely | 4 points or less |

DVT, deep vein thrombosis.

# Fever

About 40% of patients develop pyrexia after major surgery; however, in most cases no cause is found. The inflammatory response to surgical trauma may manifest itself as fever, and so pyrexia does not necessarily imply sepsis. A cause of fever operatively include:

- atelectasis of the lung;
- superficial and deep wound infection;
- chest infection, urinary tract infection and thrombophlebitis;
- wound infection, anastomotic leakage, intracavitary collections and abscesses.

The possible causes of pyrexia of a non-infective origin include:

- DVT;
- transfusion reactions;
- wound hematomas
- atelectasis
- drug reactions

Think "Wound, Wind, Water, Walk, Wonder drugs"

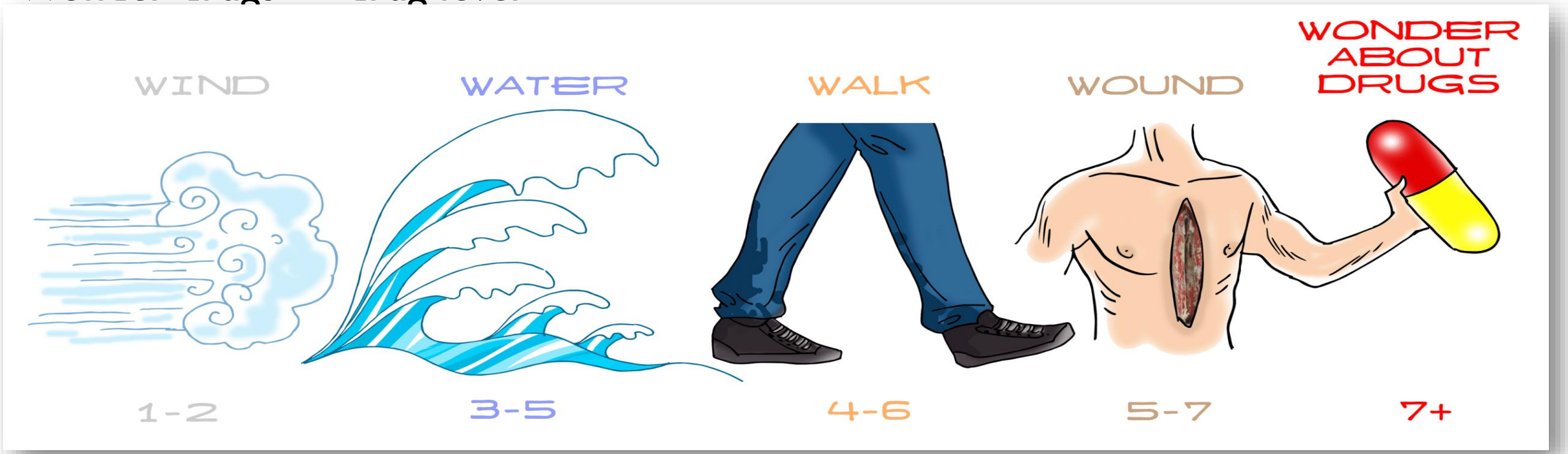
Wind → lungs (atelectasis, pneumonia)

Water → urine (UTI)

Wound → surgical site

Walk → DVT/PE

Wonder drugs → drug fever



# Wound dehiscence

- disruption of any or all of the layers in a wound. Dehiscence may occur in up to 3% of abdominal wounds, increases the risk of postoperative mortality and is very distressing to the patient.
- commonly occurs from the fifth to the eighth postoperative day when the strength of the wound is at its weakest.
- The patient may have felt a popping sensation during straining or coughing. Most patients with a full thickness dehiscence of an abdominal wound will need to return to the operating theatre for re suturing.
- In patients in whom tissues are suspected to be infected, of poor quality or under excessive tension, it may be appropriate to leave the wound open and treat with dressings or vacuum-assisted closure pumps.

## Risk factors in wound dehiscence

### General

- Malnourishment
- Diabetes
- Obesity
- Renal failure
- Jaundice
- Sepsis
- Cancer
- Treatment with steroids
- Emergency surgery

### Local

- Inadequate or poor closure of wound or closure of a wound under tension
- Poor local wound healing, e.g. because of infection, haematoma or seroma
- Increased intra-abdominal pressure, e.g. in postoperative patients with chronic obstructive airway disease, during excessive coughing

# Pressure sores

## Why They Occur After Surgery

### Intra-operative

- Prolonged surgery (>3–4 h)
- Fixed positioning on the table
- Hypotension / low cardiac output
- Vasopressors
- Hypothermia
- Hard operating surfaces

### Post-operative

- Sedation or mechanical ventilation
- Poor mobility
- Incontinence
- Edema
- Malnutrition / low albumin
- Diabetes or vascular disease

## Common Post-Op Sites

Sacrum & coccyx

Heels

Occiput

Scapulae

Trochanters

Elbows

Device-related: oxygen masks, ET tubes, drains, cervical collars

# STAGES OF PRESSURE ULCER

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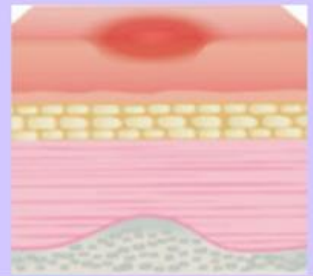
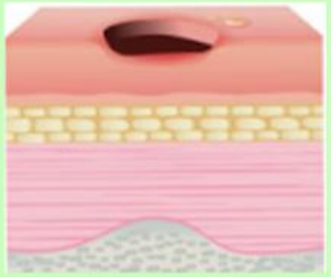
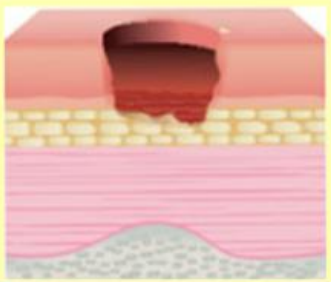
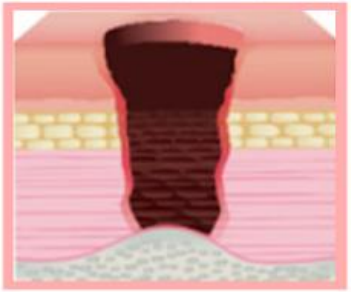
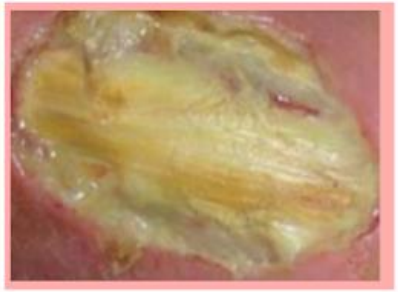
| | | | |
|---|---|---|---|
| **STAGE 1** | Non Blanching Erythema, With Intact Epidermis |  |  |
| **STAGE 2** | Partial Thickness Ulcer involving Epidermis & Dermis  |  |  |
| **STAGE 3** | Full Thickness Ulcer extending through Dermis in to Subcutaneous Tissue. |  |  |
| **STAGE 4** | Deep Tissue Destruction extending through Fascia & may involve muscle, bone & tendons. |  |  |

# Treatment of Post-Operative Pressure Ulcer

- **Pressure relief (** Reposition patient every 2 hours, Use pressure-relieving mattress, Elevate heels, Reduce friction and shear)
- **Local wound care (** Clean wound with normal saline, Keep wound moist, Apply appropriate dressing)
- **Stage-based management**
  - Stage I: Skin protection and observation
  - Stage II: Non-adhesive dressing
  - Stage III–IV: Debridement and advanced dressings
- **Debridement (**Surgical, Mechanical, Enzymatic)
- **Infection control(**Assess for clinical infection, Wound swab if infected, Antibiotics only if infection is present)
- **Nutritional support (**High-protein diet, Adequate calories, Correct vitamin and mineral deficiencies)
- **Pain management(** Analgesia, especially before dressing changes)
- **Negative pressure wound therapy(** For deep or non-healing ulcers)
- **Surgical treatment (**Surgical debridement, Skin graft or flap reconstruction (advanced cases)
- **Prevention of recurrence(**Regular repositioning, Early mobilization, Daily skin inspection)

# SURGERY-SPECIFIC COMPLICATIONS

## Abdominal surgery

- Paralytic ileus
- Localised intra-abdominal infection or anastomotic leakage
- Bleeding

## Orthopaedic surgery

- Neurovascular supply to the extremity
- Compartment syndrome

## Neck surgery

- accumulation of blood in the wound, which may obstruct the airway and cause rapid asphyxia.
- damage to the recurrent laryngeal nerve, which can produce voice change

## Thoracic surgery

- fluid overload in the first 24–48 hours postoperatively.
- Chest drains require regular review. If the fuid in a chest drain swings then the drain has been correctly inserted into the pleural cavity.
- Bubbling of the chest drain confirms the release of air from the pleural cavity; however, if the bubbling persists, this may represent a bronchopleural fistula.
- A hemothorax or pleural effusion will reveal itself as a prolonged loss of blood or fluid, respectively, into the drain.
- Cardiac patients require continuous ECG monitoring postoperatively \

## Neurosurgery

- A rise in intracranial pressure may be signaled by a deterioration in the state of consciousness,
- an intracranial hematoma.

## Vascular surgery

- The patency of grafts and anastomoses, for example femoropopliteal bypasses and abdominal aneurysm,

# Wound care

sterile dressings applied in theatre should not be removed before this time.

Inspection of the wound should be performed under sterile conditions.

Infected wounds and hematomas may need treatment with antibiotics or even wound washout.

excise dead tissue and to control any bleeding. Depending on location, the wound may require packing.

The dressing should then be changed regularly until the wound is clean.

Skin sutures or clips are usually removed between 6 and 10 days after surgery. .

Wound healing is delayed in patients who are malnourished or in those who have vitamin A and C deficiency. Steroids also inhibit the adequate healing of wounds

# THANK YOU