NHS
Countess of Chester Hospital
NHS Foundation Trust

An Introduction To Anaesthesia

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Contents

Introduction

This booklet aims to give you an insight into the core principles of anaesthesia.

It is suitable for the following:

- Senior student doctors undertaking their anaesthetic rotation or special study module in anaesthetics.
- Foundation years doctors undertaking a taster week in anaesthetics.

We hope you find this booklet useful and wish you the best of luck with your anaesthetics placement.

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Pre-operative Assessment

Prognostic Indicators
1. Age
2. Frailty
3. Sex
4. Socioeconomic status
5. Ischaemic heart disease
6. Heart failure
7. Cerebrovascular disease
8. Peripheral vascular disease
9. Renal failure
10. Exercise tolerance

History

Presenting complaint

- Reason for surgery and correct surgical site

Past medical history/review of systems

Cardiorespiratory	Gastrointestinal	Musculoskeletal	Neurological	Endocrine/metabolic	Haematological
• Cardiac or respiratory disease • Exercise tolerance	• Reflux - increases aspiration risk	• Neck pathology (e.g. arthritis/ fractures) - can cause airway difficulty • Kyphoscoliosis/ spinal surgery - can cause difficulty with regional blocks • Positioning for surgery	• Previous stroke/TIA/ neurological deficits • Any other neurological disease	• Diabetes – level of control • Thyroid dysfunction • Obesity - increases aspiration risk & difficulty of regional blocks	• Coagulation problems • Bleeding disorders

Past anaesthetic history

- Previous problems with anaesthetic drugs / severe side effects
- Previous airway difficulties

Family history

- Inherited conditions with complications related to anaesthesia (e.g. malignant hyperthermia, suxamethonium apnoea, inherited porphyria)
- Cardiac abnormalities
- Anaesthetic complications affecting other family members

Social history

- Smoking and alcohol intake
- Recreational drug use
- Social support (e.g. able to go home following day case anaesthesia)

Medication/allergies

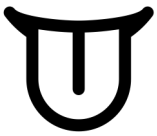
- Current medications – any interactions with anaesthetic drugs/side effects
- Drugs to stop/continue prior to surgery
- Allergies + extent of reaction (e.g. rash vs. anaphylaxis)

Fasting Status

- Food > 6 hours, Clear fluids >2 hours

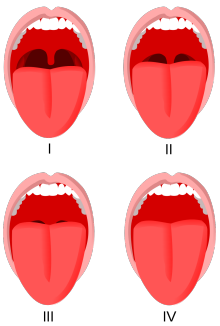
Examination

Airway



- Any airway obstruction
- Dentition (e.g. loose teeth)
- Neck range of movement (e.g. arthritis/c-spine fractures)
- Prediction of ease of laryngoscopy (see below)

Mallampati Test



I Faucial pillars, soft palate, uvula all visible.

II Faucial pillars, soft palate visible. Uvula masked by tongue.

III Only soft palate visible.

IV Soft palate not visible.

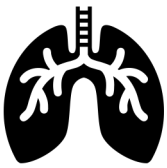
Thyromental Distance (TMD)

Distance between thyroid cartilage + chin.

Should be > 7cm.

< 6cm associated with difficult airway

Breathing



- Abnormal breath sounds
- Respiratory rate
- Oxygen saturation + any supplemental oxygen?

Circulation

- Blood pressure & volume status
- Pulse – rate & rhythm
- Murmurs

Disability

- Conscious level (AVPU/GCS)
- Blood glucose level

Exposure

- Patient positioning
- Any existing IV access / potential sites for cannulation
- Relevant anatomy for regional blocks
  (e.g. examine the back for spinal anaesthesia)

ASA Grading & Pre-operative Investigations

ASA Grading

- Simple score used to grade patient fitness prior to surgery.

ASA Grade	Physical Status
1	Normal healthy patient – no comorbidities relevant to surgery and no significant medical history
2	Mild systemic disease
3	Severe systemic disease
4	Severe systemic disease that is a constant threat to life
5	Moribund patient – not expected to survive with or without operation
6	Declared brain-dead patient who's organs are being removed for donor purposes
E	Suffix added when operation is an emergency

Simple Pre-operative Investigations

- NICE recommends that the following tests should be based on age, severity of surgery/ASA grade and presence of systemic disease.

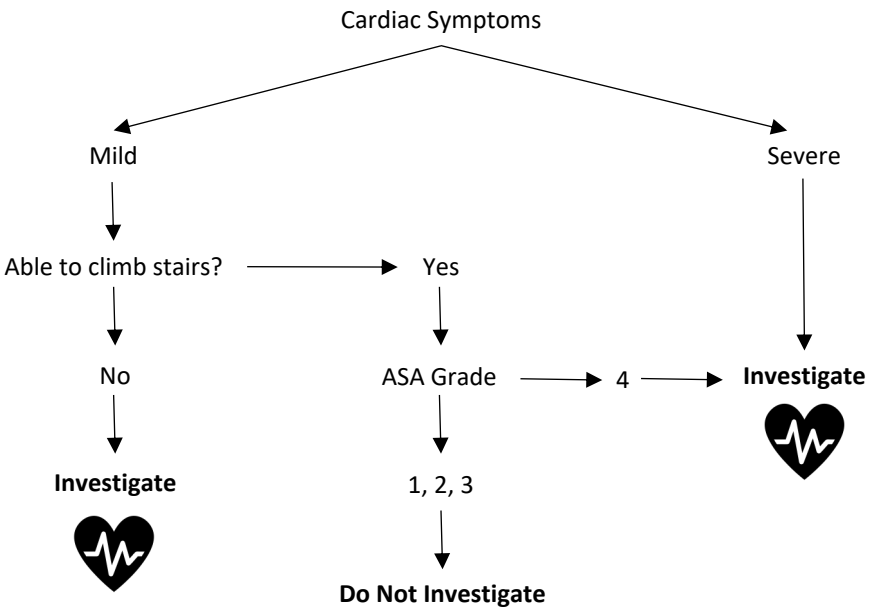
Investigation	Indications
FBC	• >60 years AND ASA 2 • Any ASA 3+ • Severe renal disease
U&E	• >60 years AND ASA 3+ • Any ASA 4+ • Any renal disease • Severe cardiovascular disease
ECG	• >60 years AND ASA 3+ • Any cardiovascular disease • Severe renal disease

Other Simple Investigations

- FBC – suspected anaemia or prolonged bleeding
- Coagulation screen – prolonged bleeding
- Pregnancy test – any woman who may be pregnant
- CXR – recent respiratory illness that remains symptomatic
- ECG – palpitations
- Pulmonary function tests & ABG – severe respiratory disease
- Echocardiogram – undiagnosed murmur

Advanced Cardiac Investigations

- The American College of Cardiology and American Heart Association (ACC/AHA) suggest further cardiac investigations should be ordered based on exercise tolerance, cardiac symptoms and grade of surgery.



- Further cardiac investigations may include cardiopulmonary exercise testing (CPX), treadmill exercise ECG testing, dobutamine stress echocardiography or myocardial perfusion scanning.
- These tests should only be carried out if their results should be acted on.
- The main limitation to such tests is lack of ability to exercise due to other pathology (e.g. arthritis).

Safe Surgery

The Role of the Anaesthetist

Pre-op	Intra-op	Post-op
• Thorough assessment of the patient: history, examination & relevant investigations. • Ensure plan in place for anaesthesia, including analgesia, anti-emetics and other medications to be given intra-op. • Discussion with critical care department if patient likely to require intensive care/high dependency care post-op. • Initiate WHO checklist.	• Responsible for patient safety throughout the operation. • Check the anaesthetic machine and ensure safe administration of drugs. • Communicate with surgeon when required. • Formulate a plan (with the surgeon) for post-op care of the patient.	• Transfer patient to post-anaesthesia care unit (PACU) and handover to recovery nurse. • Analgesia, antiemetics, supplementary O_2, IV fluids. • Ensure patient's regular medications are prescribed. • Ensure patient is stable prior to transfer to ward. • Transfer to critical care (if relevant) and ensure thorough handover.

The Theatre Team

Surgeon
- Ensures patient is consented and prepared for surgery
- Performs operation
- Provides post-op care

Theatre Sister/Nurse
- Coordinate theatre team
- Ensure relevant sterile equipment available
- Ensure no swabs/equipment missing at end of operation

Operating Department Practitioner (ODP)
- Assists the anaesthetist

Anaesthetist
- Role described above

The World Health Organisation (WHO) Surgical Safety Checklist

Before induction of anaesthesia

(with at least nurse and anaesthetist)

Has the patient confirmed his/her identity, site, procedure, and consent?

- ☐ Yes

Is the site marked?

- ☐ Yes
- ☐ Not applicable

Is the anaesthesia machine and medication check complete?

- ☐ Yes

Is the pulse oximeter on the patient and functioning?

- ☐ Yes

Does the patient have a:

Known allergy?

- ☐ No
- ☐ Yes

Difficult airway or aspiration risk?

- ☐ No
- ☐ Yes, and equipment/assistance available

Risk of >500ml blood loss (7ml/kg in children)?

- ☐ No
- ☐ Yes, and two IVs/central access and fluids planned

Before skin incision

(with nurse, anaesthetist and surgeon)

- ☐ **Confirm all team members have introduced themselves by name and role.**
- ☐ **Confirm the patient's name, procedure, and where the incision will be made.**

Has antibiotic prophylaxis been given within the last 60 minutes?

- ☐ Yes
- ☐ Not applicable

Anticipated Critical Events

To Surgeon:

- ☐ What are the critical or non-routine steps?
- ☐ How long will the case take?
- ☐ What is the anticipated blood loss?

To Anaesthetist:

- ☐ Are there any patient-specific concerns?

To Nursing Team:

- ☐ Has sterility (including indicator results) been confirmed?
- ☐ Are there equipment issues or any concerns?

Is essential imaging displayed?

- ☐ Yes
- ☐ Not applicable

Before patient leaves operating room

(with nurse, anaesthetist and surgeon)

Nurse Verbally Confirms:

- ☐ The name of the procedure
- ☐ Completion of instrument, sponge and needle counts
- ☐ Specimen labelling (read specimen labels aloud, including patient name)
- ☐ Whether there are any equipment problems to be addressed

To Surgeon, Anaesthetist and Nurse:

- ☐ What are the key concerns for recovery and management of this patient?

Airway

Basic knowledge of airway devices is essential for <u>all</u> clinicians involved in the acute care of patients

Airway adjuncts

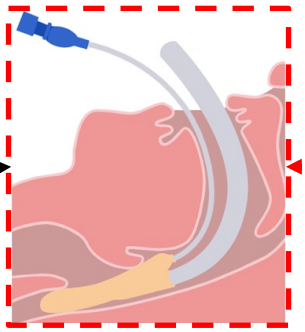
Nasopharyngeal airway

- Sizing: tip of nose -> tragus of ear
- Better tolerated in patients with intact gag reflex
- Contraindicated in base of skull fracture patients

Gudel oropharyngeal airway

- Sizing: incisors -> angle of jaw (colour coded)
- Assist in obtunded patients with partial airway obstruction (tongue hitting pharyngeal wall)
- Complications: gagging, laryngospasm, airway obstruction if incorrectly sized and placed

Supraglottic devices



Supraglottic airway devices sit <u>above</u> the vocal cords with the airway orifice sitting anteriorly into the glottis.
Its tip sits behind the cricoid cartilage and encircled by the upper oesphageal sphincter.

Laryngeal Mask Airway (LMA)

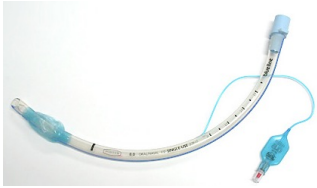
- Sizing: Based on weight ranges
- Uses: mainly for elective/daycase procedures, where there is no risk of regurgitation/aspiration
- Complications: patient biting on tube, risk of aspiration, poor seal or airway leak causing inadequate ventilation

iGel Airway

- Sizing: Based on weight ranges (colour coded)
- Uses: as above for LMA
- Complications: as above for LMA with exceptions
- vs LMAs: I gels have bite block to ensure airway patency, a gastric port to allow aspiration of contents, the cuff is thermoplastic allowing better moulding around airway for a theoretically better seal

Airway

Is one that goes past the vocal cords and into the trachea, and is secured in place by a cuff



Definitive airway

Endotracheal tube (ETT)

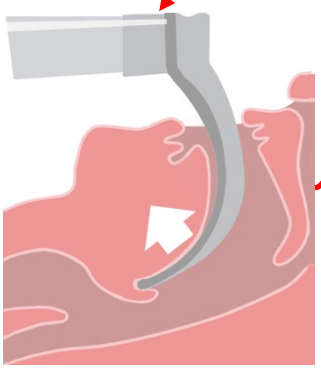
- Sizing: roughly female: 7-7.5 ID, male 8.0-8.5 ID
  (ID – internal diameter in mm)
- Need to paralyse patient to insert and maintain airway
- Complications: airway/vocal cord trauma, endobronchial intubation, oesophageal intubation, failed intubation, tracheal stenosis (ICU patients needing multiple and prolonged intubation)

Indications for ETT

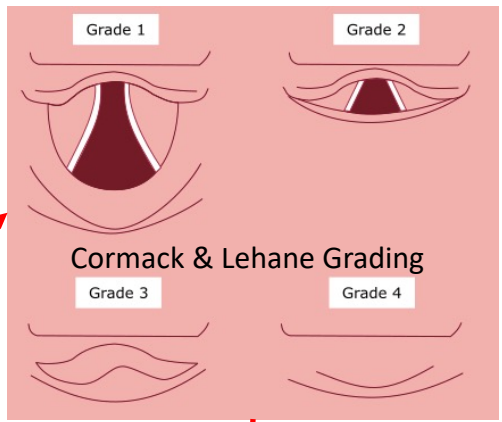
- Patient: risk of aspiration (reflux, hiatus hernia, trauma, pregnancy), airway or respiratory compromise (acute asthma)
- Surgical: need paralysis for surgery, prolonged surgery
- Other: airway burns, cardiorespiratory arrest

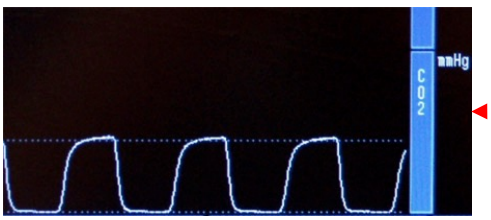
Insertion - Intubation

- Planning is *essential* prior to procedure: team, equipment, drugs, monitored environment, positioning, preoxygenation, airway plan A, B, C (if plan A fails to secure the airway)
- Laryngoscopy – a laryngoscope is used to obtain the view of the vocal cords, grading classified by Cormack & Lehane
- Confirmation of correct insertion: end tidal CO2 (ETCO2) trace seen, misting of ETT, chest rise bilaterally and confirmed on auscultation



Macintosh Laryngoscope blade tip inserted into valeculla and lifted up to give view for ETT insertion





Normal ETCO2 confirming correct ETT placement –
"if in doubt take it out!"

Induction of Anaesthesia

Planning

- ✓ **Airway choice and plan:** see "Airway chapter"
- ✓ **Team and huddle**: ODP – operating dept. practitioner, consultant/senior. Communication of anaesthetic plan and potential issues
- ✓ **Environment**: anaesthetic room, ICU, A+E resus, ward (in emergencies)
- ✓ **Equipment**: checked and ready, including emergency airway and cardiac arrest trolleys readily available
- ✓ **Drugs**: induction drugs and emergency drugs drawn up and ready
- ✓ **WHO checklist**: done before induction of anaesthesia (see "Safe Surgery chapter")

Monitoring

Association of Anaesthetists of GB & Ireland (AAGBI) advocate minimum standard patient monitoring undergoing anaesthesia/sedation:

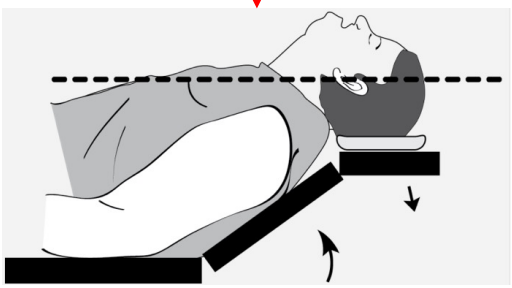
- ✓ End Tidal CO2
- ✓ Inspired and expired oxygen and anaesthetic gas monitoring
- ✓ Pulse oximetry (SpO2)
- ✓ Three lead ECG
- ✓ Non-invasive blood pressure monitoring
- ✓ Peripheral nerve stimulator – if using muscle relaxants
- ✓ Temperature – for any procedure >30mins

Venous access

IV access should *always* be visible, secured, easy to reach and running well without issues (i.e. no tissuing of cannula)

This *must* be done prior to induction of anaesthesia

Positioning



- ✓ For optimal views for laryngoscopy, patient positioning is essential
- ✓ Ideally position so that a line drawn crosses both the sternum and tragus
- ✓ For obese/pregnant patients consider "ramping" or using an Oxford pillow to ensure the above position

Induction of Anaesthesia

Pre-oxygenation

- ✓ *Essential practice if performing a Rapid Sequence Induction*
- ✓ Aim: to de-nitrogenise and fill all alveoli involved in ventilation with oxygen
- ✓ This increases apneoic time given before hypoxaemia, to insert the airway
- ✓ Should be done for at least 3 minutes / 5 x vital capacity breaths
- ✓ Until end tidal oxygen concentration >85%

IV induction

- ✓ The following drugs are usually used in this *order*:
- ✓ **Opioid**: a fast acting drug (fentanyl or alfentanil) is used to obtund the patient's response to laryngoscopy during airway insertion
- ✓ **Induction agent**: this is the drug to induce anaesthesia (propofol, thiopentone or ketamine)
- ✓ **Muscle relaxant**: this is used to paralyse the patient if an endotracheal tube is inserted (atracurium, rocuronium, suxamethonium). These are not used when usually inserting supraglottic airways.

RSI Rapid Sequence Induction

- ✓ A procedure used only *if a patient is an aspiration risk*.
- ✓ Commonly done in emergency theatres and non-theatre settings. Risk factors that indicate RSI include:
  - Not fasted - >6hrs food, >2hrs clear fluid
  - Acute abdominal pathology – eg bowel obstruction, appendicitis causing ileus
  - Trauma patients – unlikely to be fasted, pain or opioids causing vomiting
- ✓ The procedure involves:
  1. Comprehensive pre-oxygenation before IV induction
  2. Rapid IV induction of anaesthesia
  3. Application of cricoid pressure – this reduces risk of gastric contents entering the airway
  4. Insertion of a definitive airway
  5. Cuff inflation and confirmation before ventilation

Unconsciousness

- ✓ There are four different stages of unconsciousness as per **Gudel's Classification**.
- ✓ Intubation requires the patient to in the third stage – "onset of surgical anaesthesia"
- ✓ Stage 3: Loss of consciousness, static eyes, loss of muscle tone, gradual intercostal paralysis.

Airway insertion – see previous chapter

Maintenance of Anaesthesia

Monitoring

- ✓ Basic patient monitoring essential - as per AAGBI recommendations (see p11 *"Induction of Anaesthesia"* chapter)
- ✓ Also monitor:
  - Ventilator: airway pressures, respiratory rate, tidal volumes
- ✓ Depth of anaesthesia monitoring
  - Minimum Alveolar Concentration (MAC): used when volatiles are commonly used to maintain anaesthesia
  - Bi-Spectral Index (BIS) monitoring: This is a four-point basic encephalographic (EEG) lead used when total intravenous anaesthesia (TIVA) is used instead of volatiles to maintain anaesthesia.
  - Peripheral nerve stimulator: to measure depth of neuromuscular blockade during surgery and extubation.

Volatiles

- ✓ A volatile is a *vapour* below its critical temperature (above this temperature = gas state)
- ✓ A common method of maintaining anesthesia
- ✓ It is administered from a specific container (vapouriser) from the anaesthetic machine and delivered to the patient with oxygen
- ✓ It is only administered and eliminated via the lungs
- ✓ Once the vapour is in the alveoli, it is able to transfer via the blood stream to the target organ (brain) to maintain anaesthesia
- ✓ It is a very rapid way of delivering and also turning off anaesthesia
- ✓ Modern day anaesthesia uses three different volatiles (colour coded) and only one volatile can be used at any time (cannot be mixed):
  - **Sevoflurane**: also used for gas induction
  - **Isoflurane:** not used for gas induction (irritant)
  - **Desflurane**: rapid onset and offset, used for long surgeries
- Each volatile has a different MAC – a MAC is defined as the <u>minimum alveolar concentration of the volatile used to maintain anaesthesia for 50% of the general population when a standard surgical incision is made.</u>
- MAC is commonly adjusted to patient age and weight and usually a target MAC of > 1.0 is used during surgery.

<u>NB: Nitrous Oxide (N_2O)</u>

- ✓ N_2O is sometimes mixed with volatiles to maintain anaesthesia
  - It reduces the amount of volatile used deliver target MAC
  - This means it reduces dose-dependent undesirable effects of volatiles (e.g. hypotension)
  - N_20 provides additional analgesia
  - But it increases risk of post-operative nausea and vomiting

Maintenance of Anaesthesia

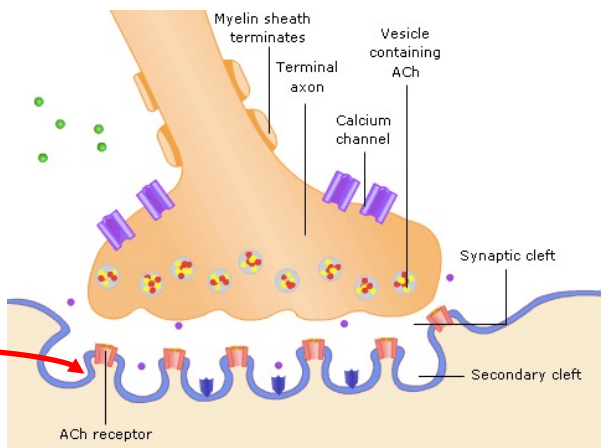
Analgesia

- ✓ Multi-modal analgesia is essential for effective pain relief for patients going into the post-operative phase:
- ✓ See "*Analgesia*" chapter for further details
- ✓ Analgesia can be categorised into:
  - ✓ Paracetamol
  - ✓ NSAIDs: avoided in elderly, renal impairment, bleeding risk
  - ✓ Opioids: morphine / oxycodone (if poor renal function)
  - ✓ Local anaesthetic (LA): various options including infiltration at incision sites, LA infusion pumps, LA used for regional blocks or neuraxial blocks (e.g. spinals, epidurals)
  - ✓ Ketamine / Magnesium: occasionally used

Muscle Relaxants

- ✓ Neuromuscular blocking agents are used to maintain paralysis for either surgical control to tissues or for anaesthetic control (control of ventilation) during surgery.
- ✓ These agents act as competitive antagonists at the post-synaptic acetylcholine (ACh) receptors at the neuromuscular junction at *skeletal* muscle.
- ✓ Blockage of these receptors prevents depolarization and actional potential release that is required for contraction.
- ✓ It does not affect *striated* muscles found in the heart and vasculature.
- ✓ Commonly used agents are atracurium and rocuronium.

Muscle relaxant acts here



IV fluids

- ✓ IV fluids are used to replace insensible losses from surgery, maintenance and resuscitation – see "*Fluid Management*" chapter

Oxygen

- ✓ Fraction of inspired concentration of oxygen delivered to ensure SpO2 >= 94%

Recovery from Anaesthesia

Extubation

Please endeavour to see this as it is one of the most important aspects of anaesthetic practice

✓ Criteria must be met to ensure safe extubation:

1. Full reversal of muscle relaxant: a peripheral nerve stimulator is used (usually on the facial or ulnar nerve). If adequate amount and amplitude of twitches have been seen, then reversal can be given. This is an acetylcholine esterase inhibitor (Neostigmine), which prevents ACh breakdown, allowing lots of ACh present at the neuromuscular junction to compete against the small remaining number of muscle relaxants blocking the post-synaptic receptor.
2. Full washout of volatile agent: the vapouriser will be turned off and 100% oxygen given to the patient to blow off all the volatile gases remaining in the lungs.
3. Adequate respirations: patient should then start to take their own breaths of adequate rate and volume
4. Following commands: tested by asking the patient to open their eyes, squeezing hands, sticking out tongue. This indicates adequate muscle reversal and washout of volatile.
5. Extubation: in theatre, in case if the patient deteriorates and needs emergency re-intubation (e.g. laryngospasm).

Recovery

✓ Patients are then transferred to recovery for handover and close monitoring until:

- ✓ Observations are stable and acceptable for that patient
- ✓ Patient is fully alert and pain adequately controlled

Destination

✓ Daycase: patients get discharged home from recovery if well. Patients must ensure they have a chaperone to take them home. Patients *cannot* drive themselves.

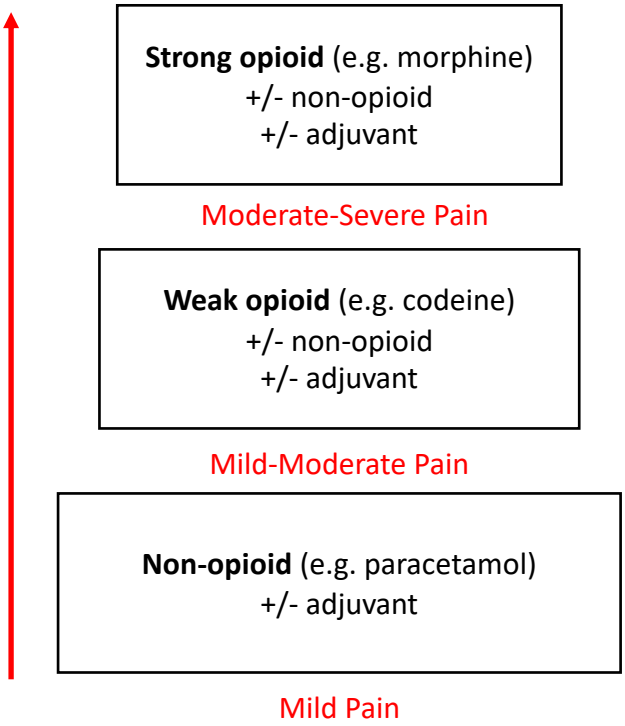
✓ Elective Inpatients: patients will have been booked a bed on the ward prior to surgery. Some high risk patients may have been admitted the night before surgery for monitoring/optimisation.

✓ Emergency Patients: most emergency patients will need to stay overnight for monitoring, except for simple procedures in fit and well patients (e.g. drainage of perianal abscesses).

✓ High dependency / Intensive Care: some patients (both elective and emergency) may need constant monitoring or high levels of care post-op, that cannot be managed on the ward. These patients would have been risk-assessed and reviewed by all disciplines (surgeons, anaesthetists, intensivists).

Analgesia

The WHO Analgesic Ladder



- Initially designed for use in cancer pain.
- 'Adjuvant' analgesia can include NSAIDs/drugs used for neuropathic pain (e.g. amitriptyline, gabapentin).
- For pain not adequately controlled with strong opioids, interventional treatments may be an option (e.g. peripheral nerve blockade) depending on the site of pain.

Intra-operative Analgesia

Fentanyl

- Opioid - 100x more potent than morphine
- Dose of 1 micrograms/kg (IV) usually given at induction
- Repeated doses may be given intra-operatively depending on duration of surgery
- Helps suppress airway reflexes to laryngoscopy
- Side effects: bradycardia, hypotension, respiratory depression, post-op nausea & vomiting (PONV), urinary retention, constipation, itching.

Morphine

- Used intra-operatively after initial fentanyl bolus
- Dose usually 2-5mg bolus (IV) depending on duration of surgery/how stimulating the operation is. This can be repeated approximately every 30-40 mins.
- Side effects: same as fentanyl

NSAIDs

- Ibuprofen/diclofenac can be given pre-op
- Diclofenac can be given intra-op (IV) or post-op as a suppository
- Beware of contraindications (e.g. asthma, renal impairment, peptic ulcers)
- Can reduce post-op opioid requirements when used with fentanyl

Paracetamol

- Given intra-op
- Dose = 1g (IV)
- Can reduce post-op opioid requirements when used with fentanyl

Post-operative Analgesia

Inpatient Analgesia

Drug	Recovery	Ward
Morphine	1-2mg IV every 5 mins	E.g. 5-10 mg PO 2-4 hourly PRN
Diclofenac	1mg/kg IV (if required)	Diclofenac 50mg PO/rectal PRN TDS
Paracetamol	1g IV (if not given intra-op)	1g PO/IV 6 hourly (regular)

Patient-controlled analgesia (PCA)

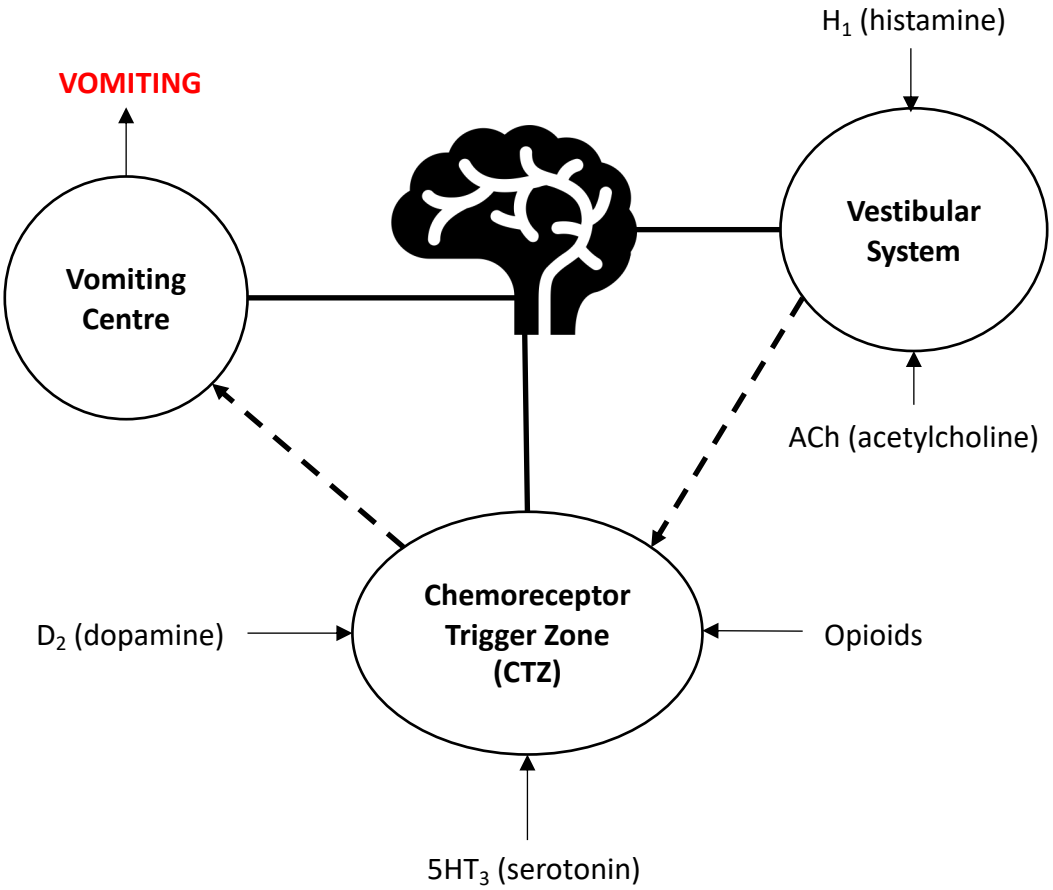
- Morphine 1-2mg (IV) given on demand, with a 5 minute lockout period
- Lockout period helps prevent overdose
- Requires careful monitoring

Day Case Analgesia

- Strong opioids avoided post-op
- Codeine phosphate 30-60mg 4 hourly can be used, for shortest possible time (e.g. 3 days)
- Ibuprofen/diclofenac can be used as required
- Regular paracetamol

Anti-emetics

Physiology of Nausea & Vomiting



Common Anti-emetics

Drug	Mechanism	Dose	Notes
Ondansetron	$5HT_3$ antagonist	4-8mg IV	• Minimal side effects • Rapid onset • Best 'rescue' anti-emetic
Cyclizine	H_1 antagonist	50mg IV	• Anti-cholinergic side effects • Can cause tachyarrhythmias
Prochlorperazine	D_2 antagonist	12.5mg IM	• Slow onset
Dexamethasone	Steroid	4-8mg IV	• Slow onset + long half-life • Used as prophylaxis

Post-operative Nausea & Vomiting

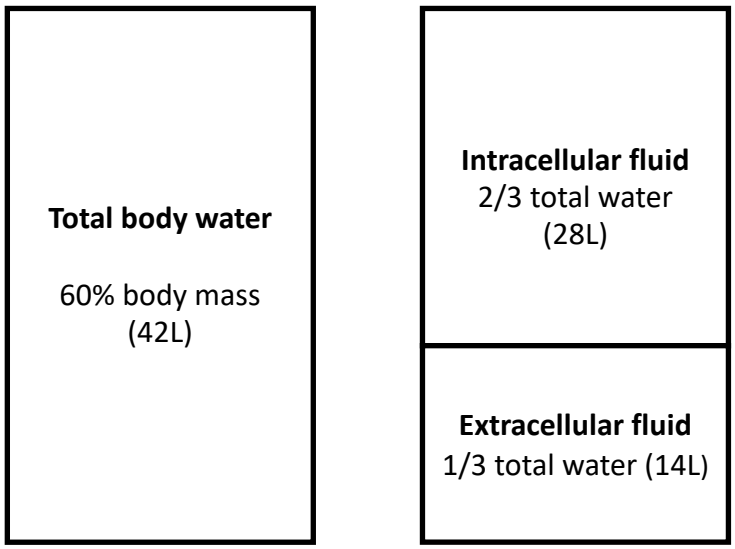
- Very common post-op problem
- Nausea is most common adverse effect of anaesthesia (1:3)
- Many contributing factors

Patient Factors	Physiological Factors	Anaesthetic Factors
• Young age • Female • Non-smoker • Previous PONV	• Hypotension • Dehydration • Hypoxia • Pain	• Volatile agents • Opioids • Nitrous oxide • Duration of anaesthesia

- Treatment should be multi-modal, i.e. use different classes of anti-emetic (with different mechanisms of action) for prophylaxis and acute relief.

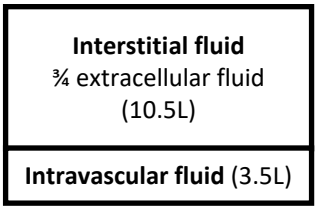
Fluid Management

Fluid Compartments



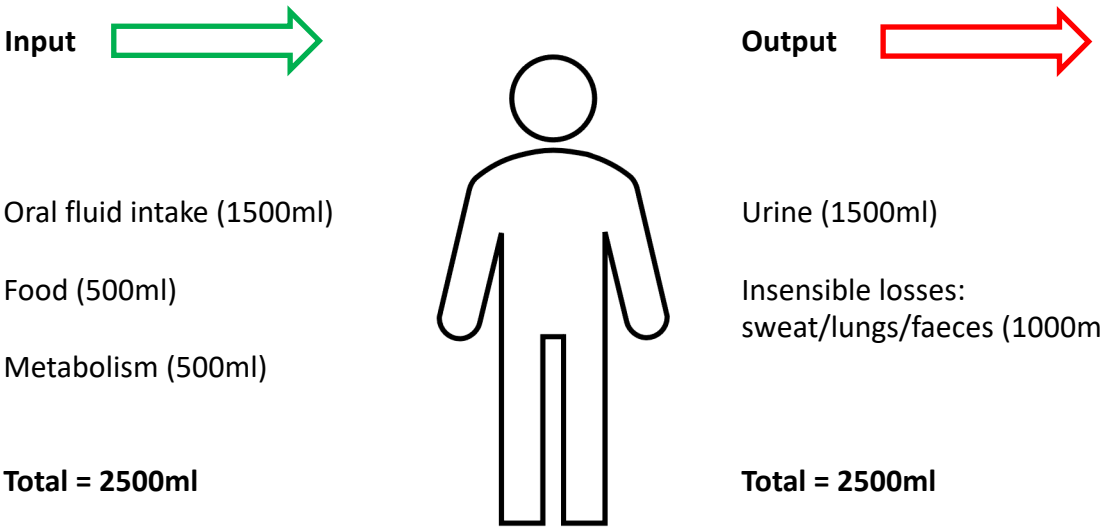
Disturbed fluid distribution can occur in people with:

- Increased vascular permeability (e.g. sespsis)
- Increased cardiac filling pressure (e.g. RHF, pulmonary hypertension)
- Reduced plasma oncotic pressure (e.g. hypoalbuminaemia)



Above volumes based on an average 70kg adult

Fluid Balance



- Insensible losses can be increased by fever, exercise, raised room temperature, burns and diarrhoea.
- Homeostasis ensures that renal sodium and water excretion are adjusted to maintain euvolaemia despite large variation in fluid intake from person to person.

The 5 Rs of Intravenous Fluid Therapy*

Resuscitation

- 500ml bolus (e.g. 0.9% NaCl)
- Reassess patient (ABCDE)
- If more fluid needed - give further 250-500ml bolus
- Further boluses can be given if required
- Seek expert help if >2000ml IV fluid needed OR patient has signs of shock

Routine Maintenance

Daily fluid/electrolyte requirements are:

- 25-30 ml/kg water
- 1mmol/kg Na^+, K^+, Cl^-
- 50-100g glucose

Maintenance fluid requirements can be calculated as follows:

- 4ml/kg/h for first 10kg
- 2ml/kg/h for next 10kg
- 1ml/kg/h for every kg >20kg

E.g. 70kg patient needs 40 + 20 + 50 =**110ml/h**

Choice of maintenance fluid should reflect the above electrolyte requirements.

Replacement & redistribution

Existing Losses/excess	Ongoing Losses	Redistribution
• Dehydration • Fluid overload • Hyper-/hypokalaemia	• Vomiting + NG losses • Biliary drainage losses • Diarrhoea/stoma losses • Blood loss (e.g. melaena) • Sweating/fever/dehydration • Urinary loss (e.g. polyuria)	• Severe oedema • Sepsis • Hyper-/hyponatraemia • Renal/hepatic/cardiac impairment • Post-op fluid retention & redistribution • Malnutrition/re-feeding problems

Treat by adding to or subtracting from routine maintenance, ensuring adjustment is made for all other sources of fluid & electrolytes.

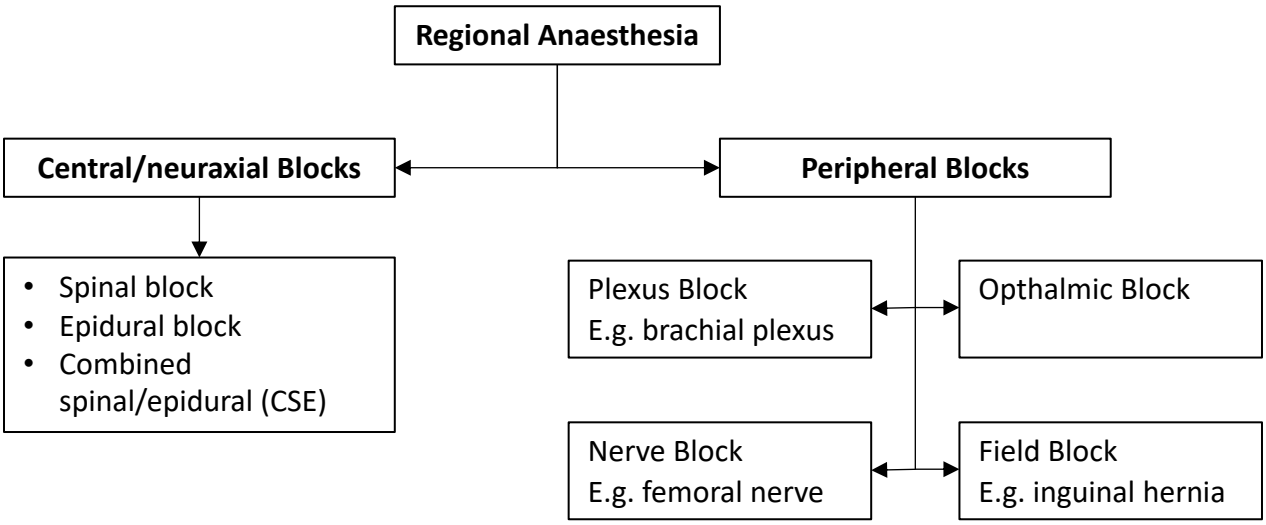
Reassessment

- Stop IV fluids when no longer required.
- NG fluids or enteral feeding should be considered when maintenance needs are >3 days.

**adapted from the NICE algorithms for IV fluid therapy in adults*

Regional Anaesthesia

Regional anaesthesia (RA) can be defined as loss of sensation in a circumscribed area of the body. Many techniques exist.



Complications of Regional Anaesthesia

	Very common-common	Uncommon	Rare-very rare
Neuraxial Blocks	• Hypotension • Itching • Urinary retention • Headache • Nausea • Pain/bruising at injection site	• Temporary nerve damage	• Permanent nerve damage due to direct injury, haematoma or infection • Toxic effect of the drugs
Peripheral Blocks	• Pain/bruising at injection site • Temporary nerve damage	-	• Permanent nerve damage • Drug toxicity

There are also specific complications related to the anatomy of different blocks. E.g. upper limb blocks may result in drooping of eyelids, hoarse voice or pneumothorax.

Why use regional anaesthesia?

- Avoid adverse effects of GA
- Significantly less PONV
- Early oral intake post-op
- Faster recovery/discharge
- Provides early post-op analgesia
- No sore throat caused by intubation
- Better patient experience

Practical example: caesarean section

- Typically utilises spinal anaesthesia
- Lower risk of hypoxia caused by airway instrumentation
- Significantly enhanced patient satisfaction - women can 'witness' the birth and experience early bonding with the new-born
- Less intra-operative bleeding due to the hypotensive effect of spinal anaesthesia and avoidance of volatile agents that can cause uterine relaxation

Local Anaesthetic (LA) Toxicity

Two causes:
- Rapid absorption into bloodstream after correctly placed block
- Accidental injection into blood vessels at time of block

Early signs include tinnitus, tongue numbness and visual disturbance, with potential catastrophic late signs being coma, respiratory arrest and cardiovascular collapse.

Management

IV access

Assess cardiovascular state

100% O_2 + adequate ventilation

STOP giving drug

Call for help

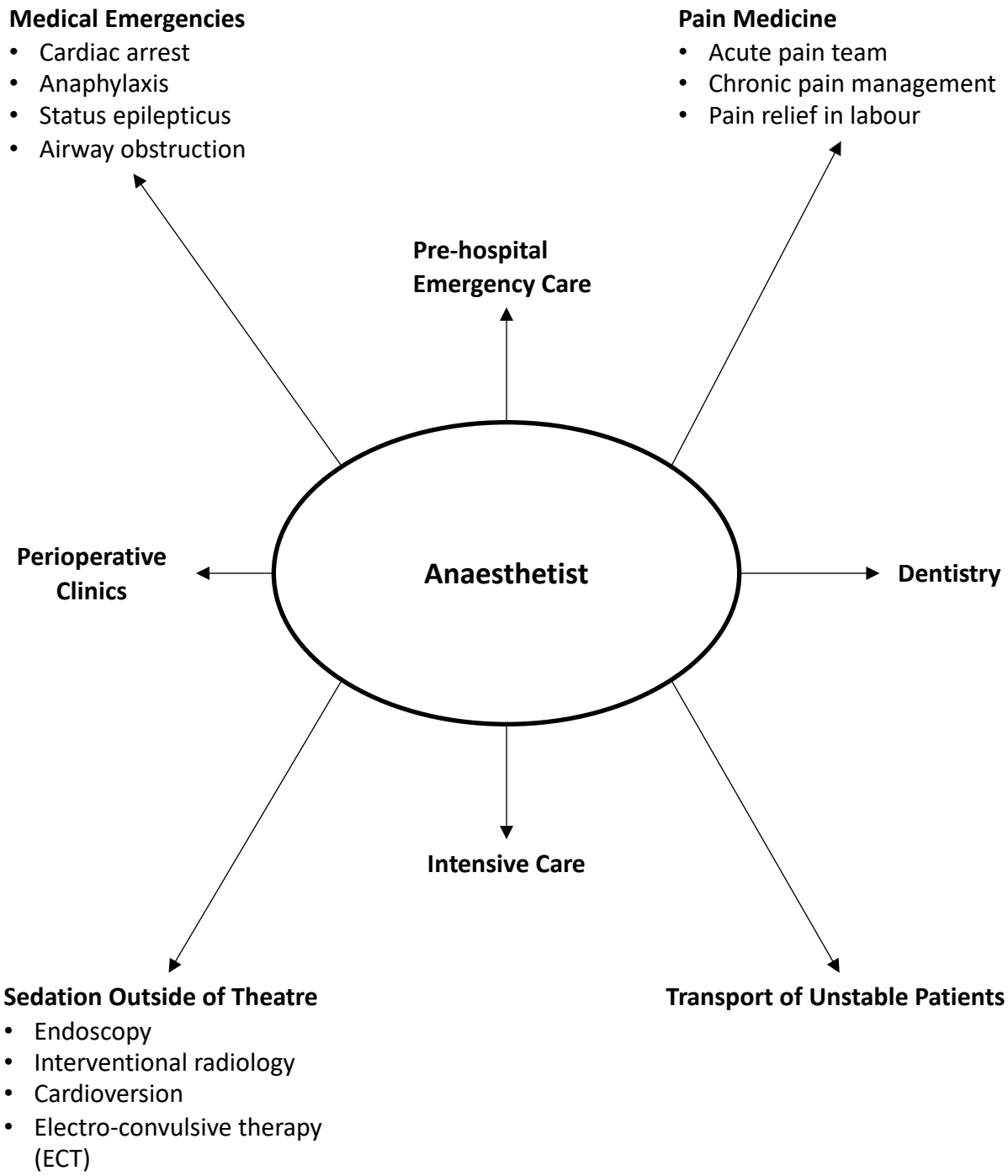
Control seizures: IV benzodiazepines/propofol/ thiopentone

Maintain airway + secure with ETT if needed → Definitive management = **IV lipid emulsion**

Reducing risk of LA toxicity

- Aspirate prior to injection
- Small volume injection
- Slow injection
- Ask patients about initial symptoms, e.g. "tell me if your tongue feels numb"
- Do not exceed maximum dose per kg

The Anaesthetist Outside of Theatre



Clinical Skills Log

Mandatory Skills

Skill	Signature
Bag-mask ventilation	
IV cannulation	

Other Skills (e.g. iGel insertion)

Skill	Signature