

TEAM

ANESTHESIA



435

Anesthesia Cases

(References: From 434 + F2-435 cases)

Cases:

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Preoperative Evaluation

A 45-year-old man is undergoing a preoperative evaluation for a laparoscopic cholecystectomy due to acute cholecystitis. He has a history of rheumatoid arthritis for 10 years, last attack 2 months ago, Body weight 118 kg, height 161, Bp: 165/89, HR: 98/min.

- What are the goals of preoperative assessment?
 - ❑ To educate about anesthesia, perioperative care and pain management and to reduce anxiety.
 - ❑ To obtain patient's medical history and physical examination.
 - ❑ To determine which lab test or further medical consultation are needed.
 - ❑ To choose care plan guided by patient's choice and risk factors.
 - ❑ Provide analgesia post operatively.
- What is ASA status for this patient?

Significant or severe systemic disease that limits normal activity. Significant impact on daily activity. Likely impact on anesthesia and surgery.

- What are your preoperative evaluation considerations (airway, arthritis, morbid obesity)?

Airway:

1. Observation of the patient's anatomy.
2. Simple bedside tests: Mallampati, thyromental distance.
3. X-rays.
4. Jaw movements.

Rheumatoid arthritis:

Airway: If the Arthritis involves one of the joints needed for intubation, the intubation will be difficult.

- **Temporomandibular joint** involvement can reduce mouth opening, hindering intubation or laryngeal mask insertion.
- **Atlanto-occipital joint and cervical spine** up to 80% of RA patients have neck involvement, including instability and subluxation. Care must be taken when moving the head and neck position as well as transferring patients.

Pain And Joint Limitation: Severely limited movement and pain of their joints make positioning the patient for surgery hard.

Medication: Current medication must be reviewed, e.g. if taking corticosteroids, extra steroid might need to be given in the perioperative period.

Morbid obesity:

Preoperative evaluation for patients with morbid obesity is used to assess the anesthetic risks in relation to the proposed surgery, to decide the anesthetic technique (general, regional, combination) & to plan the postoperative care including any analgesic regimens.

What should we look for?

- ❖ Psychological aspects. Risk of psychiatric disorder, especially depression.
- ❖ Drug metabolism. Any amphetamine-based appetite suppressants as these contribute to increased perioperative cardiac risk.
- ❖ Associated diseases (Hypertension, coronary artery disease, diabetes). Symptoms and signs of cardiac failure and obstructive sleep apnea.
- ❖ Difficult venous access.
- ❖ Airway. Difficult to intubate or maintain.
- ❖ Hypoxaemia more likely intraoperatively—ventilation mandatory.
- ❖ Regional anesthesia—difficult to perform. Obese patients have normally smaller cerebrospinal fluid volumes and the reduced epidural space resulting in a higher spread of local anesthetics.

- ❖ **Position of patient for surgery.** An assessment of the ability to tolerate the supine position may reveal unexpected profound oxygen desaturation, airway obstruction, or respiratory embarrassment. Awake intubation in a sitting or semi-recumbent position is often better tolerated than supine induction of anaesthesia and asleep endotracheal intubation.
- ❖ **Postoperative analgesia and physiotherapy to decrease chest complications.**
- ❖ **Immobility and deep vein thrombosis prophylaxis.** Appropriately sized compression stockings, low molecular weight heparin, and dynamic flow boots should be used from arrival in theatre until full postoperative mobilization.
- ❖ **Wound dehiscence and wound infection.**

CVS & Respiratory:

CVS	Respiratory
<ul style="list-style-type: none"> ● IHD. ● HTN. ● Cardiac Failure ● Dysrhythmias (hypoxia, hypercapnia) 	<ul style="list-style-type: none"> ● Obstructive sleep apnea ● Difficult intubation ● Ventilation problem.

- **What is the NPO Status required preoperative?**
 - 8 hours after a meal that includes meat, fried or fatty foods.
 - 6 hours after a light meal (such as toast, crackers and clear fluid) or after ingestion of infant.
 - Formula or nonhuman milk.
 - 4 hours after ingestion of breast milk or jello.
 - 2 hours after clear fluids (water, black coffee, tea, carbonated beverages, juice without pulp)
- **What is Preoperative Medications can be use?**
 - Anxiolysis.** Reduction of anxiety and pain.
 - Antisialagogue.**
 - Analgesia.**
 - Antiemesis.** Reduction of postoperative nausea and vomiting.
 - Amnesia.**
 - Antacids, H2 blockers.** Reduction of volume and pH of gastric contents (to avoid **mendelson's syndrome**).
 - Specific indications** - e.g. prevention of infective endocarditis.



Difficult Airway

A 35-year-old woman presents for laparoscopic lysis of adhesions. Her first laparotomy occurred 10 years prior to this admission. After induction of anaesthesia the patient had airway obstruction.

- **What is the causes of airway obstruction after induction of general anaesthesia?**

Following sedation/induction of anaesthesia, obstruction can occur from relaxation of the tongue and pharyngeal musculature.

Many of the drugs used will cause respiration to cease.

- **Ensuring adequate oxygenation is the priority at all times.**

Difficult airway Causes: Congenital - Acquired.

- Depending on the type of general anaesthesia (inhalation or IV) , we can list different attributable factors leading to airway obstruction.

Inhalational anesthesia	<ul style="list-style-type: none"> ● Atelectasis :Atelectasis causes pulmonary shunt and, therefore, undoubtedly contributes to the impairment of gas exchange during general anesthesia. ● Alveolar hypoventilation : CO₂ retention is the hallmark of hypoventilation and is always present. ● Aspiration Pneumonitis: it is the result of regurgitation and aspiration of gastric contents during induction of anaesthesia. ● Increased salivary and respiratory secretions: Anesthetic gasses and tracheal intubation may impair normal mucociliary transport. ● CNS respiratory depression: affect the central regulation of breathing, changing the neural drive to respiratory muscles such as the diaphragm which will lead to decreased O₂ consumption. ● Increased RR :which will lead to decreased tidal volume which will decrease alveolar minute ventilation. ● Decreased muscle tone : which will lead to difficulty in respiration.
IV anesthesia	<ul style="list-style-type: none"> ● Respiratory depression and apnea. ● Response to hypoxia will decrease. ● Laryngeal and pharyngeal muscle relaxation. ● Decreased tracheal reflexes.

➤ How will you manage to maintain the airway patency?

Respiratory airway patency can be achieved by simple maneuvers such as (chin lift and (jaw thrust), or (abdominal thrusts) in case of foreign body obstruction.

- **REMEMBER: DO NOT insert your finger into a patient's mouth and take good care of a patient who has loose or crowned teeth.**
- **In emergency situations** some devices can be used to allow a patent airway when intubation and ventilation can't be achieved. Such devices include (cannula), nasotracheal procedure, endotracheal tube.
- Direct surgical access such as **cricothyrotomy** and **tracheostomy**.

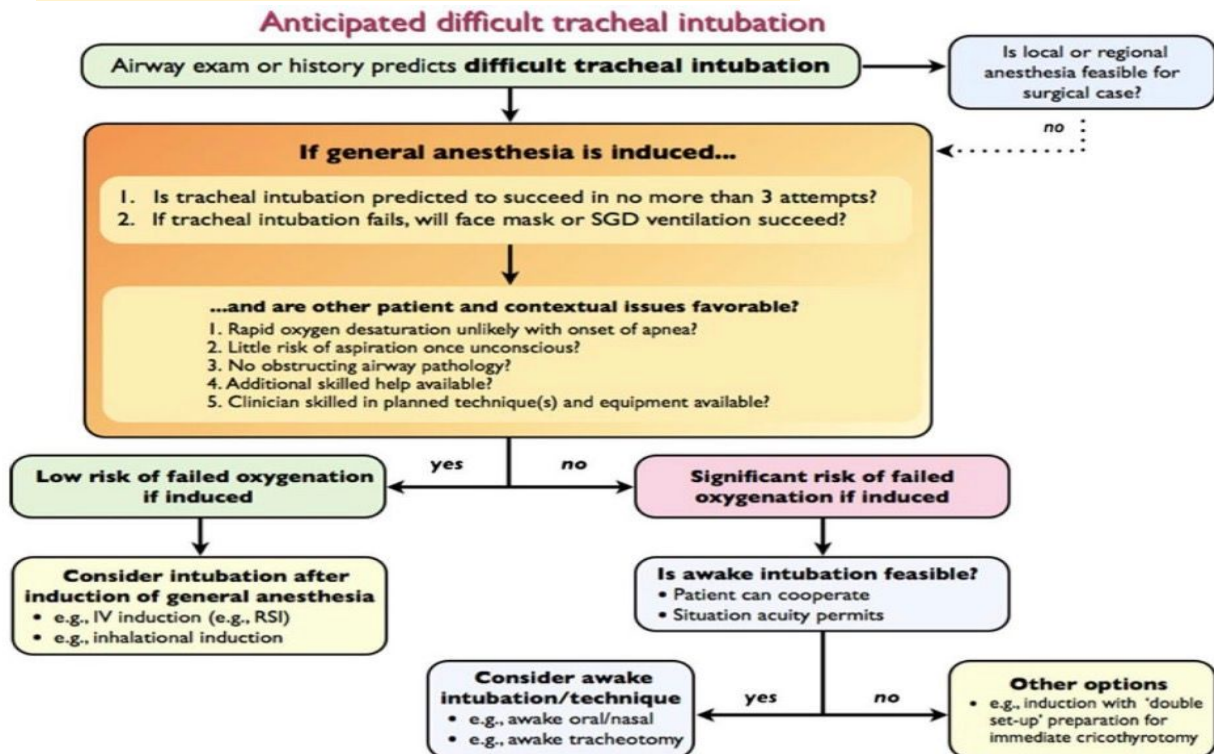
At that time, the process of tracheal intubation consumed 1 hour. She awakened with a severe sore throat, but does not know the details of the intubation. The old records are unavailable.

➤ What are the predictors of difficult mask ventilation and difficult intubation?

- Obstruction.
- Laryngospasm or pharyngospasm.
- Previous head\neck\thoracic\abdominal surgeries.
- Facial deformities or injuries.
- Tongue size (tumors).
- Mouth opening (temporomandibular joint dysfunction) use Mallampati classification (mouth opening must be 4-6 cm).
- Nasal blockage (polyps\septum deviation\ Enlarged Adenoids).
- Cervical spine arthritis or trauma, burn, radiation, tumor (huge goiter), infection, down syndrome, scleroderma, short and thick neck.
- Obesity.

Must stabilize neck properly or it will lead to spinal cord damage.

- How is the anticipated difficult intubation approached?



- Describe the management options for a patient who can't ventilate can't intubate.

1. **Cricothyrotomy:** It is an incision made through the skin and cricothyroid membrane to establish a patent airway during certain life-threatening situations, such as airway obstruction by a foreign body, angioedema, or massive facial trauma.
2. **Tracheostomy:** It is creating an opening in the neck in order to place a tube. The tube is inserted through a cut in the neck below the vocal cords this allows air to enter the lungs.

- How is successful tracheal intubation verified?

Physical examination methods such as auscultation of chest and epigastrium, visualization of thoracic movement, and fogging in the tube are NOT sufficiently reliable to confirm endotracheal tube placement.

Similarly, pulse oximetry and chest radiography are NOT reliable as sole techniques to determine endotracheal tube location.

So, How?

1. During intubation, direct visualization of the endotracheal tube passing through the vocal cords into the trachea, especially with the use of a video laryngoscope, constitutes firm evidence of correct tube placement, but additional techniques should be used as objective findings to confirm proper endotracheal tube position.
2. Use an **end-tidal carbon dioxide detector** (i.e., continuous waveform capnography, colorimetric and non-waveform capnography) to evaluate and confirm endotracheal tube position in patients who have adequate tissue perfusion.
3. Use **esophageal detector device, ultrasound, or bronchoscopy** for patients in cardiac arrest and for those with markedly decreased perfusion.



Anesthesia for healthy patient

A 52-year-old man has had progressive knee pain with swelling. His orthopedic surgeon has tentatively diagnosed a torn meniscus, and recommended an arthroscopy as an outpatient. The patient has had no major illnesses other than the typical childhood diseases. He has had no previous operations or anesthetics, nor a family history of problems with anesthesia. He has no allergies to medications, does not smoke, diabetics on oral medication blood sugar is controlled. His laboratory results and physical examination by an intern is were all normal. He has had nothing to eat or drink since he went to bed last night.

➤ What is ASA status?

- There are many general risk-scoring systems; the most well known is the American Society of Anesthesiologists (ASA) grading.
- Physical status classification system is a system for assessing the fitness of patients before surgery.

➤ How you will prepare diabetic patient for surgery?

- Determine the type of diabetes and its management.
It is important to confirm the form of diabetes present, as patients with type 1 diabetes must continue a basal rate insulin replacement preoperatively while patients on oral hypoglycemics should stop using them 1 day before surgery.
- Ensure that the patient's diabetes is well controlled.
- Consider the presence of complications of diabetes that might be adversely affected by or that might adversely impact upon the outcome of the proposed procedure, and make sure to explain this well to the patient.
- Ensure that patients with diabetes are not placed on an evening list. This avoids prolonged starvation times, the use of a VRIII and potentially an unnecessary overnight stay.
- Check blood glucose early in the morning of the surgery.
- Ensure good hydration.
- Ensure that the patient is capable of managing their diabetes after discharge from hospital.

On examination, the patient weighs 75 Kg and is 182 Cm, in tall. His neck appears to be flexible and mobile. He opens his mouth without difficulty, and with his head extended and tongue protruding, his uvula is completely visible.

➤ Discuss the airway assessment for this patient?

- Check Patient's History.
- Past anesthetic history.
- Surgery or radiotherapy to the head & neck.
- Obstructive sleep apnea.
- Conditions affecting tongue size, such as: Acromegaly, tumors or infections.
- Conditions affecting neck mobility, such as: Ankylosing Spondylitis, infections or tumors.
- Conditions affecting mouth opening, such as: Temporomandibular joint dysfunction.

LEMON Criteria:

- L: Look externally
- E: Examination
- M: Mallampati classification
- O: Obstruction
- N: Neck mobility

➤ Discuss anesthesia plan for this patient.

Preoperative management:	<ul style="list-style-type: none"> ● Preoperative assessment clinic. ● Anesthetic consent should be taken. ● Discuss type of anesthesia. ● Explain the side effects.
Intraoperative management:	<p>Before moving into the operating theater:</p> <ul style="list-style-type: none"> A. Establish IV access. B. Apply Monitors: ECG, Oximeter non-invasive ??, blood pressure. <p>At the OR:</p> <ul style="list-style-type: none"> A. Airway must be secured: E.g. with an LMA or endotracheal tube. B. Then further monitoring/interventions are performed: e.g. nasogastric tube, urinary catheter insertion occur if indicated.
Post-operative management:	<p>End of operation:</p> <ul style="list-style-type: none"> A. Extubated in the operating theater and an oropharyngeal airway inserted if needed. B. Transferred to the recovery room with LMA still in situ. C. All patients receive supplemental oxygen during transfer. <p>In recovery room, mention:</p> <ul style="list-style-type: none"> A. Patient's name and age. B. Operation details. C. Blood loss. D. Analgesia, Antiemetics, Antibiotics given. E. Thromboprophylaxis. <p>Leave recovery room:</p> <ul style="list-style-type: none"> A. Awake and complete control of airway reflexes. B. Pain free. C. no/minimal N/V. D. no/minimal bleeding from surgical site. E. Normothermic.

➤ What is the check list for sign in and time out?

SIGN IN:(Before induction of anesthesia):

- Patient has confirmed:• Identity • Site • Procedure • Consent •the site is marked.
- Anesthesia safety check completed, Pulse oximeter.
- Does patient have a known allergy?
- Difficult airway/aspiration risk? if Yes (equipment/assistance available).

TIME OUT:(in the operating theatre before the start of the operation):

- The team all introduce themselves.
- identify the patient and the planned operation and site.
- any medical concerns about the patient.
- A check of availability of all equipment and all images needed for the operation.
- Confirm all team members have introduced themselves by name, role.
- Surgeon, Anesthesia professional and nurse verbally confirm (Patient, Site, Procedure).

SIGN OUT:(Before patient leaves operating room): Nurse verbally confirms with the team:

- The name of the procedure recorded That instrument, sponge and needles counts.
- How the specimen is labelled (including patient name).
- III. Whether there are any equipment problems to be addressed.

➤ Discuss the safety features of anesthesia machine.

1. **Non-interchangeable screw threads (NISTs)** prevent the incorrect pipeline gas being connected to the machine inlet.
2. A **pin index system** is used to prevent incorrect cylinder connection.
3. **Pressure reducing valves/regulators** and flow restrictors to prevent barotrauma.
4. **The oxygen failure warning alarm** is pressure driven and alerts of imminent pipeline or cylinder failure.
5. **Interlocking vaporizers** on the back bar prevent two anaesthetic vapours being given simultaneously.
6. Flow delivered through the anaesthetic machine is displayed by a **bobbin** within a **rotameter** to allow accurate gas delivery.
7. **Hypoxic guard:** the O₂ and N₂O control knobs are linked, preventing <25% O₂ being delivered when N₂O is used.
8. **Emergency oxygen flush:** when pressed, oxygen bypasses the back bar and is 35 L/min delivered to the CGO (common gas outlet) at L/min.
9. **Suction:** generated suction is used to clear airway pressure-adjustable negative secretions/vomit and must be available for all cases.
10. Scavenged gases are usually vented to the atmosphere. **Scavenging tubing** has a 30 mm (wider bore mm), preventing accidental connection to breathing circuits.
11. **Ventilator alarms** warn of high and low pressure.



Muscle relaxants “NMJ Blockers”

A 4-year old male patient booked for right eye squint surgery.

➤ What particular questions would you like to ask in preoperative assessment?

History and examination:

- Previous Illnesses.
- Medication and Allergies.
- Past Anaesthetic History.
- Weight and Age.
- Family History Malignant Hyperthermia.
- Dentition Pre-existing Damage, Risk of Damage.
- Rapport should be established with the child and his/her parent(s).

Airway Assessment:

- Small mouth.
- Cervical spine problems.
- Infection to the airway.
- Protruding/ 'buck' teeth.
- Previous difficulties with airway management.
- Surgery/Radiotherapy to head and neck.
- Conditions affecting tongue size.
- Obesity- obstructive sleep apnoea (OSA).
- Atlanto-occipital mobility.
- Thyromental distance >6 cm.
- Interincisor gap 4–6 cm.
- Mandibular protrusion.
- Sternomental distance >12.5 cm.
- Mallampati score.

- ❖ URTI common in young children and place the child at increased risk of perioperative respiratory problems.
- ❖ Ideally, several weeks should have elapsed following a URTI. Child with a productive cough, chest signs or a temperature should not be submitted to elective surgery.

➤ Discuss fasting time and premedication.

Generally, all medication is continued perioperatively except: • Drugs that affect coagulation (warfarin, heparin, aspirin, clopidogrel); • Hypoglycemics; • Some hypotensive drugs, e.g. ACE inhibitors are stopped only on the day of surgery.

Fasting: To prevent aspiration elective surgery should not proceed unless the patient has had:

- >2 hours since last clear fluid.
- >4 hours since milk.
- >6 hours since last solid food.

Premedication: The 6 As of premedication.

- Anxiolysis E.g. Benzodiazepines.
- Amnesia E.g. Lorazepam.
- Antiemetic e.g. dopamine antagonists.
- Antacid E.g. Oral sodium citrate.
- Anti-autonomic: Preoperative drying of secretions.
- Analgesic.

The patient seen in preoperative anesthesia clinic and cleared for squint surgery under general anesthesia, Bwt: 16 kg.

➤ What are the physiological difference between adult and pediatric patient?

Respiratory system :

- ★ Higher VO₂ per kg
- ★ Higher RR; same VT per kg
- ★ Reduced lung compliance and increased airway resistance .
- ★ Neonates at risk of apnoea.

CVS :

- ★ CO rate dependent
- ★ BP lower.

Thermoregulation:

- ★ High SA : Wt ratio leading to more rapid heat loss.
- ★ Poor thermo- regulatory control.

Others:

- ★ Immature liver function.
- ★ Kidney unable to excrete Na Load.
- ★ Blood volume higher per kg.
- ★ Blood brain barrier more permeable.

➤ Discuss anesthesia consideration with special concerns for this surgery.

- ❑ **The airway:** is covered by drapes and needs to be secured by LMA or a tracheal tube is often preferred in younger children.
- ❑ **The oculocardiac reflex:** pressure/ tension on the globe or eye muscles can cause a marked bradycardia : pretreatment with atropine for prevention
- ❑ **Postoperative N/V :** pretreatment with antiemetic for prevention.
- ❑ **Postoperative malignant hyperthermia :** suxamethonium is best avoided as this is a trigger for MH .
- What would be your choice of muscle relaxant for this surgery and why?
- Administer **atropine** at induction is necessary if **propofol**, which has a bradycardic effect, is used for induction or maintenance of anaesthesia.
- **Sevoflurane** is more suitable as it is associated with less oculocardiac reflex (OCR).

- If muscle relaxation is needed (**rocuronium**) appear to attenuate the oculocardiac reflex.
- Children with a positive oculocardiac reflex are much more likely to develop **postoperative nausea and vomiting (PONV) reflex** can be prevented by Blocking the afferent limb of the reflex using a peribulbar block by **bupivacaine** and **lignocaine**. (high risk procedure).

During surgery the patient developed severe bradycardia.

- Discuss the cause and treatment.

Differential Diagnosis:

- ❖ **Hypoxia**: It is almost always the cause of intraoperative bradycardia. Children undergoing such anesthesia are known to have a greater likelihood of developing intraoperative hypoxemia which Lead to hypoxia in part due to reduced functional residual capacity and higher metabolic requirements compared to adult. Note: Hypotension definitions in children aged 1-10 years: $SBP < 70 + (\text{age in years} \times 2)$

Management: If $SpO_2 < 94\%$ assume HYPOXIA until proven otherwise and must be treated immediately !

When hypoxia occurs, it is essential to decide whether the problem is with the patient or the equipment.

1. Administer 100% oxygen.
 2. Ventilate by hand.
 3. call for help and consider 'ABCDE'.
 4. Check for likely causes in a logical sequence and Treat causes as you identify them.
 5. After a quick check of the common patient problems, make sure the equipment is working.
- ❖ **The oculocardiac reflex**: It is a decrease in pulse rate (marked bradycardia) associated with traction applied to extraocular muscles and/or compression of the eyeball. This reflex is especially sensitive in neonates and children In such surgeries, However, it may also occur with adults.

Management: It can be avoided by pretreatment with an anti-muscarinic acetylcholine antagonist like atropine.

Management of bradycardia in general

Initial evaluation:

- Assess appropriateness for clinical condition
- Heart rate typically < 60 bpm if bradyarrhythmia.

Initial intervention:

- Maintain patent airway
- Assist breathing as needed.
- Administer oxygen if hypoxemic.
- Attach monitor/defibrillator.
- Monitor blood pressure and oximetry.
- Obtain intravenous (IV)/intraosseous (IO) access.
- Perform 12-lead electrocardiography (ECG); do not delay therapy.
- Check for signs of poor perfusion(Hypotension,Acutely altered mental status,Signs of shock)
- Consider expert consultation.

Management of persistent bradycardia:

- Administer epinephrine.
- Consider atropine for increased vagal tone or primary atrioventricular block (AV) block.
- Treat underlying causes



Fluid replacement therapy

A 54-year-old man is undergoing a laparotomy and colon resection for Carcinoma. The anesthesiologist is attempting to calculate the fluid Replacement. The patient body weight is 80 kg, 8 hours fasting with bowel preparation blood loss 500 ml and urine output is 400 ml.

➤ What are the components that must be considered when calculating?

- Weight.
- NPO status.
- Type of surgery.
- Duration of surgery.
- Any other deficits.
- Blood losses.
- Type of fluid replacement (Crystalloid or colloid).

The patient body weight is 80 kg, 8 hours fasting with bowel preparation, blood loss 500ml ,and urine output is 400 ml.

➤ Discuss the volume of fluid that should be replaced.

Perioperative fluid application basically must replace two kinds of losses:

1. REPLACEMENT of fluid losses from the body via insensible perspiration and urinary output.
2. MAINTENANCE therapy replacement of plasma losses from the circulation due to fluid shifting or acute bleeding.

Replacement therapy:

The following factors must be taken into account:

- Maintenance fluid requirements.
- NPO and other deficits: NG suction, bowel prep.
- Third space losses.
- Replacement of blood loss.
- Special additional losses: diarrhea.
- What are the signs of preoperative hypovolemia?
 - HTN.
 - Weight loss.
 - Dry skin.
 - High respiratory rate.
 - Cool skin.
 - Flat neck vein.
 - Oliguria.
 - Lethargy.
 - Increased SVR.
- How to calculate the fluid replacement in the intraoperative period all of which take into consideration the preoperative fluid deficits?

Preoperative Fluid Loss Replacement:

500 Cc Multiplied By 3 = 1500 Cc Plus Urine Output 400 Cc.

Maintenance requirements:

4:2:1 rule

- First ten kilos x 4 mL/kg/hr
 - Second ten kilos x 2 mL/kg/hr
 - Every kilo after that x 1 mL/kg/hr
- a 80-kg adult will require $(10 \times 4) + (10 \times 2) + (60 \times 1) = 120$ mL/h of maintenance.

PREOPRETAVE FLUID DEFECT:

Normal maintenance requirements: (4:2:1 rule) x number of hours of fasting "NPO"
120 X 8H = **960** Cc

Anticipated Surgical Fluid Loss:

Severe Tissue Trauma In Bowel Resection 6-8cc/Kg/Hr8x80= **640** Cc/Hr

➤ Which type of Fluids should be used?

- **Dextrose:** is metabolized leaving the water, which distributes freely within the total body water. Large quantities will cause *hyperglycemia* and *dilutional hyponatremia*.
- **Crystalloids:** a similar concentration to extracellular fluid. They will distribute within the extravascular compartment but not within the intracellular compartment Excessive saline can cause a *hypochloremic alkalosis*.
- **Colloids:** suspensions of osmotically active, large particles. They are usually of either starch or gelatin in origin. Initially, they are largely confined to the vascular compartment, although some have only a relatively short half-life prior to excretion.



Approach to patient monitoring

A-65 years old patient attended the operating theatre for vaginal hysterectomy known case of diabetes controlled on oral medication.

➤ Discuss ASA standard monitor for this patient.

The patient is classified as ASA class **2** because she has a controlled systemic disease.(DM on oral hypoglycemics)

- The patient's oxygenation, ventilation, circulation and temperature shall be continually evaluated.

After induction of general anesthesia, the patient developed hypotension so inhalational agent reduced. Intraoperatively anesthesia was maintained with sevoflurane 1 % and frequent dose of muscle relaxant. At the end of surgery patient was extubated and shifted to the PACU. Two days later, the patient started complaining of recall of all conversation in OR and she was paralyzed feeling pain can't alert anybody because tube of in her throat (awareness under anesthesia).

➤ What are the methods for monitoring awareness under anesthesia?

No single technique or equipment is perfect for monitoring and detecting awareness. Currently, bispectral index monitoring is popular.

The autonomic changes that are monitored include:

1. Pupil size and reactivity:

Unreliable indicators. Mydriasis may be caused by anticholinergics (e.g. atropine, hyoscine), whilst opiates cause miosis.

2. Changes in blood pressure:

May be related to other factors, such as circulating catecholamines and drugs (e.g. beta blockers).

3. Heart rate variability:

There is a reduction in respiratory sinus arrhythmia with anaesthesia.

4. Sweating and lacrimation are also warnings of awareness.

METHODS AVAILABLE TO MONITOR AWARENESS INCLUDE THE FOLLOWING:

- Electroencephalograph (EEG): Tracks and records brain wave patterns.
- Bi-spectral index (BSI): a simplified EEG which uses an algorithm that converts EEG signals into an index of hypnotic level.
- Isolated forearm technique (IFT): Blood pressure cuff before giving neuromuscular block agents then patients asked to squeeze their hands.

- Evoked potentials:
- 1. Auditory evoked potentials (AEPs) Auditory clicks via headphones.
- 2. Visual evoked potentials.
- 3. Somatosensory evoked potentials Peripheral Stimuli (median nerve).
- Discuss non routine monitors for the detection of awareness during general anesthesia.
- Which patient are at risk of awareness?
- How will you manage this patient?

As for the diabetics we should consider a few things:

- **Infections:** These are more common and great care should be taken with any invasive procedures.
- **The airway Glycosylation of collagen** in the cervical vertebrae and temporomandibular joints: can cause difficulties in tracheal intubation.
- **Gastroparesis:** Patients with diabetes may have a delay in gastric emptying with autonomic neuropathy and may require tracheal intubation.
- **Regional anesthesia:** Avoiding general anaesthesia with a quicker return to diet and medication is desirable but patients with diabetes may compensate poorly following sympathetic blockade and the infection risk (e.g. epidural abscess) is increased.
- Many of the endocrine changes that occur following major surgery (e.g. increase in catecholamines, cortisol, and glucagon): may increase blood glucose further so intensive monitoring for diabetics is required. Plus, we should monitor to prevent any vascular event and to prevent the ER consequences of poor glycemic control like DKA or HONK.

General management of diabetic patients undergoing surgery:

- **HbA1c is a marker of glycaemic control.** A non-diabetic HbA1c is 3.5–5.5%. In patients with diabetes, 6.5% (48mmol/mol) represents good control and >8% (64 mmol/mol) poor control, and thus more prone to micro-vascular complications.
- **Assessment of major diabetic complications.** especially vascular. The degree of compromise from cardiovascular, cerebrovascular and renovascular impairment should be estimated from simple tests (e.g. serum urea and electrolytes) to more detailed investigations such as exercise testing, cardiac scans and cerebrovascular scan.



Anesthesia for CS

A24 – years female patient 39 weeks pregnant booked for Elective CS.

- Discuss physiological changes in pregnancy and its anesthesia consideration.
- **Cardiovascular system:** increase in cardiac output, risk of aortocaval compression.
- **Airway:** difficult tracheal intubation (e.g. upper airway edema).
- **Respiratory system:** decrease in functional residual capacity, risk of hypoxia.
- **Blood:** dilutional anemia, hypercoagulable state.
- **GI system:** increase risk of esophageal reflux.
- What are the benefits of regional anesthesia over GA for this case?
- Avoidance of the risks of GA : failed intubation, aspiration of stomach contents, neonatal depression and awareness under GA.
- Good analgesia immediately postoperatively.
- Possible reduction in blood loss and pulmonary thromboembolism.
- Usually a positive experience for both mother and partner.

Regional anaesthesia is preferred to general anaesthesia as it is safer for the mother and the baby compared to GA.

➤ What are the contraindication of regional anesthesia?

Absolute:

- Patient refusal.
- Infection at the Injection site.
- An allergy to local anesthetics.
- The inability to guarantee sterile equipment to perform the block.
- Coagulopathy (acquired, induced, genetic).
- Severe hypovolemia.
- Increased intracranial pressure.
- Severe aortic or mitral stenosis.
- Ischemic hypertrophic subaortic stenosis.
- Severe uncorrected anemia.

Relative:

- Sepsis (may spread infection to subarachnoid/epidural space).
- Uncooperative patient (dementia, psychosis, emotional instability).
- Pre Existing neurological deficits (hard to differentiate natural progression versus neurological trauma related to neuraxial blockade).
- Demyelinating lesions.
- Stenotic valvular heart lesions.
- Severe spinal deformity.

After giving intrathecal dose of bupivacaine and fentanyl, patient vomited and developed tachycardia, hypotension.

➤ What may be the cause of hypotension?

The Hypotension is due to peripheral vasodilation which caused by sympathetic block.

➤ Describe management.

- **IV fluids:** for increasing available vascular volume.
- **Ephedrine:** for raising heartbeat rate, cardiac output and peripheral vascular resistance.
- **Alpha 1 Agonists (phenylephrine):** increasing peripheral vascular resistance.
- **Mechanical compression of the lower limbs:** for increasing venous return.

➤ What is the difference between spinal and epidural anesthesia?

Table 13. Epidural vs. Spinal Anesthesia

	Epidural	Spinal
Deposition Site	LA injected in epidural space (space between ligamentum flavum and dura) Initial blockade is at the spinal roots followed by some degree of spinal cord anesthesia as LA diffuses into the subarachnoid space through the dura	LA injected into subarachnoid space in the dural sac surrounding the spinal cord and nerve roots
Onset	Significant blockade requires 10-15 min Slower onset of side effects	Rapid blockade (onset in 2-5 min)
Effectiveness	Effectiveness of blockade can be variable	Very effective blockade
Difficulty	Technically more difficult; greater failure rate	Easier to perform due to visual confirmation of CSF flow
Patient Positioning	Position of patient not as important; specific gravity not an issue	Hyperbaric LA solution – position of patient important
Specific Gravity/Spread	Epidural injections spread throughout the potential space; specific gravity of solution does not affect spread	LA solution may be made hyperbaric (of greater specific gravity than the cerebrospinal fluid by mixing with 10% dextrose, thus increasing spread of LA to the dependent (low) areas of the subarachnoid space)
Dosage	Larger volume/dose of LA (usually > toxic IV dose)	Smaller dose of LA required (usually < toxic IV dose)
Continuous Infusion	Use of catheter allows for continuous infusion or repeat injections	None
Complications	Failure of technique Hypotension Bradycardia if cardiac sympathetics blocked (only if ~T2-4 block), e.g. "high spinal" Epidural or subarachnoid hematoma Accidental subarachnoid injection can produce spinal anesthesia (and any of the above complications) Systemic toxicity of LA (accidental intravenous) Catheter complications (shearing, kinking, vascular or subarachnoid placement) Infection Dural puncture	Failure of technique Hypotension Bradycardia if cardiac sympathetics blocked (only if ~T2-4 block), e.g. "high spinal" Epidural or subarachnoid hematoma Post-spinal headache (CSF leak) Transient paresthesias Spinal cord trauma, infection
Combined Spinal-Epidural	Combines the benefits of rapid, reliable, intense blockade of spinal anesthesia together with the flexibility of an epidural catheter	

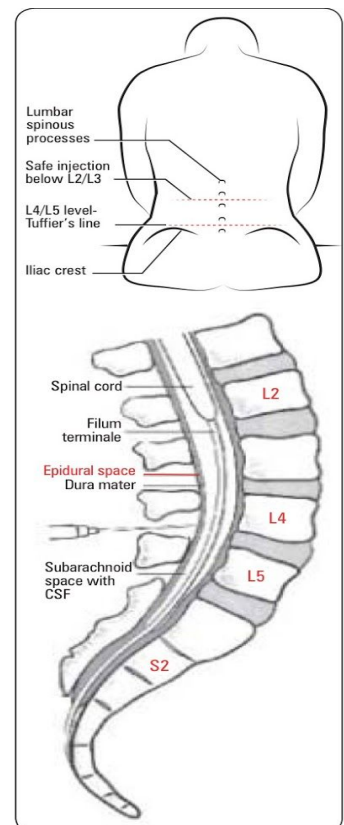


Figure 9. Landmarks for placement of epidural/spinal

- What are the complication of regional anesthesia?
 - **Hypotension:** from sympathetic block.
 - **Nausea and vomiting.**
 - **Weakness.**
 - **Urinary retention.**
 - **Headache:** from accidental dural puncture.
 - **Catheter misplacement:** may cause total spinal anaesthesia with total paralysis, loss of consciousness, and cardiac arrhythmias. Can affect upper limb power and respiration (C3–5).
 - **Neurological damage:** because of direct trauma, injecting the wrong substance or due to a space-occupying lesion in the vertebral canal compressing the spinal cord.
 - **Duration of labour may be increased.**



Post-operative pain management

A 55 years old patient had explorative laparotomy with midline incision under general anesthesia. Intraoperative course was uneventful and surgery lasted for 3 hours. The final diagnosis was perforated duodenal ulcer patient extubated and send to recovery room.

- Discuss the Methods for post-operative pain management for this case.
 - **Analgesia:** The most painful operations are thoracic and abdominal, so we should give the patients analgesia to control the pain.
 - Pain management using analgesia should be based on the intensity of pain reported by the pt. rather than its specific etiology.
 - Multimodal analgesia is used, which works on the principle that drugs acting by different mechanisms can result in additive or synergistic analgesia with lowered adverse effects. The mainstay of analgesia is paracetamol, non-steroidal anti-inflammatory drugs (NSAIDs), local anesthetics and opioids.

If the pain is persistent or increasing, we move to the next step.

-Mild: Acetaminophen • NSAIDs • ± Adjuvants.

-Moderate: Codeine • Hydrocodone • Oxycodone • Tramadol • ± Adjuvants.

-Severe: Morphine • Hydromorphone • Fentanyl • Methadone • Pethidine • ± Adjuvants.

- **Fluids:**

Patients will require IV fluids until they are able to drink normally.

- **Oxygen therapy:**

All patients need to apply oxygen and monitor for vital signs, respiration (rhythm, pulse oximetry), circulation (pulse, blood pressure, ECG), level of consciousness, score of pain.

- **others:**

Patient may need prescribing:

- **anticoagulants:** the timing of heparin administration to prevent PE needs to be balanced against the risk of postoperative bleeding, especially if an epidural is in situ.
- **antibiotics.**
- **Insulin.**

Blood pressure was 176/89 HR: 98/min so 5 mg morphine intravenous was given. Patient became tachypneic and tachycardia HR 128/ min, SPO2 dropped down to 65 % and had expiratory wheezing on chest examination.

- What may the possible causes of this condition?

1. Allergy to morphine.
2. Airway obstruction.
3. Postoperative nausea and vomiting.

4. Fluid overload.
 5. Excessive use of vasopressors.
 6. Residual anesthesia.
- How will you manage this case.

The patient may have an obstruction of the airway because he has: Tachypnea, SPO2 is dropped, expiratory wheezing, tachycardia.

Airway obstruction

Causes	Sign and symptoms	Management
<p>The main causes of early postoperative hypoxaemia are a degree of airway obstruction, central respiratory depression usually caused by opiates, and respiratory muscle weakness resulting from inadequate reversal of neuromuscular blocking drugs.</p>	<p>Signs of airway obstruction in our case includes hypertension, tachycardia, expiratory wheezing on chest examination.</p>	<ul style="list-style-type: none"> The treatment of airway obstruction is to identify the cause, and clear the airway, often with suction, to ensure patency. Extension of the neck, jaw thrust, and insertion of an oropharyngeal airway are often required. If the patient is conscious, oropharyngeal airway is contraindicated, go with the nasopharyngeal.

Hypoventilation

Causes	Treatment	Reverse (or Antidote)
<ol style="list-style-type: none"> 1. might happen due to postoperative intravenous analgesia (morphine). 2. Residual anesthesia (necrosis, muscle relaxant, inhalation agents). 	<ul style="list-style-type: none"> Close observation. Assess the problem. Treatment of the cause. 	<ul style="list-style-type: none"> Muscle relaxant > Neostigmine. Opioids > Naloxone. Midazolam > Anexate.

Hypertension

Causes	Treatment	Antihypertensives
<ol style="list-style-type: none"> 1. Pain. 2. Hypertensive patient. 3. Fluid overload. 4. Excessive use of vasopressors. 	<ul style="list-style-type: none"> Effective pain control. Sedation. 	<ul style="list-style-type: none"> Beta blockers. Alpha blockers. Hydralazine (Apresoline). Calcium channel blockers.



Complications of central line insertion

A 25-year-old presented with road traffic accident. He was scheduled for emergency exploratory laparotomy.

- Discuss the perioperative standards of monitoring.
- 1. **Standard I:** Qualified anesthesia personnel shall be present in the room throughout the conduct of all general anesthetics, regional anesthetics and monitored anesthesia care. Due to the rapidity of occurrence of physiologic derangement during surgical interference.
- 2. **Standard II:** During all anesthetics, the patient's oxygenation, ventilation, circulation and temperature shall be continually evaluated.

After induction of anesthesia, patient was positioned for central line insertion through IJV. While insertion of catheter the patient developed sudden tachyarrhythmia, sudden drop in end tidal CO₂, drop in saturation and hypotension.

- What may be the possible diagnosis? ⇒
- What are the different methods for the detection of air embolism?

- **Imaging:**

- ★ **Non-invasive** Doppler, CT, MRI.

- ★ **Invasive** Transesophageal echocardiography TEE.

- ➔ **TEE:** Highest sensitivity for detecting the presence of air in the right ventricular outflow tract or major pulmonary veins. Also identifies paradoxical air embolism PAE.
- ➔ **Doppler US:** Most sensitive noninvasive method for detecting venous air emboli.
- ➔ **CT:** Can detect air emboli in the central venous system (especially the axillary and subclavian veins), right ventricle, and/or pulmonary artery.
- ➔ **MRI:** MRI of the brain may show increased water concentration in affected tissues, but this finding alone. May not be reliable for the detection of gas emboli.

- **Laboratories:** ABG: hypoxemia, hypercapnia and metabolic acidosis

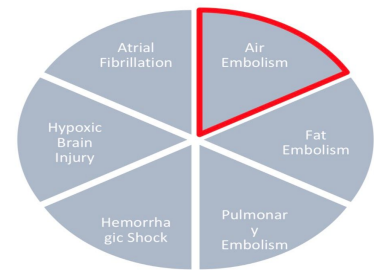
- How you can prevent air embolism while inserting central venous catheter.

- When removing the catheter, position the patient in the Trendelenburg's position to increase the intrathoracic pressure.
- Apply an occlusive dressing (an antiseptic ointment or petroleum gauze).
- Keep the patient flat for 30 mins after removal and monitor for signs and symptoms of embolism.
- Hydration.
- Avoidance of Nitrous Oxide.
- Expel air from syringes prior to any injection or infusion.
- Always assure that central catheter ports are clamped when removing Caps or lines.
- Use Luer-lock connections for needleless IV ports

- How will you manage this case?

1. Oxygen 100%
2. Airway, breathing, circulation and call for help.
3. Flood surgical site with saline.
4. Position patient in Trendelenburg/left lateral decubitus position.
5. Consider inserting a central venous catheter to aspirate gas.
6. Consider hyperbaric chamber if indicated.

Differential Diagnosis





Post-Operative hypotension/Shivering

A - 78 years old patient had transurethral prostatectomy under spinal anesthesia. He was a known case of diabetes and hypertension on treatment. Postoperatively in PACU patient was agitated and started shivering.

➤ What are the routine monitor in PACU?

- Vital signs BP,TEMP, RR.
- Oxygen monitoring.
- Electrocardiogram monitor.
- Pain score.

The patient blood pressure was 89/40, HR: 85/MIN, RR: 23/ MIN SPO₂ difficult to read because of patient shivering.

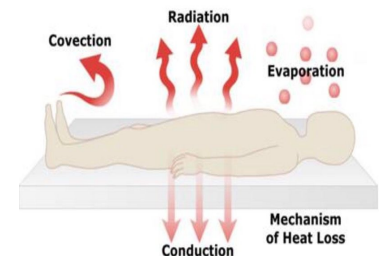
➤ What may be the causes of postoperative hypotension?

- Hematological factors: transfusion reaction, hemolysis.
- Acute or chronic blood loss.
- Anesthesia.
- Septic shock.

➤ Discuss the mechanisms of intraoperative heat loss.

Body heat is lost in several ways, and there are four major mechanisms at work:

1. **Radiation 40%** : Transfer of electromagnetic energy between two bodies of different temperature.
2. **Convection 30%** : Convection is usually the dominant form of the transfer by the surrounding “layer” of air. Energy transfer will be greater if the air immediately adjacent to a patient skin is repeatedly disturbed.
3. **Evaporation 25%**: As water becomes vapour, heat energy is lost as latent heat of vaporization. This type of heat loss will be increased if a large surface is exposed to evaporation, e.g. loops of bowel during a laparotomy. Surgical skin prep increases heat loss in this way. 10% is lost via respiratory water vapour.
4. **Conduction 5%**: Transfer of heat energy by direct contact between two objects of differing temperatures, e.g. a patient being in direct contact with the operating table. A patient lying in a pool of fluid or wet sheets will lose an increased amount of heat via conduction.



➤ Methods for maintaining body temperature in an anesthetized patient.

1. **Warmed mattresses and blankets**: Simple and effective for short cases.
2. **Ambient temperature**: In modern operating theaters temperature can be accurately controlled and should be at least 21°C. (it has been demonstrated that at ambient temperature less than 21°C, all patients become hypothermic while between 21-24°C, thirty percent patients become hypothermic).
3. **Fluid warmer**: If >500mL of fluid is given it should be warmed to 37°C using a fluid warmer, as should all blood products.
4. **Silver-lined space blankets/hats**: They reduce radiation heat loss.
5. **Heat and Moisture Exchangers (HMEs)**: Heat and moisture exchangers humidify, warm arid filter inspired gas. Their incorporation into paediatric anaesthetic breathing system is recommended, dry anaesthetic gases cause greater heat loss in children than in adults as children have higher ratio of minute volume to body surface area. However they can cause delay in the inhalational induction.

➤ What are the causes for post-operative shivering?

Postoperative shivering can occur due to:

1. Hypothermia.
2. General anesthesia itself.
3. Regional anesthesia (e.g. Spinal or epidural).

➤ How will you manage this case?

1. **Increase the blood pressure:** fluid replacement is the immediate step to correct the Hypotension.
2. **Treat the underlying causes of hypotension:** identify the causes of postoperative hypotension is essential, causes include: OR deficit, haemorrhage, cardiac cause or it could be related to regional anesthesia and treat accordingly.

➤ What drugs can be used for the prevention of postoperative shivering?

- Pethidine.
- Ondaserton.
- Propofol.
- Doxapram.
- Anticholinesterase: physostigmine.