**وزارة التعليم العالي والبحث العلمي**

**هيئة التعليم التقني**

**المعهد التقني / الموصل**


# مـــبادئ ألتـــخديـــر

# Anaesthesia

**تقديم وأعداد .....**

**ألـــدكتور**

**داود أحـــــمد داود**

**أختصاصي ألتخدير وألعناية ألمركزة**

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# An Understanding Of Our Past Guides Our Future

The history of surgery is inextricably linked to the development of appropriate anesthetic techniques & so the history of surgery follows the history of anesthesia .

## Discovery Of Anesthesia

Term Suggested By Oliver Wendell Holmes In 1846 To Describe The State Of Sleeping Produced By Ether

## History of anesthesia

- Opium First injected I.V by Wren in 1665.
- Use of diethyl ether for anesthesia by Long in 1842
- four years later Dr. Morton(dentist) used Ether and publicized.
- Dr.John Snow administered the chloroform to Queen Victoria during the birth 1853
- Dr.Wells Use of N20 for anesthesia in 1844.
- In 1930 Cyclopropane became the most important new Inhaled anesthetic.
- Boyle machine described in 1917.
- Halothane is first used in 1956.
- I.V anesthesia popularized in 1930.
- 1932 the first widely used i.v thiopental;
- methohexital in1957,
- ketamine in 1965
- Local anesthesia :-

  Cocaine isolated in 1860 , Topical anesthesia produced in 1844.
- Spinal anesthesia in 1885.

## [[ What is anaesthesia? ]]

The word anaesthesia is coined from two Greek words

"an"..... meaning "without" and "aesthesis"..... meaning "sensation".
There are various types of anaesthesia , Many of today's operations are made possible as a result of developments in anaesthesia.

Anaesthesia..... refers to the practice of administering medications either by injection or by inhalation that block the feeling of pain and other sensations, or that produce a deep state of unconsciousness that eliminates all sensations, which allows medical and surgical procedures to be undertaken without causing undue distress or discomfort, i.e provide an optimal operative condition for both patient , surgeon & to keep the patient a life during operation & in the early post operative period .

### Analgesia :

is the reduction or elimination of the patient experiencing pain by medications that act locally, such as local anaesthetics (which interfere with nerve conduction) or generally, such as opioid medications (which decrease the patient's experience of pain in the central nervous system).

### Regional anaesthesia :

is an umbrella term used to describe nerve blocks, epidural blocks and spinal blocks. Regional anaesthesia involves the injection of local anaesthetic in the vicinity of major nerve bundles supplying body areas, such as the thigh, ankle, forearm, hand or shoulder , Regional anaesthesia may be used on its own or combined with general anaesthesia.

### Conscious sedation :

is defined as a medication-induced state that reduces the patient's level of consciousness during which the patient can respond purposefully to verbal commands or light stimulation by touch.

Anaesthetists provide a wide range of medical services and are part of multidisciplinary teams providing health care to patients.

Clinical anaesthesia is built on the knowledge of physiology (how the body works) and pharmacology (how medications work in the body).. Anaesthetists must have an extensive knowledge of medicine and surgery as an understanding of the basic sciences.

## *Type of anesthesia*

**A. General Anesthesia**

**B. Local Anesthesia**

### General Anaesthesia :

Delivery of anesthetic drugs (inhaled or infused) to produce a level of CNS depression with the following goals :

- **Anesthesia** : Hypnosis , loss of consciousness (reversible)
- **Analgesia** : pain control
- **Amnesia** : loss of recall
- **Areflexia** : muscle relaxation ( this is not always required)

Autonomic Areflexia : decrease sympathetic nervous system (SNS) function

- **Anxiolysis** : Intra-operative & Post-operative

The job in Anesthesiologist should cover the **all** the

((( **peri operative** ))) period which include : ....

i. Pre operative assessment..... ( before surgery )
ii. Intra operative ..... ( during surgery )
iii. Post operative period ..... ( after surgery )

### Components of general anesthesia

- Unconsciousness (Hypnosis)
- Analgesia (Areflexia)
- Muscle relaxation

Most surgical operation (abdominal, thoracic, ENT, neurosurgical operation, loss of conscious , loss sensation ´of pain, muscle relaxation component can be varied individually .

## ROUTE OF ADMINISTRATION OF GENERAL ANESTHESIA

1. Inhalation General Anesthesia
2. Injectional General Anesthesia

    a - (I.V) intra venous General Anesthesia

    b-(I.M) intra muscular General Anesthesia

3. Oral administration of G.A used Sedation or narcotics.
4. Rectal administration of G.A e.g. (Barbiturate) both in children and Uncooperative patient.

## Difference Between (( General And Local ))Anesthesia:

1-General anesthesia describes a controlled state of unconsciousness accompanied by partial or complete loss of Protective reflexes, including the inability to maintain an Airway or respond to verbal command. The local anesthesia Causes reversible blockade of peripheral nerve conduction Or inhibition of excitation at nerve ending with resultant loss Of sensation in appropriate area of body.

2- In G.A patient loss his consciousness, while in L.A. patient will not lose his consciousness.

3-The most adverse effects of G.A are avoided in L.A, like nausea and vomiting.

4-Local anesthesia is useful for minor surgery and diagnostic And therapeutic procedures, while G.A is usually used for Major operations.

5-Unlike general anesthesia local anesthesia can be given to Non fasting Patient, without fear from regurgitation or Aspiration of gastric contents.

6-Local anesthesia can not be used in uncooperative patient, so we can use G.A.

7-IF the life of patient in danger if we use G.A for Him, we can use instead of it L.A.

8-Local anesthesia need less postoperative care for patient Compares to G.A.

9- In local anesthesia there is early ambulation of patient and Oral feeding than G.A,

10-Local anesthesia can be done in lack of skilled assistant or Nursing.

11- General anesthesia offers a quite atmosphere Which is useful for delicate surgery.

# Local Anesthesia

Act by producing a conduction blockade of neural impulse in affected nerve , Local anesthetics cause reversible blockade of peripheral nerve conduction or inhibition of excitation at nerve ending with resultant loss of sensation in appropriate area of body.

The first local anesthetic introduced into clinical practice was Cocaine for topical anesthesia for Cornea , Its use was limited by its properties of causing psychological dependence and for its irritant properties when placed topically or near the nerve , With exception of cocaine{vasoconstrictor}and Lignocaine {no effect on vessels}, local analgesic drugs are vasodilators , Addition of Epinephrine(adrenaline) or Phenylephrine to local anesthetic solution produces local tissue vasoconstriction, this results in slowing of rate of systemic absorption of local anesthetic by keeping the local anesthetic solution in contact with nerve fibers for long period of time, also has the value of decrease the bleeding in the area and preventing haematoma formation if small local vein is damage by the needle.

It is not recommended in cardiac dysrhythemia , Angina pectoris, uncontrolled hypertension, and in areas of lack collateral blood flow such as Penis and Digits.

## Side Effects Of Local Anesthesia:

1.systemic effect:

due to excess plasma concentration of local anesthetic as result Of accidental intravascular injection mostly, other due to absorption of local anesthetic from tissue injection sites which due to

(a) dose injected, (b) vascularity of tissue, (c) inclusion of vasoconstrictor in local anesthetic solution e.g. intercostal nerve block, caudal block, epidural block

**These systemic complications include:**

A-central nervous system manifestations: like restlessness, vertigo, tinnitus and slurred speech.

B-Cardiovascular manifestations like hypotension due torelaxation of arteriolar vascular smooth muscles and direct cardiac depression, cardiac arrhythemia.

2- Neurotoxicity:

placement of local anesthetic solution into epidural or

Subarachnoid space may result in transient irritation( cauda equine syndrome).

3- Allergic reaction :

rash, laryngeal odema, hypotension, bronchospasm.

# Method of local analgesia:

## 1-Topical or surface analgesia:

Application of L.A agent to produce anesthesia. It is used on the skin, conjunctiva, nasal passages, larynx, and pharynx, tracheobronchial tree, rectum and urethra , The L.A drug is used in form of Spray, drop, Ointment, cream or jell. This type of anesthesia is used in minor Surgery and diagnostic procedures like Laryngoscopy, Bronchoscopy, Cystoscopy, etc... , L.A has also been instilled into bladder, pleural cavity, peritoneal cavity and synovial cavity and synovial fluid of joints.

application may be via direct instillation, soaked swabs, pastes, ointments or sprays.

1. EMLA cream: mixture of lignocaine & prilocaine for application to the skin before venipuncture, this is especially valuable for children but take one hour to act.
2. Lignocaine: 4% maximum 5ml in 70kg man.
3. Cocaine: 5% maximum 5ml in 70kg man.

## 2-Infiltration analgesia:

to abolish the pain due to surgical intervention and ease pain associated with trauma. The anesthetic is injected in the site of operation. Subcutaneous and intradermal infiltration is performed in fan shape by needle pricks around the lesion, with further injection as required , Example :as in the extraction of teeth. Commonly performed for minor surgery, suturing, etc.

## 3- Peripheral nerve block ( May be under ultrasound Guide) :

injection of solution of local anesthetic near the Nerve or nerves supplying the area to be operated on. It needs the knowledge Of anatomy of nerves related to landmark, Preferably bony landmark , Example brachial plexuses block, intercostal nerves block, unlar nerve block,median nerve block.

## 4- I.V regional anesthesia (Bier block):

It is used for the surgery of upperlimbs and to lesser extend for lower limbs.

## 5-Central neural blockade(Conduction anesthesia):

a- Spinal( intradural) anesthesia.

b- Epidural(Extradural) anesthesia.

## 6-Refrigeration analgesia.

## Drugs Used For Local Anesthetic

| (Ester.) | Potency | Onset | Duration | Max.dose |
|---|---|---|---|---|
| Procain | 1 | rapid | 45-60 | 500 |
| Chloroprocain | 4 | rapid | 30-45 | 600 |
| Tetracain | 16 | slow | 0-180 | 100 topical |
| (Amides.) | | | | |
| Lignocaine | 1 | rapid | 60-120 | 300 |
| Mepivacaine | 1 | slow | 90-180 | 300 |
| Prilocain | 1 | slow | 60-120 | 400 |
| Bupivacaine | 4 | slow | 240-480 | 175 |
| Ropivacaine | 4 | slow | 240-480 | 200 |

### Commonly used local anaesthetics Drugs

- **Lidocaine** .... Medium-acting amide. Maximum safe dose 4mg/kg without adrenaline, 7mg/kg with adrenaline.
- **Prilocaine** ...Medium-acting amide. Used for intravenous regional anaesthesia due to its rapid metabolism. Maximum safe dose 6mg/kg without adrenalin, 8mg/kg with adrenaline
- **Bupivacaine** ...Long-acting amide. Maximum safe dose 2mg/kg with or without adrenaline.
- **Cocaine** ....Short-acting ester. Slow onset, profound vasoconstriction by preventing noradrenaline reuptake.

### Adrenaline: -

Added to local anaesthetic solution to: -

1. Decrease blood flow at the site of injection, leading to decrease vascular absorption & increase neuronal uptake of local anaesthetic, so the depth & duration of neuronal blockade are increased.
2. Decrease the likelihood of high blood level local anaesthetic (decrease toxic reaction to local anaesthetic).
3. In infiltration technique, local vasoconstriction leads to decrease bleeding.

### Side effects:

- If injected intravenously may cause cardiac effect ventricular tachycardia VT, ventricular fibrillation VF, hypertension, and myocardial ischemia.
- Should not be used for ring block of digit, penis, tip of nose that may cause vasoconstriction of end arteries & lead to ischemia & gangrene.

## The danger of local anesthesia :

1-risk of damaging the neighboring structures by the needle point e.g. Pneumothorax, haemorrhage due to injery of spleen.

2- danger of over dosage lead to shock and possibility death. The usual dose should. be reduced in following condition:

a- ill, young, old patient.

b- if the site of injectionis highly vascular.

c.if the rate of injection(intravenously) is very rapid, no time for the body todestroy or neutralized the anesthetic agent.

## Treatment:

1- stop administration.
2- check the the patient airway
3- give oxygen.
4- perform artificial respiration.
5- control convulsion by I.V injection of thiopenton
6- if cardiac arrest occur treat it.

## I.V Regional anesthesia

This was first described by Bier in 1908. I.V injection of local anesthetic agent has been **used for:**

1- G.A
2- in treatment of cardiac dysrhythmias.
3- to produced local analgesia.

Is simple method of producing anesthesia of arm or leg by injection of large volume of local anesthetic solution intravenously while the circulation to the extremity is occluded by a tourniquet. Cannula is placed in distal portion of involved extremity. Arm or leg is exsanguinated by wrapping wih Esmarch bandage Confirm the absence of radial pulse.

## Technique:

Acanula is inserted into a vein on the dorsum of the hand and very firmly secured. Another should be in vein in the other limb in case of toxic signs. The limb is drained of blood by elevation for 5 minutes with or without compression of brachial artery.

An Esmarch bandage be used for this purpose.Two narrow sphygmomanometer cuffs are placed on upper arm. One proximal to other and the upper one inflated to 50mmHg above the systolic blood pressure before the removal of the compression of pneumatic bandage (if used). 25-50ml {40mlof local anesthetic solution}without epinephrine for upper extremity is injected and after 5-10minutes the lower cuff is inflated and the upper one released to minimized discomfort , The tourniquet should be remained less than one hour.

# Central Neuroaxial Blockade(Conduction Anesthesia)

## (( Epidural And Spinal Anesthesia ))

**Anatomy :**

The vertebral Column consist of 7 cervical vertebrae, 12 thoracic, 5 lumber as well as 5 fused sacral and 4 fused coccygeal vertebrae.

C.S.F is found in spinal space between the pia and arachnoid layer.

The epidural space is found between the connective tissue covering the vertebrae and the ligamentum flavum posteriorly and the dura mater anteriorly. Laterally it is bound by the pedicles and the intervertebral foramina. The epidural space extend from the foramen magnum, where the dura is fused to the base of skull to the sacral hiatus.

***Anatomic landmark*** that anesthesiologist uses to administer a spinal anesthesia include the spinous processes and the iliac creasts. A line drawn across the patient's back at the level of the top of the iliac creast usually crosses the vertebral column at the L4 level , The interspace palpated directly above this line is the L3-L4.

Skin between two spinous processes supraspinous ligment, interspinous ligment between two vertebrae, then through ligmentum flavum where increased resistance is felt.

Finally, the dura mater is traversed and subarachnoid space is accessed 6cm(from skin to subarachnoid space.

## Epidural anesthesia :

Placement of local anesthetic solution into the epidural space, most often at lumber level. Thoracic block is useful for postoperative analgesia and pain relief following trauma. Cervical block has been performed for pain therapy and for carotid artery, thyroid and arm surgery. .

Continuous epidural anesthesia made possible by placement of plastic catheter into the epidural space in the most common method for providing epidural anesthesia.

**Technique:**

The epidural anesthesia is instituted in a similar fashion to spinal anesthesia. Patient placed in a seated upright or lateral decubitus position, with the back flexed as much as possible. the back prepared and draped sterilely, local infiltration of the skin overlying the chosen interspace is administered.

The epidural needle tip is curved to help prevent accidental puncture of the dura mater and to facilitate threading of the epidural catheter through the needle into the epidural space.

The epidural space is locatable by the loss of resistance technique.

**first**, the tough ligamentum flavum overlies the space posteriorly, providing resistance to the needle as it passes through it.

**Second**, there is negative pressure in the epidural space implying negative resistance. The change in resistance, or loss of resistance locate the epidural space,

and this can be sense the loss of resistance by connecting a syringe on the hub of Tuohy needle and applying continuous gentle pressure on the plunger of the syringe as the needle is advanced through the ligaments through into the epidural space.

Once the epidural space is located with Tuohy needle by the loss of resistance technique. The epidural catheter can be thread into the space. Typically 2-5cm after the epidural catheter has been placed and the Tuohy needle has been pulled back, the epidural catheter is best secured in place by taping it to the patient's back.

The test dose used for epidural catheter is 3ml of 1.5%Lidnocain with 1:200000 Epinephrine. The test dose is performed to exclude the possibility that the catheter has been accidentally placed into an epidural vein or into the subarachnoid space. Waite for 3minutes after the administration of the test dose to safely exclude these two possibilities.

## Difference between spinal and epidural anesthesia:

1- Both are called regional or conduction anesthesia.
2- In spinal anesthesia medicine is deposited in subarachnoid Space must commonly at lumber level. In epidural anesthesia Medicine is deposited in epidural space most commonly at Lumber level.
3- Both of them provide surgical anesthesia without affecting The state of consciousness of patient, skeletal relaxation, and lack of the need for manipulate the airway or mechanically ventilate the lungs.
4-Spinal anesthesia takes less time to perform and has a quicker onset, provides for intense sensory and motor anesthesia, and may be of less discomfort to the patient, when compared with epidural anesthesia.
5-Epidural anesthesia when compared with spinal-anesthesia has A decreased risk of post dural puncture headache, allow for more controlled over the level of anesthesia and the duration of The anesthesia. It may lead to better control of the associated Hypotension due to its slower onset, and provides for an Indwelling catheter that can be used for acute postoperative Pain management.

## Advantages of Enidural over spinal anaesthesia

1.Epidural anaesthsia can produce a segmental block focused on area of surgery or pain.
2.The gradual onset of sympathetic block allows time to manage associated hypotention.
3.Duration of anaesthesia can be prolonged by using epidural catheter.
4.There is more flexibility in the density of the block.
5.Decreased incidence of headache.

# Spinal anesthesia

Spinal cord is with three meninges. The outer layer is Dura mater and the second layer is arachnoids layer, the space between the Dura mater and arachnoids is called subdural space. The third layer is Pia mater and the space between arachnoids layer and Pia mater is called subarachnoid space which is contain the C.S.F.

The spinal column extended from the base of skull till the level of space between L1,L2, So the level of injection of local anesthetic is in subarachnoid space of intervertebral space between L3-L4 & lower down .

**Spinal anesthesia is perform for operations** of lower abdomen, Inguinal regions, lower extremities, or perineum region , It is injection of local anesthetic into the subarachnoid space , The main effect results from anesthetization of anterior and posterior nerve roots, loss of neural function (autonomic activity, superficial pain, temperature sensation, vibratory position sense, motor power, touch .

## The advantages of spinal anesthesia:

1- It offers retention of consciousness.
2- It offers excellent muscle relaxation, Contracted bowel, And quiet breathing.
3- It is useful in presence of hepatic, renal, or metabolic diseases.
4- Relative decrease in bleeding owing to hypotension.
5- It is useful in husky, muscular patient.
6- It is useful in cesarean section.
7- It is useful in alcoholic and addictive patient.
8- It is preferable when the airways management may be more Difficult.

## Contraindication Of Spinal And Epidural Anaesthesia

**Absolute : ....**

1. Patient refusal.
2. Sepsis with hemodynamic instability.
3. Uncorrected hypovolaemia.
4. Coagulopathy

**Relative contraindications : ....**

1. Elevated intracranial pressure.
2. Prior back injury with neurologic deficit.
3. Progressive neurologic disease, such as multiple sclerosis.
4. Chronic back pain.
5. Localised infection near the site of injection.

Very young patient.

6- Morbid fear and mental aberration.
7- Decrease blood volume and anemia, CVD

**Motor Power Tested By**. Asking The Patient To Dorseflex The Foot(S1,S2), Flex The Toes(L4,Ls), Raise The Knees(L2,L3), Or Tense The Rectus Muscles(T6,T12) By Lifting The Head.

**The structures penetrated** are supraspinous, interspinous ligament, ligamentum flavum and test the Dura depth of 6cm from surface.

## Disadvantages of spinal anesthesia:

**(( Complications , Physiological Effect ))**

- Hypotension due to paralysis of sympathetic nerves system And vasodilatation.
- Bradycardia
- Urenary retention.
- Possible interference with efficient respiratory exchange
- Possible difficult technique.
- Postoperative headache.
- Danger of technique: introduction of infection, injury of Nerve. .
- Postoperative nausea & vomiting.

**on circulation**, it caused hypotension(treated by vasopressor drugs and I.V fluid), it resulted from interruption of preganglionic and postganglionic sympathetic nerve impulses and interruption of baroreceptor reflexes that control the blood pressure.

Also it is due to decrease peripheral vascular resistance and vasodilatation. Bradycardia is resulted from block of Accelerator impulses to heart or decrease endogenous release of norephinephrine from sympathetic nerve ending.

**on respiration**, Paralysis of intercostal muscles doesn't cause respiratory insufficiency. If the root of phrenic nerve are not reached by The anesthetic diaphragmatic action alone should provide adequate ventilation. Patient complain from difficulty of breathing during spinal anesthesia due to lack of proprioception in abdominal and thoracic muscles.

**on bowel and urinary tract**, Intestine being contracted and hyperactive and sphincter relaxed due to unopposed of parasympathetic activity. Morphine and atropine are minimize this action.

## Equipments used for spinal anesthesia:

1- Spinal needle.
2- Syringe of 5CC for local analgesia(local infiltration of skin)at the site of lumber puncture.
3- Syringe for local anesthetic of spinal anesthesia.
4-Ampules of local anesthetic e.g. Lidocain.

5- Sterile towel.
6-Swabs and swab holder.
7- Rubber gloves.
8-Antiseptic solution like Hibitaine.

## Duration of action affected by :

1- type of local anesthetic, Procain(60min), Xylocain(90min), Tetracain(150min).
2- Quantity of local anesthetic.
3- Mixing of local anesthetic with Vasoconstrictor (Epinephrine0.2mg, or phenylepinephrine 1-2mg).

## Factors influencing spread hyperbaric spinal solutions

1.Position of the patient.
2.Spinal curvature.
3.Speed of injection.
4.Barbutage.
5.Interspace chosen.
6.Volume of local anaesthetic.
7.Dose of drug.
8.Sp.gr.of drug.
9.Fixation.

## Technique of spinal anesthesia :

The patient should have a cannula.
The patient takes either lateral or sitting position and the chin touch the knees in order to open the intervertebral space as much as possible.
All the equipment must be sterilized by autoclave.
After dressing the cap and the mask then antiseptic the anesthetic hands and he should wear rubber gloves.
sterilize the back of patient, begin from the area of injection and outside using the swab holder.
A sterile towel draped around the bottom of back
Pointing the area of injection ( space between L3- L4] BY ....

***Feeling The Two Iliac Crests And The Line Connected Between Them Passing Through The Back.***

Sometimes anesthetizing the skin at the area of injection of spinal needle (infiltration).

Puncture the skin( by spinal needle) at the level of space between L3- L4, in Middle line and slightly upward direction. When you pierce the Dura you will feel loss of resistance, then remove the satellite to see the flow of CSF which is mean the success. connect the spinal needle to syringe containing the local anesthetic e.g. Lidocain and inject it. If blood flows with CSF, The spinal needle should be drawn and try again. After three failure of performing spinal anesthesia, you should try another type of anesthesia.

## The care of patient under spinal anesthesia:

### Preoperatively :

It is the same preparation that is required for G.A except the premedication may be heavier like opioid, sedative.

### During the operation :

1- the patient should be comfortable on the operative table .
2-Monitor the vital sign :pulse, blood pressure, adequacy of respiration and encouragement.
3-The surgeon must not describe his operation in audible voice.
4- If there is nausea or vomiting result from fall in blood pressure or surgical manipulation in upper abdominal region, it will be treated by Oxygen supply, plasil and I.V fluid.
5- Test the level of anesthesia, at least during the first 5-10 minutes.
6- Respiratory insufficiency :due to phrenic nerve block, and usually the accessory muscles of respiration is used,treated by Oxygen supply by mask.
7- Hypotension may occur(systolic pressure below 80mmHg), treated by Oxygen supply by mask, I.V fluid infusion, administration of vasoconstrictive drug like Ephedrine 5-10mg I.V or phenylephrine .

### Postoperatively:

1- Avoidance of injury to limbs.
2- Monitoring of vital sign.
3- Prevention of postoperative headache which is due to leakage of CSF from hole in the Dura mater caused by needle. Loss of CSF result in decrease in CSF pressure. Treated by bed rest, analgesia, caffeine and hydration of 3L or more daily either orally or I.V, epidural blood patch.

**Definition**

**Components Of General Anesthesia**

**Route Of Administration Of General Anesthesia**

**Preoperative Evaluation**

- Anesthesia preoperative history and physical examination
- Preoperative laboratory evaluation

**ASA Physical Status Classification**

**Airway Evaluation**

- I.Preoperative evaluation :
- II. Physical examination :
- III. Airway classification
- IV. Predictors of difficult intubation

**Preparation of patient at night of operation**

- Before surgery
- After surgery

**Premedications**

- medication that may be given prior to anesthesia ...
- The goals of premedications
- contraindication
- Premedication Drugs
- Recommendation
- Preoperative Medication Guidelines

**Preoperative Fasting Guidelines**

**Consent**

**Stages of general anesthesia**

**Induction**

**Maintenance**

**(Mendelson`s syndrome)**

**Rapid sequence induction /intubation :**

Anesthesia Preoperative Evaluation .....

The overall goal of the preoperative evaluation is :

- to reduce perioperative morbidity and mortality...
- alleviate patient anxiety..
- you may discover some underlining disease that not discovered by the surgeon
- to reduce the expected complication during and after surgery
- to formulate the anesthetic plan & decide the type of anesthesia to be given

## Anesthesia Preoperative History And Physical Examination

**A.** Note the date and time of the interview, the planned procedure, and a description of any extraordinary circumstances regarding the anesthesia.

**B.** Current medications and allergies: history of steroids, chemotherapy and herb and dietary supplements .

**C.** Cigarette, alcohol, and illicit drug history, including most recent use.

**D.** Anesthetic history, including specific details of any problems.

**E.** Prior surgical procedures and hospitalizations.

**F.** Family history, especially anesthetic problems. Birth and development history .

**G.** Obstetrical history: last menstrual period (females).

**H.** Medical history; evaluation, current treatment, and degree of control.

**I.** Review of systems, including general, cardiac, pulmonary, neurologic, liver, renal, gastrointestinal, endocrine, hematologic, psychiatric.

**J.** History of airway problems (difficult intubation or airway disease, symptoms of temporomandibular joint disease, loose teeth, etc).

**K.** Last oral intake.

**L.** Physical exam, including airway evaluation (see below), current vital signs, height and body weight, baseline mental status, evaluation of heart and lungs, vascular access.

**M.** Over all impression of the complexity of the patient's medical condition, with assignment of ASA Physical Status Class (see below).

**N.** Anesthetic plan (general anesthesia, regional, spinal, MAC) is based on the patient's medical status, the planned operation, and the patient's wishes.

**O.** Documentation that risks and benefits were explained to the patient.

**A. Hemoglobin:**

menstruating females, children <6 months ,sickle cell disease, anemia, blood dyscrasia or malignancy, congenital heart disease, chronic disease states, age greater than 50 years (65 years for males).

**B. WBC count:**

suspected infection or immunosuppression.

**C. Platelet count:**

abnormal bleeding or bruising, liver disease, blood dyscrasias, chemotherapy, hypersplenism.

**D. Coagulation studies:**

abnormal bleeding, anticoagulant drug , liver disease, malabsorption, poor nutrition, vascular operation

**E. Electrolytes, blood glucose, BUN/creatinine:**

renal disease, adrenal or thyroid disorders, diabetes mellitus, diuretic therapy, chemotherapy.

**F. Liver function tests:**

liver disease, hepatitis, alcohol or drug abuse, drug therapy with agents that may affect liver function.

**G. Pregnancy test:**

patients for whom pregnancy might complicate the surgery.

**H. Electrocardiogram:**

age 50 or older, hypertension, cardiac or circulatory disease, diabetes mellitus in a person age 40 .

**I. Chest x-ray:**

asthma or chronic obstructive pulmonary disease , cardiothoracic procedures.

**J. Urinalysis:**

to rule out infection before certain surgical procedures (Genito-urologic procedures ].

**K. Cervical spine flexion/extension x-rays:**

rheumatoid arthritis or Down's syndrome , screening asymptomatic patients is generally not required.

**L . Routine test for viral hepatitis :**

**M. Routine test for AIDS :**

**N. Preoperative pulmonary function tests (PFTs)**

1. for purposes of risk assessment or modification in patients with bronchospastic disease.
2. Candidates for preoperative PFTs

A. Patients considered for pneumonectomy.

B. moderate to severe pulmonary disease scheduled for major abdominal or thoracic surgery.

C. Patients with dyspnea at rest.

D. Patients with chest wall and spinal deformities.

E. Morbidity obese patients.

F. Patients with airway obstructive lesions.

## II ASA Physical Status Classification II

*SCORING SYSTEMS IN ANAESTHESIA ( Fitness Score )*.....

American Society of Anesthesiologists Physical Status Classification

Class Description ..... & ..... " Examples "

**ASA I : ..... Normal Healthy person :**

No organic, physiologic, biochemical ,or psychiatric disturbances Otherwise healthy patient

II Absolute Mortality (0 – 0.3) II

**ASA II : .....Mild To Moderate Systemic Disturbance(S) :**

Controlled Hypertension; well-controlled diabetes; mild obesity ;age < 1 or > 70 years; malignancy without evidence of significant spread or physiologic disturbance

II Absolute Mortality (0.3 – 1.4) II

**ASA III : .....Severe Systemic Disturbance that may or may not be** related to the reason for surgery stable Angina; poorly controlled diabetes; massive obesity; uncontrolled thyroid dysfunction; COPD; chronic renal insufficiency

II Absolute Mortality ( 1.5 – 3.4 ) II

**ASA IV: ..... Severe Systemic Disturbance That Is Life-threatening :**

"Unstable" angina; congestive heart failure; debilitating respiratory disease;mhepatorenal failure II Absolute Mortality ( 7.8 – 23.9 ) II

**ASA V : ..... Moribund Patient Who Has Little Chance Of Survival :**

Septic patient with multiorgan failure; patient in cardiac arrest with major trauma ; ruptured AAA. II Absolute Mortality (9.4 – 57.8 ) II

**ASA VI :..... Brain-Dead Patient For Organ Harvesting"donation" :**

**E** .... the physical status is followed by the letter **E** for Any patient in whom an **E**mergency operation is required ; gunshot wound , GI perforation .

## I.Preoperative evaluation :

assessed by historical interview (ie, history of difficult intubation, sleep apnea) and physical examination and occasionally with radiographs, PFTs, and direct fiber-optic examination. The physical exam is the most important method of detecting and anticipating airway difficulties.

## II. Physical examination :

A. Mouth :

1. Opening: note symmetry and extent of opening (3 finger breadths optimal).
2. Dentition: Ascertain the presence of loose, cracked, or missing teeth; dental prostheses ; and co-existing dental abnormalities.
3. Macroglossia: will increase difficultly of intubation.

B. Neck/Chin :

1. Anterior mandibular space (thyromental distance): the distance between the hyoid bone and the inside of the mentum (mental prominence) or between the notch of the thyroid cartilage to the mentum. An inadequate mandibular space is associated with a hyomental distance of <3 cm or a thyromental distance of <6 cm.
2. Cervical spine mobility (atlanto-occipital joint extension): 35 degrees of extension is normal; limited neck extension (<30 degrees associated with increased difficulty of intubation.
3. Evaluate for presence of a healed or patent tracheostomy stoma; prior surgeries or pathology of the head and neck (laryngeal cancer); presence of a hoarse voice or stridor.

A. Mallampati classification (relates tongue size vs pharyngeal size).

1. **Class 1** : able to visualize the soft palate, fauces, uvula, anterior and posterior tonsillar pillars.
2. **Class 2** : able to visualize the soft palate, fauces, and uvula. The anterior and posterior tonsillar pillars are hidden by the tongue.
3. **Class 3** : only the soft palate and base of uvula are visible.
4. **Class 4** : only the soft palate can be seen (no uvula seen).

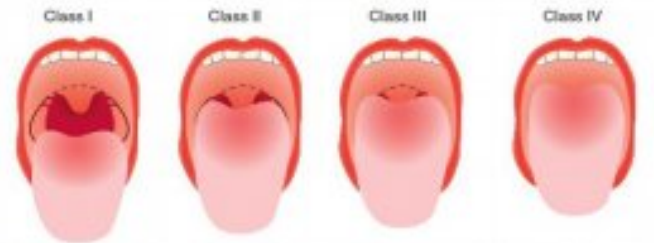



FIGURE 6–3. Classification of pharyngeal structures as proposed by Mallampati and Samsoon. Note: class III—soft palate visible; class IV—soft palate not visible.

B. Laryngoscopic view grades based on **Cormack Rs Lehane J.**

1. Grade 1: full view of the entire glottic opening.
2. Grade 2: posterior portion of the glottic opening is visible.
3. Grade 3: only the epiglottis is visible.
4. Grade 4: only soft palate is visible.

**A. *Anatomic variations:***

micrognathia, prognathism, large tongue, arched palate, short neck, prominent upper incisors, buckteeth, decreased jaw movement, receding mandible or anterior larynx, short stout neck.

***B. Medical conditions associated with difficult intubations :***

***1. Arthritis:*** decreased range of neck mobility & have an increased risk of atlantoaxial subluxation.

***2. Tumors:*** may obstruct the airway or cause extrinsic compression and tracheal deviation.

***3. Infections:*** of any oral structure may obstruct the airway.

***4. Trauma:*** patients are at increased risk for cervical spine injuries, basilar skull fractures, intracranial injuries, and facial bone fractures.

***5. Down's Syndrome:*** patients may have macroglossia, a narrowed cricoid cartilage, and a greater frequency of postoperative airway obstruction/croup; risk of subluxation of the atlanto-occipital joint.

***6. Scleroderma:*** may result in decreased range of motion of temporomandibular joint and narrowing of the oral aperture.

***7. Obesity:*** massive amount of soft tissue about the head and upper trunk can impair mandibular and cervical mobility, increased incidence of sleep apnea.

## II Preparation of patient at night of operation II

### Before surgery :

a. follow the preoperative Fasting guidelines as mentioned previously in details.

b. Ask the patient to bring container to store the Dentures ,artificial teeth , bridges , contact lens ,any prosthesis that should be removed before operation

c. Bladder should be emptied to avoid postoperative retention of urine .

d. Any cosmetics like nail varnish , mascara & lip stick should be removed .

e. Ask the patient to take a bath before the operation .

f. Ask the patient to remove all jewelry & leave it at home

g. Ask the patient to wear loose , comfortable clothing ..

h. You should check the preoperative chart .

i. Lastly the site of operation should be marked .

### After surgery :

**Tell the patient ...**

a. Don't drive or sign important papers until the day following your surgery.

b. Don't operate machinery power tool , or appliances until the day following your surgery.

c. Don't make critical decision until the day following your surgery .

d. Don't drink alcoholic beverages until the day following your surgery .

e. Your surgeon will provide post operative instruction regarding diet , rest ,medication .

## Medication That May Be Given Prior To Anesthesia …

Traditionally all patients received premedication. However now, unless there is a special reason, many patients receive no premedication or only drugs to reduce anxiety , simple analgesia (e.g. paracetamol] and/or a non-particulate antacid.

Premedication with drugs that reduce airway secretions are usually not needed and make patients mouths dry and uncomfortable and premedication with drugs to prevent bradycardia (e.g. atropine] is not usually needed , premedication with narcotic analgesics (e.g. morphine or pethidine ) may make patients drowsy and nauseated .

## The Goals Of Premedications Include:

1) Anxiety Relief ,
2) Sedation ,
3) Analgesia ,
4) Amnesia ,
5) Antisialagogue Effect ,
6) Increase In Gastric Fluid Ph ,
7) Decrease In Gastric Fluid Volume.
8) Attenuation Of Sympathetic Nervous System Reflex Responses ,
9) Decrease In Anesthetic Requirements ,
10) Prevent Bronchospasm ,
11) Prophylaxis Against Allergic Reactions ,
12) And Decrease Post-Op Nausea/Vomiting.
13) To Prevent Parasympathomimetic Effects Of The Anesthetics , I.E. To Prevent salivation,bronchial secretions and dysrhythmias caused by anesthetic agents and airway instrumentation .

Sedatives and analgesics should be reduced or withheld in the elderly, newborn/peds (<1 year of age), debilitated, and acutely intoxicated, as well as those with upper airway obstruction or trauma, central apnea, neurologic deterioration, or severe pulmonary or valvular heart disease.

A Patients should take medications with a small sip of water even if..other.wise..nothing.by.mouth..(NPO).

## Contraindications To The Premedication :



1. Allergy or hypersensitivity to the drug.
2. Upper airway compromise, or respiratory failure.
3. Hemodynamic instability or shock.
4. Decreased level of consciousness or increased intracranial pressure.
5. Severe liver, renal, or thyroid disease.
6. Obstetrical patients.
7. Elderly or debilitated patients.

- **N.B.**
  - Chewing gum does not increase gastric volume & is best treated as for clear fluids.
  - Normal medications can be taken with a sips of water.
  - There is some factors that delayed gastric emptying.

## Premedication Drugs :

***Sedatives***.....To provide relaxation and relieve anxiety.

.. diazepam 0.15 mg/kg orally or I .M
.. midazolam 0.5 mg/kg orally (max of 20 mg)
.. temazepam 0.3 mg/kg orally
.. ketamine 6 mg/kg orally (dissociation)

***Analgesics***... morphine 0.15 mg/kg intramuscularly pethidine 1 mg/kg I. M

***Vagolytic***... To prevent bradycardia especially in children atropine 0.02 mg/kg I. M

***Aspiration prevention***..... To reduce the risk of aspiration pneumonitis

.. metoclopramide 0.2 mg/kg orally
.. ranitidine 150 mg orally
.. sodium citrate 30 ml (0.3 mmol/litre) orally
.. cimetidine 300 mg orally

Dexamethasone , Granisetron , Ondansetron IV ( 4 mg ) ,

**Antisialagogue** To Reduce Secretions Like Atropine , Scopolamine IM, IV (0.3-0.6 Mg ) ,Glycopyrrolate IM, IV (0.2-0.3 Mg ) .

## Recommendation :

Patients who are not in pain and not at increased risk of aspiration receive no premedication or only a sedative . Patients at increased risk of aspiration receive histamine-2 receptor antagonist (e.g. cimetidine or ranitidine orally) one hour preoperatively and a non-particulate antacid before surgery.

There will be some patients that will need special premedication e g. diabetics, asthmatics and those patients taking steroid treatment or anticoagulant treatment.

## Preoperative Medication Guidelines :

### *Discontinue Medication (( 14 days )) Two weeks before the operation :*

a) (MAOI ) Do not stop abruptly, medication may need to be weaned or substituted .
b) Tamoxifen
c) Vitamins/ Nutritional Supplements

### *Discontinue Medication (( 7 days )) before the operation :*

a) Aspirin (or aspirin containing products ),

Clopidogrel (Plavix) must be stopped 5-7 days before surgery.

b) Herbals and nonvitamin supplements .
c) Hormone replacement therapy .

### *Discontinue Medication (( 4 -5 days )) before the operation :*

"Blood thinners" / Antiplatelet "Warfarin (Coumadin) , except for patients having cataract surgery without a bulbar block .

### *Discontinue Medication (( 48 hours )) before the operation :*

Non steroidal anti-inflammatory drugs ((ibuprofen, naproxen, others))
Should be discontinued at least 2 - 5 days before surgical procedure .

### *Discontinue Medication (( 24 hours )) before the operation :*

a) Erectile Dysfunction Medications

b) Cholesterol Lowering Medications Statins (Atorvastatin, Simvastatin, Others)

c) Renal (Phosphate Binders, Renal Vitamins, Iron, Erythropoietin, Others )

### *Discontinue Medication (until 18 hours prior to surgery) :*

a) Diuretics((furosemide, hydrochlorothiazide, others) , except :
triamterene or hydrochlorothiazide for hypertension, which should be continued

b) Insulin —all regular insulins :

- Type 1 diabetics should take a small amount (usually one-third) of their Usual morning long-acting insulin (e.g., lente ) on the day of the operation
- Type 2 diabetics should take none or up to one-half of long-acting or Combination insulins on the day of the operation
- Patients with an insulin pump should continue only their basal rate on the day of the operation

c) Iron .
d) Oral hypoglycemic agents .
e) Topical medications (e.g., creams or ointments) .
f) ACEI .. ( Benazepril , Fosinopil , Perindopril , Ramipril , Lisinopil , Quinapril ) .
G . Angiotensin Receptor Blockers(Candesartan, Valsartan, Losartan , Telmisartan ).

.. Antidepressant .. Antianxiety .. psychiatric medications
.. Antihypertensive medications .
*B - blocker (metoprolol, atenolol, others), * Calcium channel blockers (nifedipine, diltiazem, others)
*Nitrates (nitroglycerin, isosorbide, others), *Alpha-2 agonists (clonidine, others).
Except ( ACEI ) or ( ARBA ) which may be selectively discontinued on the day of the operation.
Anti seizure medications
Cardiac rhythm management medications (digoxin, beta-blockers, quinidine, amiodarone, others).
diuretic such as triamterene or hydrochlorothiazide for hypertension
Oral contraceptives.
Thyroid medications (synthroid, dessicated thyroid, propylthiouracil, others)
Steroids (prednisone, cortef, others)
Gastrointestinal : Gastroesophageal reflux (GERD) medications (ranitidine, omeprazole, others)
Antiemetics (ondansetron, metaclopramide, others) , Heartburn medication
Pulmonary Medications : Asthma medications (theophylline, inhaled steroids, others)
COPD medications (theophylline, ipratropium, inhaled steroids, others)
Pulmonary hypertension medications (sildenafil, prostacyclin, others)
Gynecology/ Urology : Prostate medications (terazosin, tamsulosin, others)
Hormonal medications
Opiate containing analgesics : (vicodin, tylox, methadone, others) .
Central Nervous System Medications :

- **Should be continued until and including the day of the operation :**

Anticonvulsants (phenytoin, tegretol, others)
Antidepressants (imipramine, sertraline, others)
Antianxiety medications (diazepam, lorazepam, others)
Antipsychotics (haloperidol, risperdal, others)
Lithium
Antiparkinson drugs (sinemet, others)

- **Special considerations before the operation :**

✓ Monoamine oxidase inhibitors (very rarely used)
{ Isocarboxazid (Marplan) Selegiline (Emsam) Phenelzine (Nardil) Tranylcypromine (Parnate) }
Do not stop abruptly, check with Primary Care physician about stopping meds, medication may need to be weaned or substituted
Should be discontinued at least 2 full weeks prior to the planned operation
✓ Recreational drugs (marijuana, cocaine, others).....
Should be discontinued as soon as possible prior to any planned elective operation
Endocrine .. .. Insulin :

- All insulin preparations should be taken at the usual dosages for the entire day preceding the operation
- For all patients, discontinue all regular insulins on Day Of Surgery.
- DM 2 take none or up to ½ dose of long-acting or combination (70/30 preparations) insulins on DOS.
- DM 1 diabetics should take a small amount (usually 1/3) of their usual AM long-acting insulin (e.g. lente or NPH) the DOS.
- Patients with an insulin pump should continue their basal rate ONLY.
- Oral Diabetic Medications

Should be taken until the day before the operation, but discontinued the day of the operation . [12]

**Autoimmune Medications :**

- Continue methotrexate on DOS unless risk of acute renal failure
- Discontinue etanercept (Enbrel) 2 weeks prior to surgery
- Discontinue infliximab (Remicade) 6 weeks prior to surgery
- Discontinue adalimumab (Humira) 8 weeks prior to surgery
- Medications for Ulcerative Colitis (Rowasa/Pentasa/Asacol; Sulfasalazine/azulfidine)
- Check with primary care physician to see if you can stop these medications.

## Preoperative Fasting Guidelines

***All patients must fast, if possible, before surgery.***

**Physiology :**

With the onset of anaesthesia , protective airway reflexes are diminished and patients are at risk of regurgitation and inhaling (aspirating) their stomach contents. The aim of fasting is to minimize the risk of aspiration As gastric secretion is continuous At 6 ml/kg/h and 1 ml/kg/h of saliva is swallowed , the stomach is never truly empty.

These volumes and the speed at which the stomach empties food and liquid will change with diseases, emotion, pain and hunger

**Recommendations for Fasting Times For elective surgery (applies to all ages)**

| Ingested Material | Minimum Fasting Period (hrs) |
|---|---|
| Clear liquids | 2 |
| Breast milk | 4 |
| Infant formula | 6 |
| Non-human milk | 6 |
| Light solid foods | 6 |

All patients must be allowed to take most of their usual medications before surgery with 30 ml of water , (Clear liquids) include water, sugar-water, apple juice, non-carbonated soda, pulp-free juices, clear tea ,black coffee.

## Preoperative Assessment OF gastric emptine

The anaesthetist should ask about a history of **the factors that make the ((( Gastric Empting Is Un Predictable & Delayed )))** as in cases of : -

1) Gastrointestinal Motility Disorders(Gastroesophageal Reflux Disease, Dysphagia)
2) Pathological Condition Involve Gastrointestinal Tract Like Hiatus Hernia, Scleroderma, Achalesia Cardia, Esophageal Tumor, Gastric Out Let Obstruction, Intestinal Obstruction ( Cancer), Ileus. (Appendicitis)
3) Metabolic Disorders E.G.(Diabetic Gastroparesis).
4) Pain, Trauma, Anxiety, Hypotension, Shock Due To Sympathetic Over Activity.
5) Patient Receives Opioids (E.G. Morphine) .
6) Physiological Condition Like Pregnancy.
7) Increase Intra Abdominal Pressure; Obesity, Ascitis.
8) Uremia , Alcoholism.

## CONSENT

Consent is an agreement by the patient to undergo aspecific procedure, Although the need for consent is often thought of as applying to surgery, it is in fact required for any breach of a patient's personal integrity, including examination, performing investigations and giving an anaesthetic.

**Touching a patient without consent may lead to a claim of battery, All people aged 16 years and over are presumed, in law, to have the capacity to consent** to treatment unless there is evidence to the contrary.

Suffering from a mental disorder or impairment does not automatically mean lack of competence, Some patients who would normally be considered competent may be temporarily incapable of giving valid consent due to intoxication from drugs or alcohol, severe pain or shock. A decision that appears to be irrational or unjustified should not be taken as evidence that the individual lacks the mental capacity to make that decision.

## Stages of general anesthesia

- **Stage I : Analgesia :**
  Start from beginning of anesthetic administration and last up to loss of consciousness, feels a dream like state, reflexes and respiration remain normal.
- **Stage II : Stage of delirium :**
  From loss of consciousness to beginning of irregular Respiration, Apparent excitement is seen, Muscle tone increases, Jaws are tightly closed, Heart rate and blood pressure may rise.
- **Stage III : Surgical anesthesia :**
  Extends from onset of irregular respiration to cessation of spontaneous breathing, This has been devided into 4 planes :
  - **Plane 1:** This plane ends when eyes become fixed.
  - **Plane 2:** Loss of corneal and laryngeal reflexes.
  - **Plane 3:** Pupil start dilating and light reflexes.
  - **Plane 4:** Dilated pupil, decrease muscle tone, BP falls.
- **Stage IV : Medullary paralysis :**
  Respiratory and vasomotor control ceases.

Delivery Of Anesthetic Drugs ( Inhaled Or Infused ) To Produce A level Of CNS Depression & The Components Of General Anesthesia Include Unconsciousness (Hypnosis) , Analgesia , Muscle Relaxation(Areflexia)

## [[ Induction OF G . A ]]

Means Transition From Awake To The Anesthetized State, The Following May Occur : Hypotension, Arrhythmias, Laryngeal Spasm, Hiccups, Vomiting, Aspiration Of Gastric Contents, Apnoea, Hypoventilation.

(( Inhalation and I.V ]] injection techniques are most commonly used,

**Inhalation Anesthesia** is usually used for children, patient with airway obstruction and in difficult intubation by allowing continuous spontaneous ventilation , May also be used inpatient with poor veins or needle phobia, Anesthetic agent is gradually introduced to patient in increasing concentration e.g (( Sevoflurane 4-6 %. ]], the Inhalation induction is slower than I.V agent, The stage of excitement may be longer ,

**I.V induction** much faster{rapid passage through the stage of excitement} , Usually more pleasant for adult than an inhalation technique. Appropriate dose should be given slowly and the patient observed for its effect before injection more.

**Crush induction ( rapid sequence induction )** used in which risk of regurgitation and aspiration of gastric contents are present e.g. emergency of abdominal surgery ,With checking of anesthetic equipment, suction equipment before induction and emergency drug.

**Aspiration of gastric contents** if it present before induction nasogastric tube left in situ, Use of rapidly action I.V induction agent and suxamethonium to achieve rapid muscle relaxation. , Analgesic or sedative drugs should not precede the I.V agents, Application of **cricoid pressure** as patient loss his consciousness , Avoid manual inflation of lung by face mask to prevent inflation of stomach which will lead to regurgitation. Preoxygenation, therefore , required to prevent hypoxia during apnoea until tracheal intubation is achieved, Tracheal intubation and cuff inflation before released of cricoid pressure.

## [[ Maintenance OF G . A ]]

I.V induction anesthetic agent may also be used for maintenance of anesthesia or at subanesthetic doses as sedative, Most simple short procedures require only spontaneous ventilation under volatile or I.V anesthetic agent and analgesia , ***In complex procedures high doses opioid technique are used.***

***General anesthesia*** ..... may be maintained after I.V induction either by converting to inhalation anesthesia or by continuing I.V administration of induction agent using an infusion device , usually Neonate requires intubation.

# II Mendelson`s syndrome II

**Result of aspiration of regurgitated gastric acid** & Was first described in obstetrical cases by Curtis L. mendelson in 1946 , it Is chemical pneumonitis caused by aspiration of acidic gastric content in patient under general anesthesia & More commonly seen in obstetric , classically , there is a Hx. Of vomiting after inhalational anesthesia , either during the operation or in the early postoperative period.

**Pathology :**

it is a result of aspiration of small volume more than 25 ml with PH less than 2.5 of regurgitated acidic gastric material which may include gastric juice ,blood , bile, water.

**pathogenesis :**

the chemical burn cause an occlusion of the bronchi & bronchioles ,damaging the epithelium typically leading lung edema (ARDS] ,2ry. Bacterial superinfection may also developed .

**Clinical presentation :**

The syndrome develops rapidly ( 2-12 hours after aspiration ) & with in hours the patient may develop dyspnoea , tachypnoea , hypoxia , febrile and on examination Bronchospasm , bronchial hypersecretion ( crepitation will heard all over the chest ] , pulmonary vasoconstriction , cyanosis & Pulmonary edema may develop.

**Investigation :**

Chest X-ray shows soft patch mottling scattered through the lung field but no evidence of lung collapse (snow storm appearance ),CT may depict fleeting infilitrate (which don't last more than 1 or 2 days ],atelectasis & non cardiac lung edema .

**Differential diagnosis :** .... Cardiac failure ... amniotic fluid embolism.... lung mass.

**Treatment & prevention :**

To Prevent further aspiration by tilting head down or turning the patient on one side, Use suction & give O2, tracheal suction may be sufficient in mild cases, where as in other, suction through bronchoscope will be required , Further treatment is supportive; bronchodilator, A.B & physiotherapy , The risk of ***aspiration*** can be reduced by***( fasting)***, emptying the stomach , ***( Mechanical )*** by Wide bore N.G tube, used in special cases like intestinal obstruction . ***(Pharmacological )*** by drugs that affect the volume & increase PH of gastric content ***Anti-acid:*** - e.g. sodium citrate will raise gastric PH above 2.5., ***H2 receptor blockers:*** - e.g. cimetidin , ranitidine, ***Proton pump inhibitor:*** - e.g. omeprazol, ***(drugs that increase Lower Esophageal Sphincter tone*** e.g. metoclopromide which also increase peristalsis of stomach , ***Avoid drugs that decrease LES tone*** e.g. atropine , If the the patient at an increased risk of regurgitation and aspiration then they will need to alter their anaesthetic management (e.g. ***rapid sequence induction*** and intubation of the trachea].

## II Rapid sequence induction /intubation II

intubation in the presence of cricoid pressure (Sellick's maneuver)

RSI is employed in the patient with a full stomach who requires G.A , The concept is loss of consciousness followed by intubation in the presence of cricoid pressure (Sellick's maneuver) , used to minimize the spillage of gastric contents into the pharynx during the period of time from induction of anesthesia (unconsciousness) to successful placement of a cuffed tracheal tube , An assistant's thumb and index finger exert downward pressure on the cricoid cartilage (approximately 5 kg pressure) so as to displace the cartilaginous cricothyroid ring posteriorly and thus compress the esophagus against the underlying cervical vertebrae.

**A. Indications :** patients who are at risk for aspiration (eg, history of recent meal, gastroesophageal reflux, pregnancy, trauma) and there is reasonable certainty that intubation should not be difficult.

**B. Method :**

1. Nonparticulate antacids, H2-blockers and metoclopramide may be used preoperatively to decrease the acidity and volume of gastric secretions.
2. Equipment includes several ETT, with stylet and cuff-inflation syringe in place, laryngoscope blades, functioning suction, and a patent IV..
3. Preoxygenate with 100% oxygen by mask. Four maximal breaths of 100% oxygen over 30 seconds is as effective as breathing 100% oxygen spontaneously for 3-5 minutes.
4. Premedicate as appropriate (fentanyl, atropine, lidocaine, defasiculating agent).

**C. Induction is accomplished with any induction agent.**

Administer a sleep dose of I.V induction agent ( thiopental 2–5 mg/kg, etomidate 0.2–0.3 mg/kg, propofol 1–2 mg/kg) followed immediately by 1.5 mg/kg of suxamethonium , Position the patient's head as if 'sniffing the morning air' ( cervical spine flexed with extension at the craniocervical junction). Just before administration of the induction agent , cricoid pressure ( Sellick's maneuver) should be applied.

**D. Muscle relaxant :**

given to facilitate intubation , Succinylcholine (1-1.5 mg/kg; use 2.0 mg/kg for infants and children) given immediately after the induction agent. Once the induction agent and muscle relaxant are given, there should be no attempt to ventilate the patient by mask.

**E. Intubation :**

should be performed as soon as jaw relaxation has occurred , Cricoid pressure should be maintained until confirmation of tracheal placement of the endotracheal tube , placement of the tube is confired by capnography and auscultation of the lungs , The main problem with rapid sequence induction is haemodynamic instability, Excessive doses of induction agent may result in circulatory collapse (especially if the patient is hypovolaemic), whereas an inadequate dose may result in tachycardia and hypertension, With patients in whom hypertension and tachycardia is undesirable ( e.g. ischaemia /hypertension) , consider alfentanil 10 μg/kg 1 min prior to induction and following preoxygenation , In the event of intubation failure this may be reversed with naloxone (400 μg IV).

The TAP Block is a regional anaesthetic technique used to provide analgesia to the anterior and lateral abdominal wall.

## Indication:

Postoperative analgesia(somatic abdominal wall from the pubis to the level of the umbilicus without neuraxial blockade) for laparotomy, appendectomy, laparoscopic surgery, abdominoplasty, and caesarean delivery as an alternative to epidural anesthesia for operations on the abdominal wall

## Contraindication:

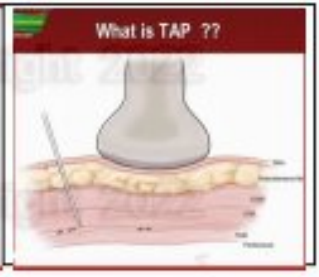
Absolute - Patient refusal, allergy to local anaesthetic, localized infection over injection point
Relative - Coagulopathy, surgery at injection site , Hemorrhagic diathesis, anticoagulation treatment, abdominal wall hernias (particularly lumbar hernia through the "Triangle of Petit" or "Grynfelt's lumbar orifice").

## Anatomy:

Innervations of the anterolateral abdominal wall arise from the anterior rami of spinal nerves T7 to L1. These include the intercostal nerves (T7-T11), , the subcostal nerve (T12), and the iliohypogastric and ilioinguinal nerves (L1).

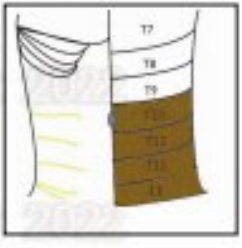
Table 1. The classification of ultrasound-guided TAP blocks and the corresponding supplied areas.

| Approach | The main segmental thoracolumbar nerves [R] | | Supplied area [R] |
|---|---|---|---|
| Subcostal [38–42] | T6–9 | Anterior cutaneous branches | Upper abdomen just below the xiphoid and parallel to the costal margin |
| Lateral [30, 36] | T10–12 | Anterior cutaneous branches | Anterior abdominal wall at the infraumbilical area, from midline to midaxillary line |
| Posterior [30, 42] | T9–12 | Anterior cutaneous branches (possibly lateral cutaneous branches) | Anterior abdominal wall at the infraumbilical area and possibly lateral abdominal wall between costal margin and iliac crest |
| Oblique subcostal [8, 13, 16, 17, 43] | T6–11 | Anterior cutaneous branches | Upper and lower abdomen |




**The Aim Of A TAP Block** is to deposit local anaesthetic in the plane between the internal oblique and transversus abdominis muscles targeting the spinal nerves in this plane. The innervations to abdominal skin, muscles and parietal peritoneum will be interrupted. If surgery traverses the peritoneal cavity, dull visceral pain (from spasm or inflammation following surgical insult) will still be experienced .

The analgesia results in decrease requirement of opioids in the postoperative period resulting in less opioid related side effects. The ability of a single-shot technique to provide significant analgesia for up to 48 hours postoperatively allows prolonged benefit of the decreased opioid consumption facilitating earlier mobilization.




## Preparation:

Full resuscitation equipment, patient monitoring (ECG, pulse oximeter, BP), antiseptic skin preparation and sterile gloves, short bevel block needle or 16-G Tuohy needle, with an extension set, 10 or 20 ml syringes LA – a long acting LA (bupivacaine, Ropivacaine), ultrasound machine - High frequency (6-13MHz) linear array probe with probe cover and sterile gel. An assistant to perform injection of the local anaesthetic (optional)

## Sonoanatomy:

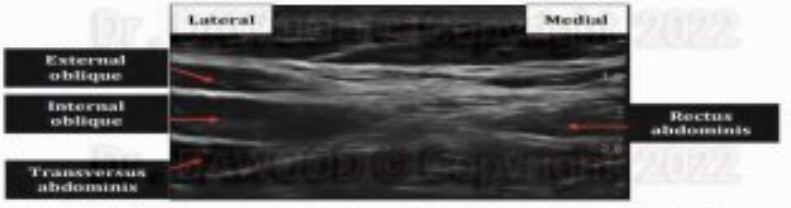
### Ultrasound Guided TAP Block:

**TAP block for lower abdominal incision or the posterior TAP block:**

This approach can reliably be used for lower abdominal incisions. There is a subcostal modification to achieve analgesia for the upper abdomen. USG is recommended due to the benefit of viewing the needle during insertion, thereby ensuring that the needle is placed correctly and that no other structures are injured. It must be emphasized that the needle should be continuously seen during insertion.

### Technique:

With the patient in supine position, the ultrasound transducer is positioned horizontally across the abdominal wall. The muscle layers in the antero-lateral part of the abdomen can be traced by scanning from the midline towards the area between the iliac crest and the costal margin, in the mid-axillary line. The rectus abdominis muscle is identified, just off the midline, as an oval / elliptical structure. The rectus abdominis abuts a fascial plane -linea semilunaris. This fascial plane then gives rise to 3 muscle layers: external oblique, internal oblique and transversus abdominis

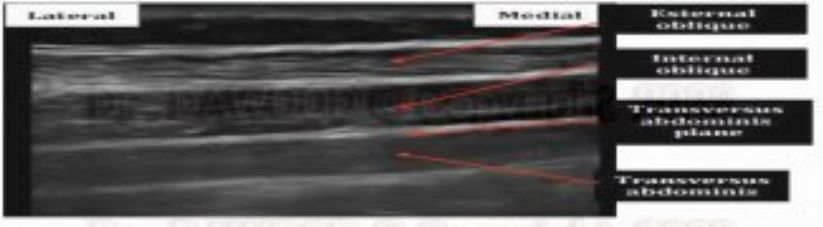



Ultrasound image of the view if probe is place adjacent to the midline to visualise the rectus abdominis muscle medially and the origins of the external oblique, internal oblique and transversus abdominis muscles laterally.

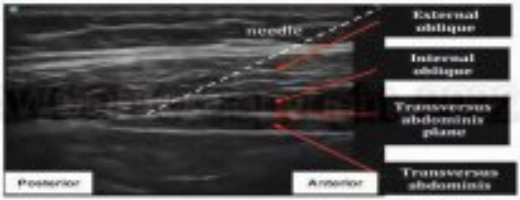
The U/S transducer is moved to scan laterally where the 3 muscle layers can be seen running parallel to one another

At the level of the **lumbar triangle of (( Petit ))** the muscle of the external and internal oblique muscles become fascia prior to insertion into the perilumbar fascia.

The lumbar triangle of Petit is an easily palpable landmark found posterior to the mid-axillary line. The triangle is bounded posteriorly by the lateral edge of the latissimus dorsi muscle, anteriorly by the external oblique muscle, inferiorly by the iliac crest, with the external oblique aponeurosis as the floor.



The U/S transducer is moved more posteriorly, aiming to view the point where the TAM begins to tail off.




Ultrasound image during posterior TAP block. The transversus abdominis muscle can be seen to taper into a fascial line. The approximate needle insertion angle is indicated.

With an adequate ultrasound image, the regional block needle is inserted anterior to the transducer. This allows an in plane view of the needle as you pierce the transversus abdominis plane


Picture showing the ultrasound transducer position and incision needle technique for the posterior TAP block on the right side of the patient.

The local anaesthetic is then slowly injected. If the needle is correctly positioned, the fascial plane is seen to separate and form a well-defined, hypoechoic, elliptical shape between the internal oblique and transversus abdominis muscles. It is essential to watch for the spread of local anaesthetic. If a patchy opacity appears within the muscle either superficial or deep to the transversus abdominis plane, then the needle should be

repositioned until local is seen to spread within the plane, separating the fascia between the muscles. If no local is seen to appear – stop; the needle tip may not be where you think it is, or the local is being injected into a vessel or the peritoneal cavity.

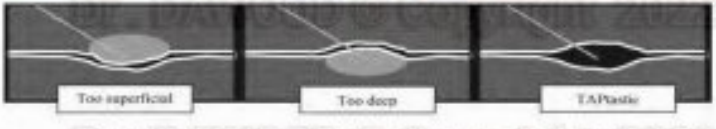



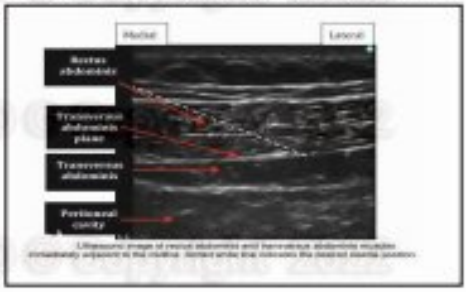

Figure highlighting the optimal needle position during ultrasound-guided TAP block.

## TAP block- the subcostal approach:

The subcostal approach is performed if analgesia of the abdominal wall above the umbilicus is required. It will provide analgesia for areas of the upper abdomen that are not usually adequately covered by the landmark or posterior TAP approaches.

Patient in supine position with the ultrasound transducer placed under the costal margin, close to the midline and the upper portion of the rectus muscle is identified. In the midline of the subcostal region the transversus abdominis muscle can be seen deep to the rectus abdominis muscle, unlike near the umbilicus where it is seen only lateral to the rectus muscle.

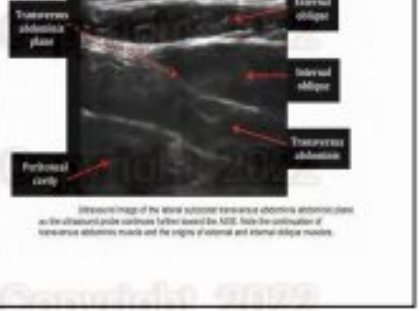

Picture showing the ultrasound transducer position and in-plane needle technique for the oblique subcostal TAP block on the left side of the patient.




Ultrasound image of rectus abdominis and transversus abdominis muscles immediately adjacent to the midline. Dotted white line indicates the needle insertion position.

Insert the needle at the medial end of the transducer to obtain an in-plane view. Use a long regional block needle for a single-shot technique or a Tuohy needle if a catheter is to be placed as for a continuous technique. Once the tip of the needle is placed between the posterior rectus sheath and superficial border of transversus abdominis, inject a small amount of local anaesthetic (after aspiration). The needle should then be cautiously advanced into the space created by the local anaesthetic. Further injection and needle advancement should continue following along an oblique line from the xiphoid process towards the anterior part of the iliac crest. As you scan along this line you reach the lateral border of rectus abdominis. Here you find the origin of the internal and external oblique muscles. The transversus abdominis muscle continues to run deep to the IO muscle


Ultrasound image of the subcostal transversus abdominis plane as you scan laterally from the midline along an oblique line form the xiphoid process towards the anterior superior iliac spine. Note the lateral border of rectus abdominis and the origin of external oblique muscle. (Antonia semilunaris.




Ultrasound image of the lateral subcostal transversus abdominis abdominis plane as the ultrasound probe continues further toward the ASIS. Note the continuation of transversus abdominis muscle and the origins of external and internal oblique muscles.

Up to 20ml of local anaesthetic may be needed to fill the TA plane along this oblique subcostal line. Some recommend using higher volumes of more dilute local anaesthetic. • It should be said that this is an advanced level block, as significant needle-guidance skills are required to safely perform this block.

## Clinical notes

• The operator should stand on the contralateral side to the block site to maintain best control of the needle during the block & An assistant can be used to deliver the LA solution injection.

• This block can be performed safely in anaesthetised patients. In anaesthetized patients, lateral displacement of the lower limbs away from the side to be blocked aids identification of the triangle of Petit and performance of the block by 'stretching' of the fascial layers.

• The use of muscle relaxant decreases the perception of the passage of the needle through the fascial extensions of the external and internal oblique muscles and therefore the block should be performed prior to muscle relaxation to increase the safety profile and the success rate.

• As the needle starts to pass through the fascial extension of both E & I oblique muscles the pressure applied to the needle should be lessened to avoid advancement of the needle into and through the next layer.

This block can easily be performed in awake patients by providing local infiltration to the skin prior to performance of the block. In awake patients palpation of the triangle of Petit and block performance can be aided by asking the patient to raise their head from the bed, and by so doing i tension can be exerted on the fascial extensions of the external and internal oblique muscles.

## Side effects and complications

- **Vascular injection** is possible—inject slowly with repeated aspiration.
- **Peritoneal perforation** if the needle is advanced through the transverses abdominis muscle.
- **Systemic toxicity**

As this block relies on the administration of relatively large volumes of injectate, there is potential for systemic toxicity. Little is known as to the pharmacokinetics of local anesthetic agents injected into the TAP. Care should be taken not to exceed safe maximal doses of agents used (e.g. levobupivacaine 2 mg/kg total dose).

- **Abdominal organ injury**

one report of abdominal organ injury with TAP block in a patient with undiagnosed hepatomegaly. Careful attention to technique and the use of ultrasound guidance may help avoid this potentially serious complication.

- **Localized swelling**

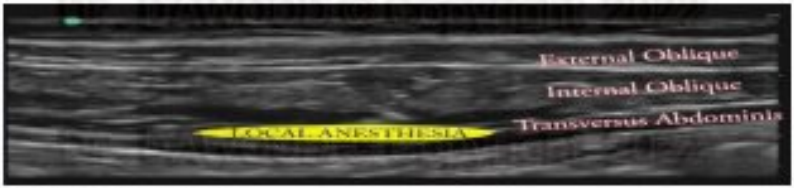
A flank bulge has been described following TAP block, which may simply reflect motor block and relaxation of the abdominal wall muscles.

- **Femoral nerve block**

Transient femoral nerve block is possible and is associated with local anesthetic agent tracking between the transversus abdominis muscle and the transversalis fascia. This space is continuous, with a tissue plane deep to the iliacus fascia which contains the femoral nerve. Ambulatory patients should be examined for femoral nerve block prior to ambulation and home discharge.

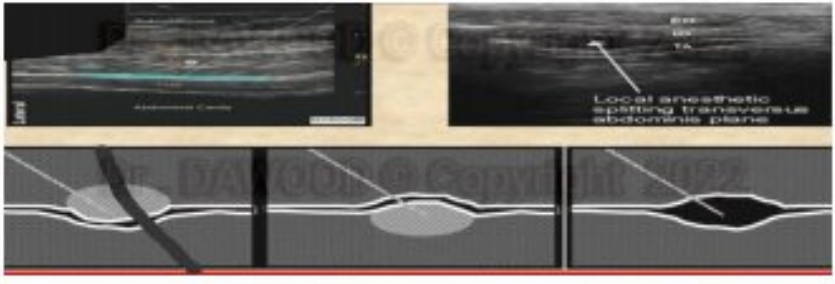
## Key points:

- TAP blocks are adjunctive techniques for analgesia. They do not adequately provide anaesthesia for surgery as it provides no visceral anaesthesia or analgesia.
- Landmark and Posterior USG TAP blocks, if performed correctly, will reliably provide analgesia for operations at or below the umbilicus.
- Oblique Subcostal TAP blocks can be considered for areas above the umbilicus.
- These are fascial plane techniques, and rely on the deposition of large volumes of local anaesthetic to anaesthetise multiple small abdominal wall nerves. Maximum local anaesthetic doses must be calculated to avoid the effects of systemic toxicity.

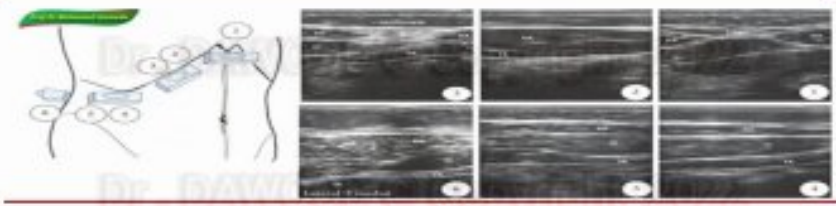



## CLINICAL PEARLS

- Simple and easy to perform
- Provides excellent analgesia following many types of abdominal surgery
- Midline incisions require bilateral blocks
- May be used for rescue analgesia
- An ultrasound- guided transversalis fascia plane block has been described that blocks the lateral cutaneous branches of the subcostal (T12) and iliohypogastric nerves (L1) more successfully than the TAP block.







## Effect Of General Anesthesia on Respiratory System

### A. Effect Of Anesthesia on Lung Volume and Compliance

Induction of anesthesia produces an additional 15-20% reduction in FRC.

### B. Effect on airway resistance

The reduction in FRC associated with general anesthesia would be expected to increase airway resistance. Increased in airway resistance is more commonly due to pathological factors (posterior displacement of the tongue, laryngospasm, bronchoconstriction, or secretion, blood, tumor in the airway) or equipment problems (small tracheal tubes or connectors, malfunction of valves or obstruction of the breathing circuit).

### C. Effect of anesthesia on the control of breathing

The most important effect of the most general anesthetics on the breathing is a tendency to promote hypoventilation as central depression & also depression of diaphragm and External intercostal muscle activity.

### D. Effect of anesthesia on gas exchange

Abnormalities in gas exchange during anesthesia are common, they include increased dead space, hypoventilation, and increased intrapulmonary shunting.

### E. Effect of anesthesia on the work of breathing

Increases in the work of breathing under anesthesia are most often secondary to reduced lung and chest wall compliance and less commonly, increases in airway resistance, The problems of increased work of breathing are usually circumvented by controlled mechanical ventilation.

## Plan Of Anesthetic Technique

Factors Influence the Choice of Anesthetic Technique Include:

- 1. The patient's history of medical problems and diseases.
- 2. Whether the surgery is elective or emergency.
- 3. The site of surgery.
- 4. The body position of patient during surgery.
- 5. The likelihood of the aspiration of gastric contents.
- 6. The age of the patient.
- 7. The patient preference.

Indications of controlled ventilation during anesthesia:

- 1. When NMB is required, often performed when tracheal intubation is indicated.
- 2. Thoracic surgery.
- 3. When ventilation is inadequate.
- 4. To control arterial PCO2.
- 5. To reduce requirement for inhalation agent. e.g., In cardiovascular disease.
- 6. To ensure adequate air entry e.g. in respiratory disease.

Techniques:

- -monitoring is important to ensure adequate ventilation and gas exchange, and to detect disconnection.
- -tracheal intubation is usually employed, but it may be performed via laryngeal mask airway or even face-piece.
- - manual ventilation was formerly used, ventilators are now widespread.
- - a tidal volume of 10 ml/kg, at a rate of 10-12 breath/min, is commonly used, ideally adjusted to arterial PCO2.
- - NMB is usually employed, deep anesthesia using (volatile agents, combined with opioid analgesic drugs).

## Anesthesia for General Surgery

**Requirements for general anesthesia in abdominal surgery:**

1- Unconsciousness, with complete absence of awareness.

2- Prevention of gastric content entering the respiratory Passages.

3- Suppression of reflex response to surgical stimuli.

4- Good relaxation of the anterior abdominal wall.

5- Rapid return of consciousness and of upper respiratory reflex. e.g., of diseases which often need surgery: Appendicitis, intestinal obstruction, gall stone, peptic ulcer, etc.

**Preparations for emergency abdominal surgery:**

1- Fluid and electrolytes balance ( hypovolemia and dehydration ) must be corrected.

2- If there is suspicion that stomach is not empty, nasogastric tube is passed and stomach aspirated, Ptasil , cimetidine drug can be given

3- Crush induction is done to patient to prevent danger of aspiration of gastric content. Including preoxygenation for 3- 5min, giving of I.V induction agent immediately followed by intubation dose of Suxamethonium (Scoline) with application of cricoid pressure as the patient lose his consciousness. Perform tracheal intubation and inflation of the cuff, after that Remove the cricoid pressure and the tube checked for Correct position.

# ANESTHESIA FOR LAPAROSCOPIC AND ABDOMINAL SURGERY

**INTRODUCTION** — The laparoscopic approach has become a standard of care for many abdominal surgical procedures. Compared with laparotomy, laparoscopy can reduce postoperative pain, result in shorter recovery time, allow smaller incisions, and reduce the postoperative stress response. Laparoscopy requires insufflation of intraperitoneal or extraperitoneal gas, usually carbon dioxide ($CO_2$), to create space for visualization and surgical maneuvers.

**SURGICAL TECHNIQUES** — Laparoscopy requires creation of a pneumoperitoneum by insufflation of gas, usually carbon dioxide ($CO_2$), to open space in the abdomen for visualization and allow surgical manipulation. $CO_2$ insufflation can be performed blindly using a Veress needle or by placement of a port under direct vision through a small subumbilical incision. The gas source is connected to the needle or port; intraabdominal pressure (IAP) is monitored as gas is insufflated, aiming for a pressure ≤15 mmHg to minimize physiologic effects. For laparoscopic prostatectomy, which is performed in steep Trendelenburg position, the Surgery recommends IAP below 12 mmHg . After insufflation, a port is placed, and the laparoscope is inserted. Under direct intra-abdominal vision, further instrument ports are placed. The surgeon uses a video monitor connected to the laparoscope to see intraabdominal contents and perform the procedure.

**PREOPERATIVE EVALUATION** — A medical history , anesthesia-directed physical examination & Anticipation of laparoscopy, we focus the preoperative evaluation on those medical conditions that may affect the response to physiologic changes associated with laparoscopy and the surgical procedure, with a range of risks of perioperative cardiac and pulmonary adverse events and surgical complications. As example diagnostic laparoscopy may be a brief procedure with minimal tissue trauma, while laparoscopic radical hysterectomy requires extensive dissection, may take a number of hours, and can result in significant blood loss , the preoperative evaluation for laparoscopic procedures should be equivalent to the open procedure

## PHYSIOLOGIC EFFECTS OF LAPAROSCOPY

**Cardiovascular changes** — The C.V. changes during laparoscopy are variable and dynamic,These effects are generally well tolerated by healthy patients. However, significant intraoperative cardiac dysfunction can occur in older patients and in those with cardiopulmonary disease (eg, congestive heart failure, pulmonary hypertension, valvular heart disease). Studies of hemodynamic events during laparoscopy have been reported an increase in mean arterial pressure (MAP), systemic vascular resistance (SVR), and central venous pressure (CVP), with decreases in cardiac output (CO) and stroke volume (SV) during peritoneal insufflation,Compared with healthy patients, those with cardiopulmonary disease may require more pharmacologic interventions and more intensive monitoring to respond to these changes , C.V. changes during laparoscopy relate to the increase in intra-abdominal pressure (IAP) associated with carbon dioxide ($CO_2$) insufflation, effects of positioning, and of absorption of $CO_2$, as follows:

- **Effects of pneumoperitoneum:** increase in IAP result in neuroendocrine and mechanical effects..

· **Neuroendocrine effects** – Increase in IAP results in catecholamine release and activation of the renin–angiotensin system with vasopressin release,This increases MAP in most patients and may contribute to increases in SVR and pulmonary vascular resistance (PVR) [14].

Vagal stimulation, from insertion of the Veress needle or peritoneal stretch with gas insufflation, can result in bradyarrhythmias. Bradycardia is common in this setting, while atrioventricular dissociation, nodal rhythm, and asystole have been reported.

- **Mechanical effects:** are dynamic; the resulting C.V. effects depend on the patient's preexisting volume status, insufflation pressure, and position. Compression of arterial vasculature with pneumoperitoneum increases SVR and PVR, with variable effects on CO and blood pressure (BP).

  Hypercarbia caused by $CO_2$ absorption may also increase SVR and PVR; in most cases, minute ventilation is increased to prevent hypercarbia, but the required increase in intrathoracic pressure may further increase SVR and PVR.

- **Effects of positioning** – Laparoscopic surgery is often performed in head-up (eg, for cholecystectomy) or head-down (eg, pelvic surgery) positions to allow the intraabdominal organs to fall away from the surgical field. Extremes of position can affect cardiovascular function.

- *Head up* – (ie, reverse Trendelenburg) leads to venous pooling, tends to reduce venous return to the heart and may result in hypotension, especially in patients who are hypovolemic.

- *Head down* – (ie, Trendelenburg) position increases venous return and cardiac filling pressures. A study of the hemodynamic effects of laparoscopic radical prostatectomy with 12 mmHg intra-abdominal pressure and a 45 degree Trendelenburg position CVP, MAP, and pulmonary capillary wedge pressure increased two- to threefold, and mean arterial BP (ABP) increased by 35 percent, without changes in CO, heart rate (HR), or SV. Cardiac filling pressures normalized immediately after surgery.

- **Effects of hypercarbia** – Absorption of $CO_2$ during laparoscopy can have direct and indirect cardiovascular effects. The direct effects associated with acidosis include decreased cardiac contractility, sensitization to arrhythmias, and systemic vasodilation. Indirect effects are the result of sympathetic stimulation, and include tachycardia and vasoconstriction, which may counteract vasodilation.

**Pulmonary changes** — Pneumoperitoneum with $CO_2$ and surgical positioning are associated with changes in pulmonary function and gas exchange .These changes can result from increased IAP with pneumoperitoneum and from absorption of $CO_2$ . During laparoscopy, minute ventilation must be increased to compensate for absorption of $CO_2$ .Hyperventilation may be difficult for patients with (COPD), asthma, and in morbidly obese patients, especially in Trendelenburg position. In patients with COPD and in older patients, end-tidal $CO_2$ ($ETCO_2$) may not accurately reflect arterial partial pressure of $CO_2$; in such patients, arterial blood gases may be required to monitor ventilation.The absorption and elimination of $CO_2$ in the morbidly obese appears to be similar to non-obese patients.Arterial oxygenation decreases and alveolar–arterial oxygen gradient increases in obese anesthetized patients when placed in Trendelenburg position, though $CO_2$ insufflation tends to slightly reverse these effects .

- **Changes in pulmonary mechanics** – Pneumoperitoneum causes cephalad displacement of the diaphragm and mediastinal structures, which reduces functional residual capacity (FRC) and pulmonary compliance, resulting in atelectasis and increased peak airway pressures. These effects are exacerbated with steep Trendelenburg positioning (eg, during pelvic surgery) and are reduced with reverse Trendelenburg positioning (eg, during cholecystectomy and gastric surgery). The changes in pulmonary compliance may be less with retroperitoneal insufflation (eg, during renal or adrenal procedures) compared with intraperitoneal insufflation .

- **CO2 absorption** – $CO_2$ is highly soluble and is rapidly absorbed into the circulation during insufflation for laparoscopy. $CO_2$ absorption increases quickly and reaches a plateau at approximately 60 minutes of insufflation .Ventilation must be increased to maintain normal end-tidal and arterial partial pressure of $CO_2$ Surgical technique may influence the degree of $CO_2$ absorption. Multiple studies have found that subcutaneous emphysema, a possible complication of laparoscopy, is associated with increased absorption of $CO_2$ .Subcutaneous emphysema may be more common during retroperitoneal insufflation of $CO_2$ compared with intraperitoneal insufflation, but it is not clear whether the retroperitoneal approach itself increases $CO_2$ absorption.

- **Ventilation/perfusion matching** – The reduction in FRC and atelectasis associated with laparoscopy may theoretically lead to shunting and ventilation/perfusion mismatch; however, in healthy patients, these effects are minimal and well tolerated, even with steep Trendelenburg positioning .

- **Endotracheal tube** – Pneumoperitoneum and Trendelenburg positioning may cause cephalad movement of the carina, which can result in mainstem endobronchial migration of the ETT, hypoxia and high inspiratory pressure .In addition, ETT cuff pressure increases in some patients during laparoscopy

**Regional circulatory changes**

- **Splanchnic blood flow** – The mechanical and neuroendocrine effects of pneumoperitoneum can decrease splanchnic circulation, resulting in reduced total hepatic blood flow and bowel perfusion, However, hypercapnia can cause direct splanchnic vasodilatation. Thus, the overall effects on splanchnic circulation are not clinically significant .

- **Renal blood flow** – The creation of a pneumoperitoneum results in reduction in renal perfusion and urine output associated with renal parenchymal compression, reduced renal vein flow, and increased levels of vasopressin. When IAP is kept under 15 mmHg, renal function and urine output generally normalize soon after pneumoperitoneum deflation, without histologic evidence of pathologic changes. In most cases, we believe that the benefits of a minimally invasive surgical approach outweigh theoretical concerns about the effect of increased intra-abdominal pressure on renal function.

- **Cerebral blood flow** – Increased intra-abdominal and intrathoracic pressures, hypercarbia, and Trendelenburg positioning can all increase cerebral blood flow (CBF) and intracranial pressure (ICP). In healthy patients undergoing prolonged pneumoperitoneum and steep Trendelenburg position, cerebral oxygenation and cerebral perfusion remain within safe limits. In patients with intracranial mass lesions or significant cerebrovascular disorders (eg, carotid atherosclerosis and cerebral aneurysm), the increase in ICP may have clinical consequences. Therefore, in this patient population, we maintain strict Normocapnia during laparoscopy.

- **Intraocular pressure** – Intraocular pressure (IOP) increases with pneumoperitoneum and increases further when the patient is positioned in Trendelenburg . The clinical implications of this degree of increase are unknown, though increased IOP may play a role in the rarely reported postoperative visual loss in patients with prolonged cases.

## ANESTHETIC MANAGEMENT

In most cases, we perform G.A for laparoscopy & For procedures performed in Trendelenburg position, G.A with endotracheal intubation allows optimal ventilatory control and support. Others use spinal or epidural anesthesia for short procedures in the supine or head-up position (eg, diagnostic laparoscopy, laparoscopic cholecystectomy). A sensory level of T4 to T6 is required for adequate neuraxial anesthesia. Monitoring (eg, blood pressure [BP], electrocardiography, oxygen saturation, capnography, and temperature) are applied prior to laparoscopy. Further monitoring (eg, continuous intraarterial pressure) should be added as required by the patient's medical condition, the expected blood loss, and the duration of surgery. All patients require placement of at least one venous catheter for anesthesia.

**Induction of anesthesia** — A variety of medications and techniques can be used for induction of anesthesia and are chosen based on patient factors. For most adults, intravenous (IV) induction is performed. After induction, the eyes should be closed and covered (ie, with tape or adhesive transparent dressing) to avoid cornea damage. An orogastric tube should be placed and suctioned to decompress the stomach prior to needle or trocher insertion and to minimize stomach injury.

**Choice of airway device** — We place an endotracheal tube for airway management for laparoscopy, rather than a supraglottic airway (SGA), to provide optimal control of ventilation for elimination of carbon dioxide ($CO_2$) and to protect against aspiration. A cuffed endotracheal tube allows the use of positive end expiratory pressure (PEEP) and the high peak airway pressures that may be required during pneumoperitoneum, especially with Trendelenburg positioning.

SGAs are commonly used for airway management for anesthesia and can be used with positive pressure ventilation. The use of SGAs for laparoscopy is controversial. These devices do not fully protect against aspiration of stomach contents and are ordinarily used with lower peak inspiratory pressures.

**Positioning** — Laparoscopy is often performed in extreme head-up (ie, reverse Trendelenburg) (eg, for cholecystectomy or gastric surgery) or head-down (ie, Trendelenburg) (eg, pelvic surgery) positions to allow the intraabdominal organs to fall away from the surgical field. In addition, any of the positions used for open procedures may be required (ie, lithotomy, lateral decubitus, operating room [OR] table flexion or rotation). The arms are often tucked at the patient's sides for laparoscopic and robotic surgery. As for all longer surgical procedures, a goal for positioning and padding is the prevention of injuries to peripheral nerves and bony prominences. Pressure points should be padded, as should the plastic connectors on IV tubing and monitoring devices. Positioning devices are often used to avoid having the patient slide on the operating table with steep Trendelenburg or reverse Trendelenburg positioning. A foot support attached to the end of the operating table is used for laparoscopic cholecystectomy and other procedures that require reverse Trendelenburg positioning. Non-slip padding, cross-body taping, and padded shoulder supports are options for steep Trendelenburg positioning. We use nonslip padding with cross-body taping (ie, tape attached to the operating table from over the shoulder to near the opposite hip). We test for sliding with

maxima Trendelenburg positioning prior to surgical prep and drape and confirm that taping does not restrict chest excursion or affect ventilation.

Maintenance of anesthesia

Use of nitrous oxide — As for open abdominal procedures, various inhalation and IV anesthetics can be used for maintenance of general anesthesia for laparoscopy.

The use of nitrous oxide ($N_2O$) for maintenance during laparoscopy is controversial.Concerns regarding the use of $N_2O$ for laparoscopy include an increase in PONV and bowel distention.

- PONV – Findings from studies have been inconsistent, with some showing an increase in PONV with $N_2O$ and others not .
- Bowel distention – $N_2O$ diffuses into air-containing closed spaces over time and can lead to bowel distention, which can theoretically impair surgical exposure and dissection. Based on small studies, $N_2O$ does not appear to affect operating conditions during relatively short procedures.

  Bowel distention with laparoscopy may be a more significant concern during longer procedures since diffusion of $N_2O$ into gas-filled spaces increases over time. In a surgeon-blinded study of approximately 350 patients who underwent colon surgery lasting 3 to 3.5 hours, surgeons were asked to rate intraoperative bowel distention at the end of surgery .Moderate or severe bowel distention occurred more than twice as often when $N_2O$ was administered compared with air (23 percent versus 9 percent), but there was no reported bowel distention in the majority of cases in both groups.

Neuromuscular blockade — Neuromuscular blocking agents (NMBAs) are administered during abdominal surgery to facilitate endotracheal intubation and to improve surgical conditions. At the end of surgery, neuromuscular blockade is reversed either by metabolism and excretion of the NMBA or by administration of reversal medication. The speed of reversal with neostigmine depends on the degree of block; if deep block is maintained until the end of the procedure, reversal may not be complete after the brief wound closure of most laparoscopic procedures, and emergence and extubation may be delayed. We administer NMBAs as required by the clinical situation, aiming for the least degree of block necessary for the clinical situation. The need for neuromuscular blockade may depend on the surgical procedure, positioning, and the patient's body habitus. As examples, exposure during laparoscopic cholecystectomy in a lean patient may be adequate with minimal neuromuscular block, while laparoscopic deep-pelvic surgery may require relatively deep block to optimize surgical conditions..

Mechanical ventilation — The dynamic changes in pulmonary function during laparoscopy require intraoperative adjustment of mechanical ventilation.

Modes of ventilation — We follow a lung-protective intraoperative ventilatory strategy, using a tidal volume of 6 to 8 mL/kg ideal body weight and 5 to 10 cm$H_2O$ PEEP. Such a strategy may reduce postoperative pulmonary complications and improve oxygenation during laparoscopy. We prefer to increase the respiratory rate, rather than the tidal volume, to increase minute ventilation and compensate for $CO_2$ absorption while avoiding barotrauma.Various modes of ventilation have been used in an attempt to reduce peak inspiratory pressure during laparoscopy. While pressure support ventilation may reduce the chance of high inspiratory pressure compared with volume control, changes in intra-abdominal pressure (IAP) during surgery can result in varied minute ventilation with pressure control settings. Pressure support with volume guarantee, where available, can be used to limit peak airway pressure while maintaining constant ventilation.We accept mild hypercapnia (ie, end-tidal $CO_2$ [$ETCO_2$] approximately 40 mmHg) if necessary to maintain, peak airway pressures under 50 cm$H_2O$ in order to avoid barotrauma. In addition, mild hypercarbia can improve tissue oxygenation by increasing cardiac output (CO) and vasodilation, and a shift to the right of the oxyhemoglobin dissociation curve. Increasing the inspiratory to expiratory (I:E) ratio may be beneficial in steep Trendelenburg position during laparoscopy.

Our strategy for ventilation — We ventilate with a starting fraction of inspired oxygen ($FiO_2$) of 0.5, tidal volume of 6 to 8 mL/kg ideal body weight, and with PEEP of 5 to 10 cm$H_2O$, at a respiratory rate of 8 breaths/minute, adjusted to maintain $ETCO_2$ at approximately 40 mmHg and oxygen saturation ($SaO_2$) >90 percent.

For patients who develop the following complications, we modify ventilation during laparoscopy as follows:

- For peak pressures over 50 mmHg, we ventilate with pressure control with volume guarantee. If peak pressure remains over 50 mmHg, we set the I:E ratio at 1:1.
- For hypoxia (ie, $SaO_2$ <90 percent), we auscultate breath sounds bilaterally to rule out bronchospasm and endobronchial intubation. We increase the $FiO_2$ and perform a recruitment maneuver (maintain peak airway pressures at 30 $cmH_2O$ for 20 to 30 seconds if arterial EPs [AEPs] permit); if oxygenation improves, we increase PEEP values and perform periodic recruitment maneuvers (eg, every 30 min.).
- If hypoxemia and/or high peak airway pressures persist, for patients in Trendelenburg position, we reduce the degree of tilt and/or reduce the insufflation pressure (eg, from 15 to 12 mmHg).
- For hypercarbia (ie, $ETCO_2$ >50 mmHg) despite hyperventilation, we examine for signs of subcutaneous emphysema.
- If hypercarbia and/or hypoxia persist, we discuss conversion to open surgery.

Fluid management — Restrictive fluid therapy with avoidance of fluid excess improves outcome after major gastrointestinal surgery, with avoidance of bowel edema and interstitial fluid accumulation.

Nausea and vomiting prophylaxis — Laparoscopy has been identified as a risk factor for PONV. Although risk-based approaches for antiemetic therapy have been proposed, the compliance with these strategies is poor. Therefore, routine prophylactic multimodal antiemetic therapy should be utilized in all patients undergoing laparoscopic surgery. The number of antiemetic combinations can be based on the patient's level of risk. Our approach to antiemetic prophylaxis in this setting is as follows:

- All patients – We administer dexamethasone (4 to 8 mg IV after induction) and 5-$HT_3$ antagonists (eg, ondansetron 4 mg at the end of surgical procedure).
- High-risk patients – For patients at very high risk of PONV (eg, history of motion sickness, history of previous PONV, high opioid requirements for pain relief), we administer additional antiemetic therapy with preoperative transdermal scopolamine or a neurokinin$_1$ ($NK_1$) antagonist. In addition we use total IV anesthesia (TIVA) with propofol.
- Rescue therapy – For rescue therapy in the immediate postoperative period, we administer low-dose promethazine (6.25 mg IV, slowly) or dimenhydrinate (1 mg/kg IV).

Plan for postoperative pain management — The origins of pain after laparoscopic procedures may be both somatic (ie, from port-site incisions) and visceral (ie, from peritoneal stretch and manipulation of abdominal tissues). The degree of pain after laparoscopic and robotic surgery is usually low to moderate and is less than the corresponding open procedure, but the degree of pain depends on the specific surgery. For example, laparoscopic nephrectomy can result in pain that requires parenteral opioids in the absence of regional analgesia. We follow a procedure-specific, multimodal approach to the management of postoperative pain, starting prior to and continuing in the OR. We aim to minimize postoperative administration of opioids. Pain after laparoscopy can often be managed effectively with acetaminophen, nonsteroidal antiinflammatory drugs (NSAIDs) or cyclooxygenase$_2$ ($COX_2$)-specific inhibitors, and dexamethasone. We routinely infiltrate the incisions with local anesthetic (LA) at the time of wound closure. In the postoperative period, if necessary, low- to moderate-intensity pain may be treated with weak opioids (eg, tramadol), and moderate- to high-intensity pain may be treated with strong opioids (eg, hydrocodone and oxycodone). For hybrid or laparoscopy-assisted surgical procedures with longer incisions, regional analgesia with a transversus abdominis plane (TAP) block may be beneficial. For most laparoscopic and robotic surgical procedures, neuraxial analgesia (ie, epidural analgesia and intrathecal morphine) is unnecessary and may not be beneficial. Intraperitoneal instillation of LAs (eg, bupivacaine and ropivacaine) may reduce the intensity of postlaparoscopic pain, but the concentration and dose of the LA, as well as optimal timing of administration, remain unknown. Management of postoperative pain is discussed in more depth separately.

INTRAOPERATIVE COMPLICATIONS — Complications during laparoscopy include those related to the physiologic effects of the laparoscopic approach (eg, hemodynamic compromise, respiratory decompensation), surgical maneuvers (eg, access-related injury; vascular, solid-organ, or bowel

injury; carbon dioxide [$CO_2$] spread to subcutaneous and intrathoracic spaces; gas embolism), and patient positioning. **Hemodynamic complications** — Hypotension, hypertension, and arrhythmias can occur during laparoscopy as a result of the physiologic effects of the technique.

- *During insufflation* – Surgical injury during abdominal access (eg, gas embolism, vascular or solid organ injury with hemorrhage) can cause rapid cardiovascular decompensation. Initial abdominal insufflation is a time for hypervigilance with regard to blood pressure (BP), heart rate (HR), peak inspiratory pressures,and tidal $CO_2$ ($ETCO_2$), and oxygen saturation. Changes in vital signs should be immediately discussed with the surgeon to allow reevaluation of the position of the needle or port and possible release of the pneumoperitoneum . Treatment of hemodynamic dysfunction includes confirmation that intraabdominal pressure (IAP) is within acceptable limits; exclusion of treatable causes; and supportive therapy including reduction in anesthetics, fluid administration, and pharmacologic interventions. If supportive therapy is ineffective, deflation of the abdomen may be necessary. After cardiopulmonary stabilization, cautious, slow re-insufflation may then be attempted using lower IAP. However, with persistent signs of significant cardiopulmonary impairment, it may be necessary to convert to an open procedure.

- *During surgery* – During surgery, hemodynamic instability can occur for a variety of reasons and may be more likely in patients with cardiac comorbidities.

  - Hemorrhage – Hemorrhage may be less obvious during laparoscopic procedures because of the limited and focused surgical field. Unexplained hypotension should be discussed with the surgeon.

  - Hyperventilation – When ventilation is increased to compensate for $CO_2$ absorption, venous return to the heart may be compromised and result in hypotension, especially with the use of (PEEP). Fluid administration and/or change in ventilatory settings may improve BP.

  - Positioning – Head-up positioning can cause venous pooling and reduced venous return to the heart. Vasopressor administration (eg, phenylephrine) and/or fluid administration may be required.

**Pulmonary complications** — Pulmonary complications during laparoscopy, including hypercarbia and hypoxemia, can relate to the physiologic effects (eg, altered respiratory mechanics, $CO_2$ absorption, ventilation perfusion mismatch) or surgical injury (eg, diaphragm or lung injury).

- *Hypercarbia* – It may be necessary to increase ventilation during laparoscopy to compensate for $CO_2$ absorption. When hypercarbia or an increase in $ETCO_2$ occurs despite increase in ventilation, causes for increased absorption or decreased elimination of $CO_2$ should be considered, including both those that may occur during any anesthetic and those specific to laparoscopy.

  When severe hypercarbia occurs during laparoscopy, the patient should be examined for signs of subcutaneous emphysema (ie, crepitus over the abdomen, chest, clavicles and neck).

  When high $ETCO_2$ persists despite aggressive hyperventilation (eg, peak airway pressures >50 $cmH_2O$), reduced insufflation pressure or conversion to open surgery may be required.

- *Hypoxia* – Oxygen desaturation can occur during laparoscopy as a result of the physiologic changes of the technique, surgical positioning, or for reasons that hypoxia can occur during any anesthetic.

  The chest should be auscultated for the quality and presence of bilateral breath sounds to rule out bronchospasm and endobronchial intubation. Initial treatment includes an increase in inspired oxygen concentration. Unless the patient is hypotensive, a recruitment maneuver should be performed (ie, manual breath with plateau pressure 30 $cmH_2O$, held for 20 to 30 seconds duration, if BP permits), and PEEP should be optimized. If refractory hypoxemia occurs, the pneumoperitoneum should be released.

**Subcutaneous emphysema** — Subcutaneous emphysema can occur during laparoscopy when $CO_2$ is insufflated into subcutaneous tissues. This can occur during intraperitoneal insufflation with an improperly placed Veress needle or trocar, during extraperitoneal laparoscopy (eg, renal surgery), or during upper abdominal laparoscopy (eg, Nissen fundoplication).In rare cases, gas can track into the thorax and mediastinum, thereby resulting in capnothorax, capnomediastinum,

and capnopericardium.The following have been identified as risk factors for subcutaneous emphysema during laparoscopy:

- Surgery lasting longer than 200 minutes
- The use of six or more surgical ports
- Patient age >65
- Nissen fundoplication surgery

Multiple studies have found that subcutaneous emphysema is associated with increased absorption of $CO_2$. When hypercarbia occurs despite hyperventilation, the patient should be examined for signs of subcutaneous gas over the abdomen, chest, and neck. If crepitus or swelling is found, the surgeon should be notified; readjustment of ports, reduction of insufflation pressure, or conversion to open surgery may be required.

In most cases, subcutaneous emphysema resolves after the abdomen is deflated, and no specific intervention is required. When crepitus or swelling occurs in the head, neck, or upper chest, the potential for airway compromise after extubation is increased, especially for patients who may be edematous after prolonged procedures in Trendelenburg position. In most cases, subcutaneous $CO_2$ is superficial and does not compromise the airway lumen. When extensive swelling is severe, options include the following:

- Laryngoscopy to assess airway edema while the patient is anesthetized.
- Extubation over a tube changer.
- Delayed extubation for several hours, with the patient positioned head-up, to allow resorption of $CO_2$.

Absorption of $CO_2$ from subcutaneous emphysema may continue for up to several hours after surgery. Healthy patients are able to increase ventilation to eliminate $CO_2$, but those with chronic lung disease or with opioid-induced respiratory depression can remain hypercarbic and acidotic early in the postoperative period. Somnolence, hypertension, and tachycardia may occur.

For symptomatic patients with subcutaneous emphysema of the head and neck region, a postoperative chest radiograph should be performed to rule out capnothorax. Patients with significant subcutaneous emphysema should be observed in the post-anesthesia care unit (PACU) for several hours, until swelling begins to subside and vital signs are normal.

**Capnothorax — Capnothorax**, although rare, can be potentially life-threatening.Capnothorax should be suspected in the setting of an unexplained increase in airway pressure, hypoxemia, and hypercapnia, especially during Nissen fundoplication. Other signs suggestive of capnothorax include subcutaneous emphysema of the head and neck, inequality in chest expansion, reduced air entry, and a bulging diaphragm (visualized by directing the videoscope towards the diaphragm) .If necessary, a chest radiograph or transthoracic ultrasound can confirm the diagnosis of capno- or pneumothorax.In this setting, treatment depends on the patient's hemodynamic and respiratory status and the stage of the surgery. If stable, reduction of insufflation pressure, hyperventilation, and increase in PEEP may be sufficient; $CO_2$ is resorbed quickly after even large capnothorax. In one reported case of near total capnothorax during Nissen fundoplication, the gas resorbed within one hour postoperatively, with no specific treatment. However, hemodynamic compromise can occur, requiring placement of an intrathoracic needle or a chest tube for decompression and to allow completion of surgery.If tension capnothorax persists despite these measures, conversion to open surgery may be required.

**Capnomediastinum and capnopericardium** — Capnomediastinum and capnopericardium, although rare, can be associated with significant hemodynamic compromise. Risk factors for these complications are similar to the risk factors for capnothorax. The diagnosis is made by chest radiograph (ie, air is visible in the mediastinum or pericardium). Management depends on the degree of hemodynamic compromise. In most patients, deflation of the pneumoperitoneum and close observation is adequate, while others might require supportive therapy along with hyperventilation.

**Gas embolism** — Venous gas embolism is extremely common during laparoscopy, though clinically significant emboli are rare. Studies using transesophageal echocardiography (TEE) during laparoscopic surgery have reported an incidence of subclinical gas embolism between 17 and 100 percent [100-103].

In this setting, gas embolism can occur via two mechanisms. Rarely, direct venous injection of $CO_2$ with the Veress needle can result in rapid, high-volume $CO_2$ embolism at the time of abdominal insufflation. Alternatively, $CO_2$ entrainment is possible if a vein is severed or disrupted during surgery, allowing the gas under pressure access to the circulation.

Signs of gas embolism include unexplained hypotension, abrupt reduction of $E'CO_2$, hypoxemia, and arrhythmias. The electrocardiogram (ECG) may show right heart strain with a widened QRS complex.

Paradoxical embolism through a patent foramen ovale (PFO) or atrial septal defect (ASD) can occur, with cerebral or coronary ischemia.

If gas embolism is suspected, the abdomen should be deflated to reduce $CO_2$ entrainment, and ventilation should be increased to reduce the size of $CO_2$ bubbles, though hyperventilation may worsen hypotension.Since gas embolism results from a vascular injury, hemorrhage is possible when the intra-abdominal pressure is reduced. Therefore, re-insufflation or open surgery may be required to stop hemorrhage if hemodynamic instability persists.

Treatment is otherwise supportive, with fluid and vasopressor administration and, if necessary, cardiopulmonary resuscitation. The left-lateral, head-down position may allow the gas bubble to float to the apex of the right heart, away from the pulmonary artery.

**Complications from surgical instrumentation** —include vascular and abdominal organ injury, both of which can result in significant hemorrhage. Up to half of serious surgical complications occur during placement of the Veress needle or an access port.Therefore, significant injury and major hemorrhage can occur even during relatively low-risk procedures (eg, diagnostic laparoscopy, laparoscopic appendectomy). In this setting, surgical access to a bleeding vessel or organ may take time; BP should be supported with IV fluid and vasopressor administration, as necessary.

Signs of hypovolemia (ie, hypotension, tachycardia) may suggest occult bleeding.

**Complications related to positioning** — Prolonged steep Trendelenburg positioning can cause conjunctival, nasal, and laryngopharyngeal edema and may result in increased upper airway resistance and, rarely, postextubation laryngospasm and airway obstruction.

Both minor (ie, corneal abrasion) and significant (ie, ischemic optic neuropathy) ocular injuries have been reported after laparoscopy performed in steep Trendelenburg position. Postoperative visual loss and ocular injury are discussed in more detail separately.

As for other long surgical procedures, patients who undergo prolonged laparoscopy are at risk for position- related nerve injury and even compartment syndrome ,Pressure points, plastic tubing connectors, monitoring cables, and leg supports for lithotomy positioning should all be padded. With steep Trendelenburg positioning, the arms should be positioned without caudad pull on the shoulders in order to reduce the chance of brachial plexus stretch injury.Shoulder braces may be used to prevent sliding during Trendelenburg positioning; their use has been associated with brachial plexus injury in this setting, though the incidence is unknown.

# Pregnancy: Physiological Changes And Anemia

## What cardiovascular changes occur during pregnancy?

Cardiovascular changes begin as early as from 4th week of gestation and these occur to maximize oxygen transport to placenta. These changes are caused by increased levels of circulating estrogen and progesterone, which cause vasodilatation and a consequent fall in peripheral vascular resistance by 20%. This causes a fall in systolic and diastolic blood pressure and a reflex increase in heart rate by 15%. Stroke volume is increased by 25% and together with heart rate causes an increase of cardiac output by 50% by the third trimester. Myocardial thickness as well as volume of chambers increases resulting in left heart enlargement. Flow murmurs are quite common due to increased plasma volume and cardiac output. Cardiac output may further increase during labor and in immediate post-delivery period on account of auto transfusion. The increased blood volume serves two purposes: First, it facilitates maternal and fetal exchange of respiratory gases, nutrients and metabolites. Second, it reduces the impact of maternal blood loss at delivery. Anatomically, the heart is displaced upward and to the left by the gravid uterus.

## What are the implications of these changes?

### *Clinical Implications*

- In pregnant patient with heart disease and low cardiac reserve, the increase in the work of the heart may cause [illegible]. In these women further increase in cardiac workload during labor must be prevented by effective pain relief, provided by extradural analgesia. Since cardiac output is highest in the immediate postpartum period, sympathetic blockade should be maintained for few hours after delivery and then weaned effectively
- Heart size and displacement: The ECG reflects these changes including left axis deviation, ST segment depression and T wave flattening

## What is aortocaval compression? What is its significance *(Clinical Implications)*

From mid-pregnancy, the enlarged uterus compresses both the inferior vena cava and the lower aorta when the patient lies supine. Obstruction of the inferior vena cava reduces venous return to the heart leading to a fall in cardiac output by as much as 20% towards term. When awake most women are capable of compensating for the resultant decrease in stroke volume by increasing systemic vascular resistance and heart rate. There are also alternative venous pathways: the paravertebral and azygos systems. During anesthesia, however, these compensatory mechanisms are reduced or abolished so that significant hypotension may develop rapidly. Obstruction of the lower aorta and its branches causes diminished blood flow to: kidneys, uteroplacental unit and lower extremities.

### *Clinical Implications*

No woman in late pregnancy or labor should lie supine without shifting the uterus off the great abdominal pelvic vessels. During cesarean section and for other indications demanding the supine position, the uterus should be displaced, usually to the left, by placing a rigid wedge under the right hip and/or tilting the table left side down. During regional anesthesia, the effects of aortocaval compression will be exaggerated due to a lack of compensatory reflexes subsequent to the sympathetic blockade. This can lead to profound hypotension. In extreme hypotension (or fetal compromise such as a bradycardia), the patient can be turned to the full left lateral position. Engorgement of veins in the epidural space due to caval compression results in a reduction in volume of the epidural and subarachnoid spaces and reduced volumes are required to produce adequate levels of block.

## What respiratory system changes occur during pregnancy? What is their significance to the anesthetist?

these changes to meet the increased requirement of oxygen as the oxygen consumption nearly doubles at term. There is an increase in the respiratory rate as well as the tidal volume. This also results in low PaCO2 and higher PaO2. There is reduction in FRC. Chest wall compliance and lung compliance decrease by about 15-30%. Anatomical dead space may decrease due to airway edema especially in patients with PIH.

### *Clinical Implications*

Pregnant patients are more prone to hypoxia. Increased oxygen consumption and the decreased reserve due to the reduced functional residual capacity may result in rapid fall in arterial oxygen tension despite careful maternal positioning. This is more marked in obese patients and with multiple pregnancies. Further the reduced functional residual capacity causes airway closure in 50% of parturients at term in the supine position making preoxygenation less effective. Preoxygenation is essential to prevent rapid desaturation during periods of apnea. Rapid induction with inhalation agents: The increased minute ventilation combined with decreased functional residual capacity hastens inhalation induction or changes

in depth of anaesthesia. This is due to increased tidal volume, which results in large volume of inspired gas mixing with smaller volume of alveolar gas. Reduced compliance necessitates higher airway pressures to maintain adequate ventilation.

**Why is pregnancy considered to be a "full stomach" patient?**

Heartburn during pregnancy is very common and as many as 80% suffer from reflux at term, which is aggravated by the supine position. The gastrointestinal system is considered to return to normal 24–48 hours after delivery. The effect of progesterone results in reduction of lower oesophageal sphincter pressure. Later in pregnancy the mechanical effects of gravid uterus cause an increase in intragastric pressure and a decrease in gastrooesophageal angle. Placental gastrin secretion is increased, which worsens gastric acidity. All these changes put the mother at increased risk of regurgitation and aspiration of gastric contents.

Prevention: Prophylaxis in the form of a H2 blocking drug, non-particulate sodium citrate and metoclopramide to all pregnant patients for surgery from 2nd trimester onwards is a must. The danger of aspiration is almost eliminated when regional anaesthesia is used. During general anaesthesia airway protection by means of a cuffed endotracheal tube is mandatory, as is rapid sequence induction from 2nd trimester of pregnancy till 48 hours post partum. Extubation should be done with the patient awake and on their side to reduce the risk of aspiration of gastric contents.

**What are the haematological and coagulation changes seen in pregnancy?**

During pregnancy the plasma volume increases by 45%. This increase is mediated by a direct action of progesterone and estrogen on the kidney causing the release of renin and thus an activation of the aldosterone-renin-angiotensin axis. This leads to renal sodium retention and an increase in total body water. Through an increase in renal erythropoietin production, red cell mass increases by 20%. As the increase in red cell mass is relatively smaller than that of plasma volume, the haemoglobin falls from 14 g/dl, pre-pregnancy to 12 g/dl, during the third trimester. The blood viscosity is reduced, which may slightly decrease cardiac work. At 2-weeks post-partum, the blood volume returns to pre-pregnancy levels. The white cell count rises throughout pregnancy and peaks after delivery. Pregnancy is a hypercoagulable state. Plasma concentrations of fibrinogen and all clotting factors, except XI and XIII, gradually increase. Although there is an increase in platelet production, the platelet count falls because of increased platelet activity and consumption. Platelet function remains normal in pregnancy.

***Clinical Implications***

1. The increased circulating volume offers protection for mother and fetus from the effects of hemorrhage at delivery.
2. Raised WBC count makes a diagnosis of infection more difficult. There is also an increase in ESR.
3. Thromboembolic complications remain a common source of morbidity and mortality associated with pregnancy.
4. In pre-eclampsia there is an increase in thromboxane A2 produced by platelets, which causes vasoconstriction and decreases uteroplacental blood flow.

**Why is failed intubation more common during pregnancy?**

During pregnancy, there is capillary engorgement and edema of the upper airway down to the pharynx, false cords, glottis and arytenoids. Edema of the airway makes upper airway obstruction and bleeding more likely and may make tracheal intubation more difficult.

The increase in chest diameter and enlarged breasts can make laryngoscopy with a standard Macintosh blade difficult. Failure to intubate the trachea is 7 times more common in the term parturient compared to nonpregnant patients. Anticipate difficult intubation and a need for a range of different ETT sizes. Also airway adjuncts should be readily available. A smaller diameter endotracheal tube may be required for intubation especially in cases of pre-eclampsia.

**Which other systems are affected during pregnancy and what are the implications?**

Renal: Renal plasma flow and glomerular filtration rate increase (about 50%) during pregnancy. Blood urea and serum creatinine are reduced by 40%. 24 hours creatinine clearance is also increased. Renin-angiotensin aldosterone and progesterone are increased leading to water retention and a decreased plasma osmolality. The tubular re-absorption of glucose falls and glycosuria is present in 40% of parturients. Progesterone mediated ureteric smooth muscle relaxation can lead to urinary stasis making pregnant women prone to urinary tract infections.

There is an increase in the volume of distribution for drugs and may have to be given in higher than normal dosages.

Hepatic: Liver blood flow does not increase. Plasma cholinesterase falls by 25%. The levels of ALT, AST and LDH are slightly elevated. Plasma concentrations of alkaline phosphatase are increased 3-fold as a result of placental production. Serum albumin is decreased reducing the plasma oncotic pressure. There may be a prolongation of neuromuscular blockade after administration of succinylcholine. This is not usually clinically significant. The total concentration of plasma protein is reduced due to the increase in plasma volume. This results in a drop in the colloid oncotic pressure, and may account for the edema seen in pregnancy. Also the pharmacokinetics of protein bound drugs will be affected.

Endocrine: There is an increased insulin resistance during pregnancy. The placenta produces human placental lactogen, which has similar effects to growth hormone and may be the cause of maternal insulin resistance. Any carbohydrate load will cause a greater than normal increase in plasma glucose concentrations. The thyroid gland

undergoes hypertrophy during pregnancy. Increased production of thyroxin and triiodothyronine are normally balanced by increased production of thyroid binding globulin so the levels of the free hormones remain the same. Levels of parathyroid hormone tend to fall during pregnancy as does the level of serum calcium although the level of ionised calcium remains constant

Musculoskeletal system: The placenta produces relaxin, which causes relaxation of ligaments. This results in widening and increased mobility of the pubic and sacroiliac joints to allow passage of the fetus through the birth canal. Due to the enlarging uterus there is a compensatory increase in the lumbar lordosis. As a result, backache is a common complaint during pregnancy. Due to increased lumbar lordosis, subarachnoid block or epidural become more challenging.

Others: Blood flow to nasal mucosa and peripheries is increased. Nasal intubation is frequently associated with epistaxis. Blood flow to the skin is increased resulting in warm and clammy feet. This is to dissipate heat from the metabolically active uteroplacental unit.

**What are the functions of placenta? What factors affect the transfer of drugs from maternal to fetal side?**

The placenta is a vital barrier and link between maternal and fetal circulations. The barrier between fetal and maternal circulations is two cells thick: the fetal capillary endothelium and its covering syncytial trophoblast. It is an imperfect barrier and substances do cross from the mother to fetus.

**Functions**

Gas exchange: O2 and CO2 exchange.

Hormonal synthesis: Placenta synthesizes and releases estrogen, progesterone, chorionic gonadotropin, prolactin, prostaglandins.

Nutrient supply: Water, electrolytes, minerals,f

Detoxification of drugs and substances

Transfer of immunity from mother to fetus by way of immunoglobulins.

**Placental transport mechanisms are:**

Simple diffusion: O2 and CO2 transport occurs due to the difference between partial pressures on both sides. Fatty acids are also transported by means of simple diffusion.

Secondary active transport: Amino acids are transferred mostly as linked carriers. Sodium down its concentration gradient drags amino acids with it.

Pinocytosis: Placenta is impermeable to proteins, only IgG is transported.

Facilitated diffusion: Glucose

Bulk transport: Water and electrolytes. Factors affecting placental transfer of drugs are:

Lipid solubility: The placental membrane is freely permeable to lipid soluble substances, which undergo flow dependent transfer. Higher the lipid solubility, higher the transfer of drugs.

Molecular weight: Drugs with smaller molecular weight diffuse easily (< 600 Da).

Degree of ionization: Ionized form will not cross the barrier easily. The degree of ionization of acidic drugs is greater on the maternal side and lower on the fetal side. The converse applies to basic drugs.

Protein binding: Protein bound drugs will not diffuse easily, only free drug would cross the placental barrier easily. Acidosis reduces the protein binding of local anesthetic agents. Reduced albumin concentration increases the proportion of unbound drug.

Maternal-fetal concentration gradient: The rate of transfer is governed by Fick's law of diffusion, when the transfer is by simple diffusion. Note: Fetal maternal concentration is used as an index for transfer of drugs.

***Anesthetic Drugs:***

Opioids: All opioids cross the placenta in significant amounts. They are weak bases, bound to a1-glycoprotein.

Pethidine: Longer half-life is due to its active metabolite norpethidine, which may lead to respiratory depression in the neonate.

Morphine: It is poorly lipid soluble but readily crosses the placenta due to low protein binding.

Fentanyl: It is highly lipid soluble and albumin bound, so crosses the placental barrier easily.

***IV induction agents:***

Sodium thiopentone is highly lipid soluble, weakly acidic, 75% protein bound and less than 10% ionized at physiological pH. It crosses the placenta easily with an F/M ratio of 0.4 -1.1. Doses of > 8 mg/kg produce neonatal depression, whereas lower doses produce no significant neonatal effects

providing induction to delivery

Propofol: It is highly protein bound and lipophilic F/M ratio of 0.6-0.8

Inhalational agents: These agents are highly lipid soluble with low molecular weights.

Muscle relaxants: These are quaternary ammonium compounds and fully ionized. These drugs are fully ionized as well as have low lipid solubility; hence they do not cross the placenta.

Local anesthetics: These drugs have low molecular weights (< 600 Da) and also are lipid soluble. Different drugs have different protein binding

Bupivacaine: Because of its high protein binding (96%) crosses the placenta in lesser concentration than lignocaine (65%). Transfer to the fetus also is dependent on the site of administration (paracervical route concentration will be higher than epidural).

Anticholinergics: Atropine passes through the placental barrier unlike glycopyrrolate.

Benzodiazepines: Diazepam crosses the placenta easily (highly lipid soluble and nonionized). F/M ratio is 1. as compared to midazolam with F/M ratio 0.76.

## Anemia in Pregnancy // What are the causes of anemia of pregnancy? //

The common causes are discussed below:

Physiological anaemia of pregnancy: Blood volume begins to increase in the 6th week of gestation and by the end of pregnancy it reaches approximately 40-50% more than in the pre-pregnant state. Red cell mass increases as much as 20-30% above pre-pregnancy levels. The plasma volume increase is greater than the increase in red blood cell mass leading to hemodilution, resulting in 'physiological anemia of pregnancy'.

Acquired causes: The common cause are Nutritional deficiency which may be of iron or folic acid/vitamin B 12.

Iron deficiency anemia (60%): The body is unable to keep up with the blood volume expansion in the 2nd and 3rd trimester resulting in iron deficiency anemia. This can be prevented by encouraging pregnant women to supplement their diet with 60 mg/day of elemental iron.

Megaloblastic anemia (10%): This is due to deficiency of folic acid and or vitamin B12. workup in addition to serum levels of vitamin B12 to determine the level of intrinsic factor to exclude pernicious anemia. Folic acid requirements are increased during pregnancy. An increase in MCV can be suggestive of folate deficiency.

Infections: Although rare, anemia can be caused by infections such as malaria, parvovirus, cytomegalovirus, HIV, hepatitis viruses, Epstein-Barr virus. If the patient's history suggests exposure to any of these infectious agents.

Aplastic or hypoplastic anemia: Pregnancy induces erythroid hypoplasia and in such cases termination of pregnancy may be indicated.

Anemia of chronic disease: such as neoplasm, chronic infection (tuberculosis), chronic renal failure, cancer chemotherapy and HIV infection. During pregnancy anemia worsens due to the associated medical condition.

HELLP syndrome: anesthetic considerations in patients with pregnancy induced HTN

Hemolytic: Inherited disorders, such as thalassemias, sickle cell anemia, and hereditary spherocytosis.

## Severity of Anemia

Anemia is defined as a qualitative or quantitative deficiency of hemoglobin. It can be classified as follows:

| | |
|---|---|
| Mild anemia | Hemoglobin 9-11 g % |
| Moderate anemia | Hemoglobin 7-9 g % |
| Severe anemia | Hemoglobin 4-7 g % |
| Very severe anemia | Hemoglobin < 4 g % |

## What are the compensatory mechanisms in anemia?

1. Increase in cardiac output
2. Rightward shift of oxygen dissociation curve
3. Decrease in blood viscosity
4. Increase in 2,3 DPG concentration in red blood cells
5. Release of renal erythropoietin to stimulate erythroid precursors in bone marrow.

The tissue oxygenation is not impaired in physiological and chronic anemia due to compensatory mechanisms but sudden onset severe anemia may precipitate cardiac failure and pulmonary edema.

**What are the anesthetic goals in anemic pregnant patient?**

The aim of anesthesia is to minimize blood loss while maintaining tissue oxygenation

*Good IV access* for maintenance of intravascular volume

*Careful positioning* to reduce venous pressure

*Scrupulous* surgical technique.

*Maintain cardiac output*, avoid myocardial depression and hypotension

*Adequate FiO2* to maintain SpO2.

*Maintenance of adequate oxygen carrying capacity* by using blood transfusion if needed

**Discuss induction and maintenance of anesthesia in an anemic pregnant patient.**

*Adequate pre-oxygenation* is essential: FRC is decreased which may result in rapid and significant fall in PaO2 during a period of apnea. This may not be well tolerated by a severely anemic patient

*Minimize the reduction in cardiac output:* Titrated doses of induction agents known to have little effect on myocardial contractility

*Decreases in cardiac output due to the high levels of spinal anesthesia* required for cesarean section may be detrimental in patients with severe anemia. G.A with careful titration of induction agent may be preferred.

*Avoid hyperventilation, hypovolemia, hypothermia, acidosis* and of peripheral pooling of blood due to adverse posturing

*Optimal blood replacement* with goals of transfusion to achieve Hb > 7-8 g/dL (or HbA > 40% of the total Hb in case of abnormal Hb)

*Avoid or vigorously treat the conditions*, which increase oxygen demand, such as shivering or fever.

*Nitrous oxide should be used with caution* in patients with folate and vitamin B12 deficiency

**Discuss postoperative care in anemic pregnant patient.**

The aim is again to maximize oxygen delivery and minimize blood loss. Patients should be closely monitored (hemodynamics) in a high-dependency unit. Provide oxygen supplementation, maintain euvolemia, good pain relief and treat any infections aggressively.

**Discuss in brief the management of Elective Cesarean Section in a patient with a normal pregnancy.**

Obstetric anesthesia is a unique situation of providing care for the mother and the unborn baby

**Premedication:**

*Aspiration prophylaxis:* pharmacologic prophylaxis is administered to all patients regardless of type of anesthesia planned. The aim of the prophylaxis is to decrease gastric volume and increase gastric pH. Suspension antacids, i.e. those which contain particulate matter. A clear antacid, such as 0.3 M non-particulate sodium citrate (30 mL) is preferred. The administration of an H2 -receptor antagonist increases gastric pH; but it will not alter the pH of existing gastric contents. Therefore, a combination of therapies, which will increase pH as well as alter pH of preexisting gastric content is more useful. Intravenous administration of ranitidine 50 mg and the oral administration of sodium citrate 30 mL results in a greater increase in gastric pH than the administration of sodium citrate alone provided both are administered at least 30 minutes prior to intubation.

*Anxiolysis:* Small dose of intravenous benzodiazepine (e.g. midazolam 0.5 to 2 mg) and or an opioid (e.g. fentanyl 25 to 50 µg) result in minimal fetal and neonatal depression and may be safely given. During regional anesthesia, major disadvantage of the benzodiazepines is their potential for amnesia; and it should be avoided if the mother wants to remember her childbirth experience.

*Antisialogogues:* Routine use of glycopyrrolate is not recommended

**Choice of Anesthesia**

Regional:

Regional anesthesia is preferred over general anesthesia for elective cesarean unless contraindicated.

*Advantages:* Avoidance of multiple drugs; mother remains awake to witness the childbirth, early breast feeding can be started. Regional technique can be safely performed if the platelet count is more than 70-75000/mm3 in a parturient, in absence of coexisting coagulopathy. Single shot spinal anesthesia can be given using 25 or 24 gauge Sprotte needle or 27 or 25 gauge Whitacre needle. It can be performed in lateral or sitting position to ensure sensory blockade up to T4-T6

*Hypotension Prophylaxis:*

Hypotension in obstetric patients is defined as a decrease in systolic blood pressure of at least 25% or systolic blood pressure less than 100 mm Hg. It is perhaps the most common complication of regional anesthesia in obstetric patients. Hypotension results from increased venous capacitance and pooling of a major portion of the blood volume in the lower extremities and the splanchnic bed; and decreased systemic vascular resistance.

**Measures to prevent hypotension include:**

- * Administration of fluids before the administration of regional anesthesia
- ** Left uterine displacement
- *** Administration of a prophylactic vasopressor

*It is recommended to administer Ringer's lactate or Normal saline 15–20 mL/kg (1000–1500 mL of crystalloid or 500–1000 mL of colloid) before the block to prevent hypotension.*

In patients undergoing elective cesarean delivery under spinal anesthesia, the timing of fluid loading (before: preload or during induction of spinal anesthesia: coload) does not have an impact on the incidence of hypotension. Therefore, the surgery should not be delayed in order to deliver a preload of fluid. Regardless of the fluid loading strategy, either prophylactic or therapeutic vasopressors may be required in a significant proportion of patients.

**Vasopressors:** Phenylephrine bolus 50–100 µg intravenously may be associated with a lower incidence of intraoperative nausea and vomiting and higher umbilical artery pH and base excess; compared with ephedrine. However, the difference in pH is small and unlikely to be clinically relevant in low-risk deliveries. It may be more useful in patients undergoing emergency LSCS for fetal distress.

**Epidural Anesthesia:** It is possible to extend the block by giving 'top-up' dose of local anesthetic agents to a patient having indwelling epidural catheter inserted for labor analgesia. Additional (5-mL boluses of 1% lidocaine + 1:400,000 epinephrine or 5-mL boluses of 0.5% bupivacaine or 0.5% ropivacaine may be given to attain motor blockade and sensory level of T4 for surgical procedures. Combined spinal-epidural anesthesia: Subarachnoid injection allows quick and dense block and then it is possible to extend the block through epidural catheter. This also allows postoperative epidural analgesia to be administered.

**General Anesthesia (GA):**

Indications: Maternal refusal of regional anesthesia, fetal distress in the absence of preexisting epidural catheter, failed regional anesthesia, significant coagulopathy, acute maternal hypovolemia.

**CONDUCT OF G.A INCLUDES:**

- H2 receptor antagonist or proton pump inhibitor and/or metoclopramide intravenously.
- Clear antacid orally
- Left uterine displacement
- Application of monitors.
- Denitrogenation (administration of 100% oxygen)
- Intravenous induction: Thiobarbiturate, 3–7 mg/kg propofol 2 mg/kg and succinylcholine 1–1 mg/kg OR rocuronium 0.6–1.2 mg/kg
- Intubation with a 6.0- to 7.0-mm cuffed endotracheal tube.
- Preparedness for difficult intubation is always mandatory.
- Nondepolarizing neuromuscular blocking agent
- Intermittent positive pressure ventilation using 30 to 50% nitrous oxide in oxygen and a low concentration (e.g. 0.5 minimum alveolar concentration [MAC]) of a volatile halogenated agent
- After delivery of the fetus, concentration of nitrous oxide can be increased, with or without a low concentration of a volatile halogenated agent; and opioids (Fentanyl 2 mcg/kg) can be administered.
- Patient should be extubated once wide awake.

**CONTINUOUS SPINAL ANESTHESIA:** This technique lost popularity because of post-dural puncture headache. Also the microcatheters are associated with large incidence of kinking and breakage.

**INTRAOPERATIVE MONITORING:**

- NIBP, pulse oximetry, capnometry are basic standard monitoring and are mandatory.
- The ASA requires the continuous electrocardiogram during the administration of anesthesia for surgery. ST-segment depression in the lateral leads may be seen in 15 to 61% of patients after the delivery during cesarean section. The possible causes are acute hypervolemia, tachycardia, venous air embolism, coronary vasospasm, vasopressor administration, and/or amniotic fluid embolism.
- Other (optional) monitoring includes: Fetal HR monitoring using scalp ECG electrodes, Doppler ultrasound for air embolism in patients with intracardiac shunts, noninvasive cardiac output monitoring in indicated cases.

**Replacement of blood loss:** In normal vaginal delivery, about 500 mL of blood loss is normally expected. This corresponds to the average amount of blood conserved during pregnancy; as about 50 mL (10–80 mL) of blood is lost during normal MC. During cesarean section, the accepted average blood loss is 1 L in a non-anemic patient.

**Pediatrician or neonatologist** should attend the cesarean section for care of the neonate. If anesthesiologist is the only physician providing care for mother and the neonate, then maternal safety is considered essential.

## What Anesthetic Technique Would You Use For Emergency LSCS

**The choice depends on:**

- Indications for the surgery
- Maternal status
- The degree of urgency
- Desire of the patient

**Spinal Anesthesia**

**Advantages:**

- Rapid onset
- Provides dense block
- Small doses of local anesthetic is used, so there is minimal transfer of drug to fetus
- Failures are very infrequent with block
- Decreased risk of failed intubation and aspiration of gastric contents
- Avoidance of depressant agents
- Ability of mother to remain awake and enjoy the birthing experience
- It has been suggested that blood loss is reduced under regional anesthesia

**Disadvantages:**

- Higher incidence of hypotension.
- Short duration of anesthesia.
- If block achieving an adequate (T4) block, some women under spinal anesthesia will experience some degree of visceral discomfort during section (particularly in situation in which the obstetrician exteriorizes the uterus). The quality can be improved by adding opioids.
- It will work longer, maybe.
- Total spinal block — a rare and serious complication that occurs after excessive cephalad spread of the L.A.
- Hematoma: The incidence of neurologic injury resulting from hematoma associated with spinal is very low.

**Epidural Anesthesia**

**Advantages:**

- It provides flexibility when catheter is placed for labor analgesia and can be used for section.
- The volume of local anesthetic drug can be titrated.
- Incidence of hypotension is less.
- All advantages of regional block as mentioned above.

**Disadvantages:**

- Takes a little longer time for insertion and institution of analgesia.
- Large doses of local anesthetic are used to achieve adequate levels.
- Failures including incomplete or patchy block are more frequent than spinal.

**General Anesthesia**

It is necessary when:

- Life-threatening fetal compromise is present.
- Cases with overt coagulopathy.
- Maternal hemorrhage.

**Advantages:**

- Speed of induction.
- Control of airway.
- Superior hemodynamics.

## What is the effect of Inhalation agent on uterine contractility?

If less than one MAC of a potent volatile inhalation agent, such as isoflurane or sevoflurane is used, there is no increase in blood loss or decrease in uterine contractility. At these low concentrations the uterus still responds to oxytocin. At higher concentration uterine contractility is decreased and blood loss is increased.

# Other Minor Obstetric Procedures

**1- Dilatation and Curettage (D & C)**

1- Lithotomy positions: see later chapter of "Anesthesia and genito-urinary surgery".

2- Cervical dilatation:

- Intraoperatively: it causes vagal stimulation leading to reflex laryngospasm and bradycardia; therefore, deep anesthesia is required.
- Postoperatively: Patients have severe pain; therefore, analgesia is important by ketorolac or diclofenac.

3- Uterine stimulants (ecbolics): such as oxytocin, methergine, and prostaglandins.

4- Emergence from anesthesia: may be accompanied by profound emotional upset due to loss of the baby. Recovery staff should be prepared to deal with the patient sympathetically.

**2- Endoscopic Endometrial Resection:**

1- Lithotomy position with its precautions and complications.

2- Unexpected great blood loss may occur. It is difficult to be estimated, as it is usually diluted with irrigation fluid.

3- Absorption of irrigation fluid may cause:

- Hypernatremia.
- Hypervolemia which decreases plasma osmolality and may produce pulmonary edema
- Hypothermia.

The clinical picture is similar to (TURP syndrome), but it occurs in a female patient.

**Post Partum Tubal Ligation :**

It is the most common type of surgery performed during the early postpartum period.

All the physiological changes of pregnancy return to the pre-pregnant state within 6 weeks postpartum, but in different degrees.

1- The MAC returns to the normal by the 3rd day post-delivery.

2- The doses of local anesthetics in regional anesthesia return to normal within 24-36 hours after delivery.

3- Functional residual capacity returns to normal within 48 hours post-delivery.

4- At 48 hours postpartum, the cardiac output is slightly lower than pre-labor values. 2 weeks postpartum, it decreases to 10% higher than the pre-pregnancy value and slowly returns to prepregnancy value within 12-24 weeks postpartum

5- The plasma volume returns to normal by 6 days post-delivery, but it increases sharply up to 1 liter 24 hours after delivery due to diversion of blood from the placenta to the main circulation (auto-transfusion), although there is blood loss during labor (about 500 mL).

6- The risk of aspiration is still present; therefore, all precautions should still be taken.

- Gastric emptying, gastric volume, and pH return to normal within 1-3 days, but the incidence of nausea and vomiting is less due to: relieved mechanical distortion of the stomach,, relieved labor pain,, rapid decline of the progesterone level.

## Anesthesia for Gynecological Surgery ..... General Problems:

1- Patients with gynecological problems tend to be young and fit. Patients with incontinence or cancer surgery tend to be old and with medical diseases.

2- There is increased risk of deep venous thrombosis; therefore, : - Prophylactic low dose heparin should be given.

- Graduated compression stocking should be ready, - Estrogen containing oral contraceptive pills (if taken by the patient) should be stopped for 2-6 weeks before surgery. This is not necessary in minor gynecological procedures as D&C

3- Some patients have menorrhagia; therefore, hemoglobin concentration is mandatory preoperatively.

4- Increased risk of postoperative nausea and vomiting. Therefore, prophylactic antiemetics are necessary.

5- In major procedures such as radical vulvectomy or pelvic exenteration , care should be taken as regards:

- Major blood loss; therefore, - preoperative assessment of hemoglobin must be done,
- good i.v. access must be established.
- good blood loss monitoring is mandatory.
- **Hypothermia.**
- **Severe postoperative pain;** therefore,
- epidural anesthesia is preferred to general anesthesia.
- opioids can be administered e.g., by patient controlled analgesia.

6- In hysteroscopy, a syndrome like trans-urethral resection of prostate (TURP) syndrome can occur, but in female patients due to irrigation with isotonic ionic solutions such as glucose or glycine.

7- Surgery may be managed as a day case anesthesia with its precautions.

8- Vagal stimulation is common as during cervical dilatation, traction on the pelvic organs or the mesentery, or during laparoscopic procedures.

9- Complications of position e.g., lithotomy position.

1. Plasma volume and red blood cell (RBC) volume increase by which of the following percentages in pregnancy?
A. Plasma volume, 10%; RBC volume, 50%
B. Plasma volume, 40%; RBC volume, 40%
C. Plasma volume, 40%; RBC volume, 20%
D. Plasma volume, 60%; RBC volume, 20%
E. Plasma volume, 60%; RBC volume, 60%

2. Which of the following factors does not influence the placental transfer of drugs ?
A. Fetal ionizability
B. The placental area
C. Ionization of the drug
D. Molecular weight
E. Concentration in fetal blood

3. Which dermatomes are affected in the first stage of labor?
A. T5–T10
B. S2–S4
C. T10–L1
D. T12–L2
E. T6–L2

4. The most common side effect of neuraxial anesthesia for obstetrics is:
A. meningitis
B. decreased variability of fetal heart rate
C. nausea and vomiting
D. hypotension
E. nerve group damage

5. Considering regional anesthesia for cesarean section, which of the following is TRUE ?
A. Epidural anesthesia is by far the most common regional technique.
B. Prehydration is not necessary when using epidurals.
C. Epidural anesthesia consistently eliminates visceral discomfort during exteriorization of the uterus.
D. Spinal narcotics are contraindicated in parturients.
E. Epidural anesthesia has the advantage of slower onset and controllability.

6. When considering anesthetic complications relating to cesarean section, which of the following is TRUE?
A. Fatality with general anesthesia is equal to that with regional anesthesia.
B. Paresthesia and pain with spinal needle placement are common, and the procedure should proceed despite these complaints.
C. Phenylephrine should not be used to treat hypotension in pregnant patients.
D. Colloid is superior to crystalloid preloydration in preventing hypotension associated with neuraxial anesthesia.
E. The risk of hypotension with regional anesthesia is increased in women in labor compared with nonlabering women.

7. The incidence of postdural puncture headache after dural puncture with a 25- or 26-gauge spinal needle in pregnant women is:
A. 0%
B. 1%
C. 3%
D. 5%
E. 10%

8. Many of the symptoms associated with pre-eclampsia may result from an imbalance between the placental production of:
A. renin and angiotensin
B. endothelin and nitric oxide
C. prostacyclin and thromboxane
D. platelets and antithrombin III
E. progesterone and estrogen

9. The greatest change in cardiac output in pregnant patients occurs:
A. during the second trimester
B. after the delivery of the placenta
C. during the third trimester
D. during the first stage of labor
E. during the second stage of labor

10. When considering fetal heart rate, which of the following is TRUE?
A. The normal fetal heart rate is 80 to 120 bpm.
B. Acceleration of fetal heart rate in response to fetal stimulation is ominous.
C. Atrial heart rate of more than 110 bpm may be caused by intravenous narcotics.
D. Baseline variability of fetal heart rate may be affected by sphincter.
E. Baseline variability of fetal heart rate is a reflection of the integrity of the sympathetic nervous system but is not affected by the parasympathetic nervous system.

11. Normal fetal oxygen saturation is:
A. 50% to 100%
B. 50% to 100%
C. 50% to 80%
D. 30% to 70%
E. 10% to 50%

12. The average arterial blood pH of healthy, vigorous infants is:
A. 7.04
B. 7.14
C. 7.24
D. 7.34
E. 7.44

13. The initial breath during neonatal resuscitation may entail a peak pressure up to_____ cm H2O.
A. 10 to 15
B. 15 to 20
C. 20 to 30
D. 30 to 40
E. 40 to 50

14. The studies that relate surgery and anesthesia during pregnancy to fetal outcomes have found that:
A. only gynecologic surgery in the third trimester is correlated with increased fetal death
B. neither surgery nor anesthesia can be correlated with an increase in congenital disorders
C. maternal condition at the time of surgery has no affect on fetal outcomes
D. operative exposure to nitrous oxide dramatically increases the chance of congenital disorders in humans
E. general anesthesia is associated with a significant increase in the incidence of congenital disorders

15. Which of the following statements concerning lung volume changes during pregnancy is/are TRUE?
A. Functional residual capacity (FRC) decreases by 40%.
B. Inspiratory reserve volume decreases.
C. Tidal volume is unchanged.
D. Minute ventilation increases 50%.

Airway safety is the most important consideration during otorhinolaryngological and head and neck surgeries because of the following reasons:

- The surgeon and anesthesiologist share the airway.
- The access for the anesthesiologist is limited by drapes and instruments.
- The problems of the underlying pathology and bleeding into the airway may endanger the airway.
- Anesthetic circut disconnections are a constant threat during surgery.

## TONSILLECTOMY / ADENOIDECTOMY

### ANESTHETIC PROBLEMS:

Anesthetic problems are summarized in the following points:

1- The type of patients: Patients are usually pediatrics with upper respiratory tract infection or obstructive sleep apnea syndrome.
2- Day case anesthesia.
3- Airway management.
4- Transmission of infections by surgical and anesthetic equipment.
5- Blood loss especially in young age.
6-- Postoperative tonsil position.
7- Risks of postoperative bleeding tonsils.

### Preoperative Management:

- Patients are usually young and healthy, but may have one of the following conditions:

- **Acute upper respiratory tract infection (URTI): Surgery should be postponed for 2 weeks** even after recovery because URTI causes hyperactive airway reflexes.
- **Obstructive sleep apnea syndrome:** due to the effect of the **hypertrophied tonsils.** This causes a combination of prolonged partial upper airway obstruction and intermittent complete obstruction.

Obstructive sleep apnea syndrome is presented by the following:

In mild cases, habitual snoring is the most common symptom, In severe cases (1 % ), chronic hypoventilation occurs resulting in hypoxia and hypercarbia. This leads to:

- *Neuro-developmental problems* such as excessive daytime somnolence, behavioral disturbances, school failure, recurrent enuresis, developmental delay and even failure to thrive.
- *Pulmonary hypertension* and congestive heart failure which may cause death.
- Precautions for day-case anesthesia if used should be taken.

**Premedication :**

**1. Sedatives:** e.g., midazolam 0.5 mg/kg (to a maximum of 15 mg) oral syrup.
They are usually needed as patients are young children. They should be avoided in OSA syndrome.
**2. Anticholinergics:** e.g., atropine 0.02 mg/kg (to a maximum of 0.6 mg) oral syrup.
They are usually needed to decrease salivation. They are better avoided in hot weather.
**3. Topical local anesthetic cream such as EMLA cream** may be applied on the hand 1 hour before i.v. cannulation (mark sites of veins).

### Intraoperative Management:

**Induction :**It is either by:

1-I.v. agents followed by suxamethonium (premedication with atropine is essential). or

2- Inhalation agents (sevoflurane) then i.v. cannula is inserted and intubation is performed.
Large tonsil may lead to respiratory obstruction which makes it difficult to maintain the airway.
In case of obstructive sleep apnea, negative pressure pulmonary edema may occur.

**Intubation :**

• **Oral intubation** is the most common by:
- a reinforced endotracheal tube to decrease the risk of kinking by the self-retaining mouth gag (BoyleDavis gag). Or
- a preformed RAE tube to direct the breathing circuit away from the field of surgery.

*In adults, nasal intubation* is preferred by some surgeons, but it may carry the risk of bleeding from adenoid trauma or even implantation of parts of adenoid in the trachea.

• **Laryngeal mask airway (LMA)** is recently used, usually the reinforced flexible type, for many types of otorhinolaryngological surgeries such as tonsillectomy. LMA offers relative good protection against aspiration of blood or surgical materials.

Advantages of LMA over endotracheal tubes: LMA avoids many of the problems associated with tracheal intubation such as bronchospasm or stress response which may increase congestion and bleeding.

Disadvantages of LMA:

- Surgical access is restricted.
- It is more prone to displacement during surgery, with potentially catastrophic results.

**Transmission of infection :**

Infections such as variant Creutzfeldt-Jakob disease or bovine spongiform encephalopathy can be transmitted, although rare, during adenotonsillectomy surgeries. Organisms or prions may accumulate in lymphoid tissue such as the tonsils and adenoids which are not reliably destroyed during standard methods of surgical sterilization. Inter-patient transmission of prions can occur via theater equipment contaminated during tonsillectomy/adenoidectomy.

**equipment used for tonsillectomy/adenoidectomy should be disposable,** including all airway equipment such as laryngoscope blades and LM airways. In the case of expensive equipment, e.g., non-disposable laryngoscopes, the metal blade should be covered by a transparent sheath. These guidelines (regarding disposable instruments) should be applied also for surgical instruments.

**Blood loss :**

It is usually mild intraoperatively. In children weighting **< 15 kg** (i.e., 3-4 years old), blood loss is considered **large**; therefore, **loss** of **100 mL blood** in them may **need blood transfusion.**

**Extubation :**

• **Awake extubation** : in the lateral position with slight head down **(tonsil position)** is usually done.
• **Deep extubation** : can be used, by a **senior staff,** to decrease coughing and laryngeal spasm and lessen the risk of bleeding especially in a child with hyperactive airway disease such as asthma, but the risk of aspiration may increase.
• **Suction :**

- Suction should be done after careful suction under direct vision and ensuring that the pharynx is free from blood. Blind pharyngeal suction with a rigid sucker may cause bleeding from the tonsillar bed and should be avoided.
- **Accumulation of blood behind the soft palate in the nasopharynx** should be avoided.

"Coroner's clot". This area is best cleared either by using a soft suction catheter via the nose or byrotating a Yankauer sucker so that its angled tip is placed behind the uvula.

**Postoperative Management :**

1- The patient should be positioned left lateral/head down with the head turned to one side (tonsil position) to allow drainage of any residual oozing out of the mouth and to allow early detection of postoperative bleeding tonsils.

2- **Postoperative analgesia** e.g., **rectal paracetamol** should be given at the end of surgery after obtaining consent from the parents. Use of **non-steroidal anti-inflammatory drugs (NSAIDs)** probably increases bleeding slightly (antiplatelet effects), but the clinical importance is doubtful. **Local anesthetic infiltration** of the tonsillar bed has been used by some.

3- In obstructive sleep apnea syndrome, intensive care admission is needed for close observation.

4- Postoperative bleeding tonsil can occur.

## *Post Operative Bleeding Tonsil*

**Anesthetic Problems:**

1- Shocked patients.
2- Full stomach.
3- Blocked nose by the blood.
4- Postoperative laryngeal edema (due to intubation).

**Preoperative Management :**

• ***The patient is usually hypovolemic and shocked,*** with orthostatic hypotension, tachycardia, pallor, sweating, restlessness, up to altered state of consciousness. **Preop. resuscitation** is very important by crystalloids or blood; otherwise, severe circulatory collapse may occur with induction.

• ***The patient has a stomach full of blood*** which increases the risk of aspiration. **Preoperative evacuation** of the stomach by a large-bore **naso-gastric tube** is important.

• ***Preoperative hemoglobin, hematocrit*** (early hematocrit usually falls due to i.v. fluids given), crossmatching blood and coagulation study are done.

**Intraoperative Management :**

• The patient is placed head down in a lateral position and the suction apparatus should be positioned within grasp before induction.

• Good preoxygenation is essential.

• Induction is performed by:

a- **Rapid sequence crash induction with cricoid pressure** by using small dose thiopentone 3-4 mg/kg or etomidate or ketamine if there is any doubt about proper preoperative resuscitation where intubation is performed by succinylcholine 1-2 mg/kg or rocuronium ( of choice).

b- **Deep inhalational induction** may be used to facilitate intubation.

• **Cuffed oral endotracheal tube** (due to presence of blood in the nose) is used, but uncuffed tubes are used in children< 5-6 years old.

• Before awakening, **re-evacuate the stomach by a large bore naso-gastric tube with** care so as not to traumatize the adenoidectomy or tonsillectomy beds.

• **Awake extubation** is used in the lateral position.

**Postoperative Management:**

Laryngeal edema may occur due to re-intubation; therefore, dexamethasone i.v. and humidified 02 should be administered.

# ENDOSCOPIC SURGERY OF THE LARYNX ( & TRACHEA )

Endoscopy includes laryngoscopy (diagnostic or operative), micro-laryngoscopy (laryngoscopy aided by an operating microscope), esophagoscopy, and bronchoscopy.

## Types of Bronchoscopes (Currently in Use)

**A. Flexible Fiberoptic Bronchoscope :**

It can be used either in awake sedated patients (0.5 mg increments of midazolam and/ or 10 µg of remifentanil boluses) under local anesthesia (allowing examination of vocal cords movements), or in patients generally anesthetized with laryngeal mask airway or endotracheal tube.

**B. Rigid Bronchoscope :**

It usually necessitates general anesthesia and muscle relaxation to avoid coughing or movement, which can cause tracheal trauma. Volatile anesthetics can leak and contaminate the operating room; therefore, total i.v. anesthesia is a valid alternative. Rigid bronchoscopes are either:

# *Rigid Ventilating Bronchoscope :* It has a side-arm adapter that can be attached to the anesthesia machine. High flow rates of inspired gases and/or packing of the oropharynx are needed because there is usually a variable air leak around the bronchoscope.

# *Rigid Venturi - Effect Bronchoscope :* It relies on an intermittent (10-12 times/minutes) high-pressure oxygen jet to entrain air and insufflate the lungs. The jet is delivered through a reducing valve into a 16- or 18-gauge needle inside and parallel to the lumen.

## Anesthetic Problems

1- Patients with upper airway problems.
2- An outpatient (ambulatory) procedure.
3- Deep general anesthesia and profound muscle relaxation.
4- Patient's head position.
5- Oxygenation and ventilation.
6- Cardiovascular instability.
7- Complications of the bronchoscope especially the rigid type.
8- Postoperative laryngeal spasm or edema.
9- Laser precautions.

## Preoperative Management:

• Careful preoperative assessment of potential airway problems e.g., foreign body aspiration, tracheal stenosis, or obstructing tumors is essential by history, examination and investigations such as CT scan, (MRI), or flow volume loops.
• If the patient is suspected to have difficult intubation, to secure the airway before induction of anesthesia e.g., by fiberoptic bronchoscope, awake intubation or tracheostomy under local anesthesia.
• All equipment for difficult intubation should be available preoperatively.

## PREMEDICATION :

• Sedatives are avoided if any degree of airway obstruction is suspected.
• Anticholinergics are used to decrease secretions and avoid bradycardia.

## Intraoperative Management:

Laryngeal endoscopy is considered as an outpatient procedure; so, its precautions should be considered.

**1. Deep general anesthesia with profound muscle relaxation** is usually indicated by using a short acting nondepolarizing muscle relaxant such as mivacurium or vecuronium (as it is usually a short procedure; about 5-10 minutes) or by using succinylcholine infusion to provide masseter relaxation for introduction of the suspension laryngoscope, but prolonged succinylcholine administration may cause phase II block In children, spontaneous ventilation without muscle relaxant may be used.

**2.Patient Head Position :** The patient's head should rest on one pillow with the neck slightly flexed and the head extended on the neck (i.e., sniffing position). A gauze swab is placed on the patient's upper teeth or gum for protection. After the bronchoscope enters the trachea, the head of the table is lowered or the pillow is removed carefully so that the whole trachea comes into view. To pass the bronchoscope into one of the main bronchi, the head is rotated to the opposite side to bring the bronchus into line with the mouth.

**3. Oxygenation and ventilation :** are done by using 100% oxygen with one of the following techniques:

*1) Caplan's Micro-Laryngeal Tracheal Tube or Mallinckrodt Critical Care Tube:*

It is the most commonly used and can be used orally or nasally. It is 4, 5, or 6 mm I.D., but with the same adult length (31 cm) and with a large high volume low-pressure cuff (filled with 10 ml.) and is stiffer (less prone to compression) .

Advantages:

- Its small size will not impede the surgeon's view.
- Its cuff will prevent aspiration of blood or debris.
- It allows introduction of inhalational agents.
- It allows monitoring of ETC02.

*2) Conventional Endotracheal Tube of Small Size:*

Use one size smaller in children, but use size 4, 5 or 6 mm I.D. in adults.

Disadvantages: - It is too short for the adult trachea.

- It has a low volume cuff that will exert high pressure against the trachea.

*3) Collard's Tracheal Tube:*

It is formed from latex reinforced with a nylon spiral. Its proximal end size is 10 mm I.D. and its distal end size is 5-7 mm I.D.

**In 1, 2, and 3**

*+ Induction:* Thiopentone and suxamethonium or short acting nondepolarizing muscle relaxant .± Spraying the vocal cord with 3 ml. lidocaine 4% or painting with cocaine 3% to assist smooth anesthesia and decrease the risk of post-extubation laryngospasm.

*+ Maintenance:* 02 and N20, volatile agents, and controlled ventilation.

*4) Intermittent Apnea Technique:*

The ventilation and anesthesia are maintained with 02 and a potent volatile agent (with a short acting muscle relaxant) by a facemask or an endotracheal tube for periods which alternate with periods of apnea during which the surgery is performed (usually 2-3 min). The oxygenation can be maintained by apneic technique via a small catheter alongside the bronchoscope., Pulse oximeter is essential. There is a risk of hypoventilation and aspiration.

*5) Insufflation of High Flow of 02* via a small catheter placed in the trachea.

*6) Ventilation via a Side Arm of a Ventilating Bronchoscope:*

Conventional spontaneous ventilation can be maintained through the side arm of a ventilating bronchoscope, which is connected to the breathing circuit. During suction or biopsy via this side arm, ventilation must be interrupted.

**In both 5 and 6:**

Anesthesia is maintained usually with (TIVA) while patients breathe spontaneously.

*7) Manual Transtracheal Jet Ventilation:*

It is a device that applies the oxygen under pressure. The jet injector such as Sanders jet injector introduced in 1967), or Enk oxygen flow modulator is connected to a catheter which is applied translaryngeally (i.e., from the mouth, via the glottis, to inside the trachea as usual intubation) .

It can be connected to a side port of the laryngoscope during laryngeal or tracheal surgery by the laryngoscope .

*8) High-Frequency Positive Pressure Ventilation:*

Positive pressure ventilation is maintained at rates of 100-300 breaths/min. This technique eliminates air entrainment (i.e., no Venturi effect) and allows ventilation with an undiluted anesthetic gas mixture.

*9) High-Frequency Jet Technique.*

It is a variation of manual jet ventilation. It utilizes a small cannula (16-18 gauge) or tube placed in the trachea or in the proximal end of the bronchoscope through which gas is injected at 80-300 times per minute at high pressure; therefore, a Venturi effect is created proximally, which entrains an air-02 mixture down the trachea. There is a risk of barotrauma and anesthetic gas dilution. Capnography will tend to greatly underestimate the PaC02 during jet ventilation due to constant and sizable dilution of alveolar gases. Carden tube is used during jet ventilation because it is made of malleable copper with a Luer connector at its proximal end that is attached to jet ventilation.

**In 7, 8, and 9:** Anesthesia is maintained usually with (TIVA) while controlled ventilation.

## 4. CARDIOVASCULAR STABILITY :

Arterial blood pressure and heart rate fluctuate markedly during laryngoscopy and may need invasive arterial blood pressure monitoring because:

- Many patients are heavy smokers or alcohol drinkers which predisposes them to cardiovascular disease.
- The procedure resembles a series of stress-filled laryngoscopies and intubations separated by varying periods of minimal surgical stimulation.

Stable cardiovascular system should be maintained by:

- Supplementation with short acting anesthetics e.g., propofol or sympathetic antagonist e.g., esmolol (during periods of stimulation).
- Regional laryngeal nerve block.
  - Glosso-pharyngeal nerve (at the anterior tonsillar pillar).
  - Superior laryngeal nerve (near the hyoid bone).
- Topical anesthesia of the larynx with spraying 3 ml. lidocaine 4%.

## 5. COMPLICATION OF BRONCHOSCOPY ( ESPECIALLY THE RIGID TYPE ) :

1. Trauma
- Injury to teeth, lips, tongue, or oropharynx.
- Injury to the larynx, or trachea resulting in postoperative laryngospasm and edema.
- Perforation of the airway resulting in mediastinal or subcutaneous emphysema.
- Pleural perforation resulting in pneumothorax.
- Pulmonary barotrauma with venturi jet ventilation.

2. Hypoventilation causing hypoxemia, hypercarbia, and acidosis.

3. Bradycardia and arrhythmias.

## 6. LASER PRECAUTIONS .

Postoperative Management: **Postoperative care includes:**

- **Clearing of the airway** from secretions, blood, and debris.
- **Keeping the patient during and after extubation in the left lateral head down position** until becoming fully awake.
- **Giving humidified 02.**
- **Close monitoring for laryngospasm and edema** is mandatory.

## *Laser Surgery*

The word "Laser" is an acronym for Light Amplification by Stimulated Emission of Radiation.
Laser light differs from ordinary light in being:

- **monochromatic: laser** (and all photons) possesses one wave length.
- **coherent: laser** (and all photons) oscillates in the same phase.
- **collimated: laser** (and all photons) exists as a narrow parallel beam.

***Advantages:*** It is used to strip polyps or tumors from the vocal cords.
It allows excellent surgical precision and preservation of normal tissues.
It allows good hemostasis.
It allows rapid healing and minimal scar formation.
It allows minimal postoperative edema and pain.

## *Hazards of Laser :*

***** FOR THE PATIENT :**

1. **Airway fire:** It is the most dangerous during airway surgical procedures. Three components should be present for occurrence of a fire; they are called tripod of fire.
- A flammable material or fuel (endotracheal tubes or tissue itself).
- A source of ignition (laser beam).
- A gas to support combustion (oxygen or nitrous oxide).

To prevent any fire from occurring, one of the limbs of the tripod should be removed.
2. Injury to normal tissues adjacent to the operative field e.g., trachea-bronchial tree, perforation of major pulmonary blood vessels, teeth...etc.
3. Hypoxemia from inadequate ventilation, distal collection of secretions, blood, or debris, or smoke is a major cause of morbidity and mortality.

***** FOR OPERATING ROOM PERSONNEL :**

**Toxic vapor and fumes (laser plume)** from tissue vaporization leading to:
- Detrimental effects on pulmonary airway resistance, gas exchange and muco-ciliary function.
- Possible infection to operating room personnel as viable bacteria have been shown to be present in the laser plume (still not certain for viral particles as human immunodeficiency virus "HIV", papillomavirus and hepatitis).

***** FOR BOTH :**

1. **Eye damage:** $CO_2$ laser causes corneal opacities, whereas Nd: YAG laser causes retinal damage.
2. **Skin burns:** It varies from erythema to blisters or charring.
3. **Electrocution:** High voltage laser equipment may cause electric shock.

## *Protective Safety Measures*

### *I. Precautions Avoiding Airway Fire:*

**A. AVOIDING USAGE OF ETT :**

Techniques that do not involve intubation are preferred such as intermittent apnea or jet ventilation techniques.

**B. LASER RESISTANT ETT** They are used if intubation is mandatory. Laser resistant tubes are either originally designed for laser protection or they are ordinary tubes that are wrapped by a protective tape.

**A. LASER RESISTANT TUBES:** (each tube type is resistant to a specific type of laser)

- ***Mallinckrodt Laser-Flex:*** It is an air tight stainless steel spiral tube with double polyvinylchloride (PVC) cuff. It resists $CO_2$ laser .
- ***Rusch Laser-Tube:*** It has a soft rubber shaft covered with a corrugated silver foil which is then covered by a Merocel sponge covering tape (FDA-approved tape). The Merocel is moistened with saline which consumes laser energy if it is struck.
- ***Bivona Torre-cuff:*** It is an aluminum spiral tube covered with silicone and has a unique self inflating foam sponge filled-cuff which remains expanded even after laser puncture.
- ***Sheridan Laser-Trach:*** It is a red rubber tube with a copper foil tape and is covered with polyester sleeve.
- ***Xomed Laser Shield and Laser Shield II:***

They are silicone-based tubes wrapped with either laser-reflective aluminum containing tape (Laser Shield) or reflective aluminum wrap with smooth fluoroplastic overwrap on the outside (Laser Shield II).

ADVANTAGES OF LASER RESISTANT TUBES:
- They are kink resistant tubes (for metal tubes).
- They are combustion-resistant tubes, but can still be ignited if enough laser energy is applied.
- They have double cuffs (a cuff within a cuff or a cuff above cuff); so, if the laser beam perforates one cuff, the other cuff will still seal the trachea.

Disadvantages:
- They have a thick wall (i.e., with a larger outer diameter for a given inner diameter than conventional endotracheal tubes) and are not available in pediatric sizes; therefore, they can not be used in small airways e.g., pediatric patients, tracheal stenosis, or obstructing lesions.
- They have decreased flexibility.
- They have more difficult cuff inflation and deflation properties.

• They can transmit heat (for metal tubes).
• They can reflect laser resulting in injury to the surrounding tissues.

**B. POLYVINYKHLORIDE (PVC) OR RED RUBBER TUBES:**

They are wrapped by a metallic tape of aluminum or copper foil in an overlapping spiral manner for several centimeters above the cuff. Nowadays, this practice is not accepted and is considered dangerous and should be avoided.

A Merocel sponge covering tape (FDA-approved tape) can be used instead of the aluminum or copper foil. The Merocel is moistened with saline which consumes laser energy if it is struck.

Unwrapped tubes have the following disadvantages:

They are highly combustible.
• PVC tubes are more dangerous because they produce hydrochloric acid and other toxic compounds.
• Rubber tubes are relatively less dangerous because they produce non-toxic compounds, so they are preferred.

Wrapped tubes with a metallic tape have the following disadvantages:

• They do not offer cuff protection.
• They add thickness to the tube; so, use 1-2 mm smaller size.
• They are not an FDA approved device.
• Protection varies with the type of the metal foil used.
• Adhesive backing may ignite.
• The reflective surface may reflect laser into the surrounding tissues.
• Rough edges may damage mucosal surfaces.

• Airway obstruction may occur from aspiration of detached pieces of foil .

**C. ADITIONAL PROTECTIVE MEASURES WITH USAGE OF THE TUBES :**

Because no tube is completely laser-proof, the following precautions should be taken :

1- Decrease the inspired 02 concentration as low as possible and avoid N20 as both 02 and N20 support combustion. Air (or helium/O, 25% mixture can be used. Some patients can tolerate 21 % 02 guided by a pulse oximeter.

2- The cuff should be filled with saline (rather than air) to dissipate the heat and it is better to use saline dyed with methylene blue to signal cuff rupture.

3- Laser intensity and duration should be limited as much as possible.

4- Isolation of the lesion with saline-soaked pledgets (gauzes) should be done to limit the risk of ignition.

5- A source of water (60 mL syringe) should be immediately available in cases of fire.

*2. Protect the Patient's Skin, Teeth and Normal Tissues Adjacent to the Operative Field by using:*

• Wet gauze pads or surgical sponges.
• Water based lubricants and flame-resistant surgical drapes.
• Matt-finished or ebonized surgical instruments rather than polished instruments to prevent reflection and inadvertent misdirection of the laser beam.

*3. Evacuation of Toxic Vapors and Fumes (Laser Plume).*

Efficient smoke evacuation must be maintained close to the operative site and operating room personnel must wear special (high filtration) masks.

*4. Eye Protection.*

• All the operating room personnel should wear eye protection glasses with side shields to protect the lateral aspects of the eyes (the glasses differ according to the type of laser used as each glass absorbs a specific wavelength according to the type of laser). These glasses have a color tint, which may make it difficult to monitor skin color changes (figure 19-5).
• A warning sign should be placed outside the operating room door whenever the laser is being used with extra glasses available for anyone entering the operating room.
• The patient's eyes should be taped shut and covered with wet eye packs.
• All windows should be covered with black window shades.

## Protocol and Management of Airway Fire:

The "4 Es" mnemonic may help to remember the steps of the protocol which are arranged in the following order:

1- Extraction: Stop ventilation and remove the endotracheal tube.

2- Elimination: Turn off 02 and disconnect the circuit from the machine.

3- Extinguishing: If the fire (flame) persists, flood the surgical field with saline immediately. Once the fire stops, ventilate with 100% 02 by face mask and re-intubate.

4- Evaluation: Assess airway damage, before patient awakening by:

- Direct laryngoscopy.
- Fiberoptic or rigid bronchoscopy (to also remove burnt debris).
- Consider bronchial lavage if needed.
- The decision to extubate the patient is based on the extent of burn, pulse oximeter readings, and arterial blood gases. The patients may need mechanical ventilation and tracheostomy in severe burns.
- The patient should be monitored for 24 hours after injury with serial chest examinations and oximetry.
- Inspired gases should be humidified.
- Steroids may be given to decrease laryngeal edema.
- Antibiotics may be given to treat superimposed infection

## FOREIGN BODY ASPIRATION

It is an emergency condition especially in the pediatric population. It requires endoscopic removal using direct laryngoscopy and rigid bronchoscopy.

### Preoperative Management :

- History of foreign body aspiration is usually short, but may be 2-3 weeks e.g., peanut.
- Clinical picture of foreign body inhalation should be assessed. The clinical picture differs according to the type of the obstruction:
  - *Acute obstruction* of the larynx: either:
- complete resulting in suffocation (the patient struggle against his/her larynx) or
- incomplete (partial) resulting in inspiratory stridor (if in the larynx) or inspiratory and expiratory stridor (if in the trachea) with dry cough, wheeze, and hoarseness. Hypoxia is usually present. Bilateral decreased breath sounds may occur.
  - *Valvular obstruction:* Emphysema of the affected lobe or segment may occur.
  - *Distal total obstruction:* Distal consolidation and collapse especially in the right lung (80%) may occur resulting in infection and hypoxemia.
- If an irritant object is aspirated e.g., a peanut, reaction and edema at the site of obstruction may occur.
- Chronically, retained airway foreign bodies often present with misdiagnosis of upper respiratory tract infections, asthma, or pneumonia.
- A child is considered full stomach because the excitement and distress will delay the stomach emptying. There are no benefits from waiting for stomach emptying.
- Chest x- ray is done , It provides direct evidence if the aspirated object is radiopaque. If the aspirated foreign body is radiolucent, indirect evidence can be obtained by demonstrating hyperinflation of the affected lung (due to air trapping) and shifting of the mediastinum toward the opposite side on expiratory chest radiograph. Atelectasis occurs as a late finding, distal to the obstruction.
- Premedication:
  - Administration of atropine (10-20 µg/kg i.v.) or glycopyrrolate (3-5 µg/kg i.v.) is useful to decrease the likelihood of bradycardia from vagal stimulation during endoscopy.
  - Dexamethasone is frequently given prophylactically to decrease sub-glottic edema

**Intraoperative Management:**

- Inhalational induction (by sevoflurane and oxygen) with the patient breathing spontaneously is usually mandatory due to presence of airway obstruction.
- The foreign body is removed by laryngoscopy and a McGill forceps (sometimes) or rigid bronchoscopy (usually).
- Total i.v. anesthesia may be used to maintain anesthesia during bronchoscopy to avoid exposing the surgeon to inhaled anesthetics and to maintain anesthesia during cessation of inhalational anesthesia.
- Spraying the larynx with a lidocaine solution is effective in preventing laryngospasm when endoscopic manipulation is performed.
- If complete airway obstruction arises, the foreign body needs to be extracted rapidly or pushed down usually to the right main-stem bronchus. This sometimes can be lifesaving; otherwise, an emergency tracheostomy or cricothyrotomy is performed.
- Muscle relaxants (especially long acting) are often avoided during bronchoscopy because:
  - Positive airway pressures could contribute to distal migration of foreign bodies, complicating their extraction.
  - If foreign bodies produce a ball-valve phenomenon, the use of positive-pressure ventilation of the lungs could contribute to hyperinflation and possibly pneumothorax. Skeletal muscle paralysis produced with succinylcholine or short-acting nondepolarizing muscle relaxants may be required to remove the bronchoscope and foreign body if the object is too large to pass through the moving vocal cords. After completion of bronchoscopy, the patient is intubated with an endotracheal tube and extubated when the appropriate criteria of extubation are met.
- After the rigid bronchoscope is placed in the trachea, the anesthetic circuit can be attached to the breathing side port of the bronchoscope to maintain ventilation or an apneic oxygenation technique is used to maintain intermittent ventilation after removal of the endoscope when the oxygen saturation is decreased.
- All patients should be observed closely during the recovery period for airway edema and respiratory compromise.

**Postoperative Management :**

- **Postoperative laryngeal stridor** is common; therefore, the patient should be closely observed for 12 hours in a high dependency unit.
- **Nebulized racemic epinephrine is useful in treating post-intubation croup.**
- **Chest radiographs should be obtained after bronchoscopy to detect atelectasis or pneumothorax.**
- **Postural drainage and chest percussion enhance clearance of secretions and decrease the subsequent risk of infections.**

## *NASAL & SINUS SURGERY*

**Anesthetic Problems:**

- Increased blood loss; so, nasal preparation, head up, and controlled hypotension are needed.
- Difficult mask ventilation.
- Associated allergic reactions.
- Pharyngeal pack.
- Eye protection.

**Preoperative Management:**

**PREPARATION OF THE NOSE WITH LOCAL ANESTHETIC & VASOCONSTRICTION**

- Lidocaine 2% with epinephrine 1: 100 000-1: 200 000 solution.
- Cocaine 4-10% as an analgesic and vasoconstrictive agent (maximal intra-nasal dose 1.5-3 mg/kg) administered by spray, paste gel, soaked swabs, or infiltration.

Preparation of the nose is performed by:

*1. Curtiss Simplified Moffatt's Method:*

• *The patient lies supine with his head fully extended* over the end of the trolley and supported by an assistant. A round-ended angulated needle is inserted with its tip directed along the floor of the nose ,When the angle of the needle is reached, redirect the tip towards the roof of the nose and 2 mL of local anesthetic solution are to be deposited when the tip has made contact. The procedure is repeated in the other nostril. The patient remains in this position for 10 min and asked to sit upright and spit out any residual solution which trickles into the pharynx.

• *In anesthetized patients, another modification of Moffatt's methods* can be applied. Instillation of 10 mL of diluted cocaine into each nostril with the head extended is performed after placement of a gauze throat pack which holds the solution in the nose for obtaining a maximum effect.

*2. Packing the Nose with gauze or cotton tipped applicators soaked with local anesthetics* and left for 10 min is also used.

Advantages of Moffatt's method over nasal packing:

• Minimal patient discomfort during preparation.

• Lower risk of cocaine toxicity.

Nasal preparation for nasal polypectomy and diathermy of turbinates are omitted by many surgeons because nasal mucosa will shrink to a degree that surgery becomes difficult.

Presence of nasal polyps is often associated with allergic reactions such as

- bronchial asthma and
- allergy to aspirin and non-steroidal anti-inflammatory drugs e.g., ketorolac.

**Premedications :** Sedatives are essential.

## Intraoperative Management:

**Choice Of Anesthesia :**

a. **Local infiltration:** with sedation is rarely done.
b. **General Anesthesia:** is more commonly used.

• **Difficult face mask ventilation** is expected due to preoperative nasal obstruction e.g., polyps, deviated septum. Oral airway during mask ventilation is very helpful.

• **Induction: Smooth induction** is preferred to avoid coughing and straining because they increase venous congestion resulting in increased bleeding.

N.B.: Do not spray the larynx with local anesthetic before intubation to allow full return of laryngeal reflexes on recovery.

• **Intubation** is performed by a **non-kinkable cuffed** endotracheal tube either oral RAE tube or Mallinckrodt critical care tube.

• **The posterior pharynx should be packed** by a two-inch ribbon gauze to absorb blood and decrease the risk of blood aspiration. The presence of the pack should be marked by writing on the strapping which secures the tube or over patient's forehead to remind the anesthesiologist to remove it at the end of surgery. Tying the pack to the endotracheal tube is another alternative.

• **The patient's eye should be taped** closed to **avoid corneal abrasion** due to the proximity of the surgical field.

• **Surgeries to control epistaxis** (e.g., ligation of the maxillary artery) are anesthetized with the same anesthetic management of post-tonsillectomy bleeding. Patients are usually elderly hypertensive.

**Patient Position :** 10 degree head up.

**Monitoring :** Besides the standard monitors, ECG is used to detect arrhythmias which occur commonly during face surgery.

**Maintenance :**

• Controlled ventilation with MR is strongly recommended due to the potential neurological or ophthalmic complications that may occur if the patient moves during sinus instrumentation.

• Controlled hypotension may be required.

**Extubation :** • **Smooth extubation** may be used to avoid coughing and straining, but this may increase **the risk of aspiration**; so, **awake extubation in the lateral position is the usual.**
• Removal of the pack then suction of the pharynx are performed while the head is in lateral position.
• An oral airway should be placed before removal of the endotracheal tube to provide a patent airway in the presence of surgical nasal packing.

## *Ear surgery*

### Anesthetic Problems:

1- Bleeding with microsurgery.
2- Effect of N2O.
3- Identification of facial nerve.
4- Postoperative nausea and vomiting.
5- Bandaging of the ear.

### Preoperative Management:

premedications :

• Sedatives are important (especially if hypotensive anesthesia is planned).
• Atropine is omitted (especially if hypotensive anesthesia is planned).

### Intraoperative Management:

A **non-kinkable** oral endotracheal tube is usually used.

**1. Measures decreasing bleeding during microsurgery** (one drop of blood can obscure the field).
• **Smooth induction** to avoid coughing and straining and avoid hypertensive response to intubation.
• 10-15 degree **head up tilt** to help venous drainage.
• **Controlled hypotensive anesthesia.**
• Local infiltration of epinephrine where its concentration must not be > 1: 100 000. Only 10 ml. are given at a time which can be repeated twice within 30 min.

**2. the effect of N2O on the middle ear :**

Normally, there is no effect of N2O on the middle ear due to presence of a patent Eustachian tube. In chronic inflammation such as otitis media or sinusitis, the Eustachian tube will be obstructed and the middle ear cavity becomes closed. Therefore, N2O will diffuse rapidly into the middle ear faster than nitrogen (N2) leaving it (the major component of air) as N2O is 34 times more soluble in blood than N2, resulting in an increased pressure which is maximum about 4 min after induction. This causes hearing loss and rupture of the tympanic membrane.

During tympanoplasty, the middle ear is open to the atmosphere and there is no pressure build-up. Once the surgeon has placed a tympanic membrane graft, the middle ear becomes a closed space again. N2O can diffuse into this space leading to an increase in the middle ear pressure with displacement of the graft. Also, discontinuing N2O after graft placement will create a negative middle ear pressure; so, the graft may be displaced also. N2O is either entirely avoided during tympanoplasty or discontinued prior to graft placement by 10-15 min.

**3. identification of facial nerve during surgery :**

This is performed by **a peripheral nerve stimulator.** Theoretically, this needs a non-paralyzed patient, but actually, most anesthesiologists use muscle relaxants.

**4. recovery :**

• **Ear bandaging at the end of surgery causes** movement of the head. It must be anticipated and supervised by the anesthesiologist. Deep extubation is advised to avoid gagging and coughing on the endotracheal tube which increases bleeding
• Ear surgery, especially if **labyrinthine function** is disturbed, produces **postoperative vertigo and vomiting**; so, anti-emetics are essential.
• **Assess facial nerve function postoperatively.**

*1. The most serious complication of tonsillectomy is postoperative hemorrhage, Approximately 75% of postoperative tonsillar hemorrhages occur within how many hours of surgery ;*

A. 1

B. 6

C. 12

D. 24

E. 48

*2. All of the following statements regarding emesis after tonsillectomy are true EXCEPT:*

A. It occurs in about 30% to 65% of patients.

B. It may result from central stimulation of the chemoreceptor trigger zone.

C. It is sometimes responsive to meperidine.

D. It may be avoided by decompressing the stomach before extubation.

E. It may be treated with 0.10 to 0.15 mg/kg of intravenous ondansetron.

**3. All of the following statements regarding negative pressure pulmonary edema are true EXCEPT:**

A. It is associated with a decrease in pulmonary hydrostatic pressure.

B. It is caused by the sudden relief of a previously obstructed airway.

C. Intrapleural pressure in an obstructed airway may reach −30 cm $H_2O$.

D. It may be prevented by the application of continuous positive airway pressure.

E. It is associated with diffuse bilateral infiltrates on chest radiographs.

**4. The most common cause of stridor in infants is:**

A. peritonsillar abscess

B. foreign body obstruction

C. laryngomalacia

D. croup

E. epiglottitis

**5. Regarding the pain associated with tonsillectomy, which of the following statements is TRUE :**

A. It is usually less severe when intraoperative hemostasis is achieved with laser and electrocautery rather than with sharp surgical dissection and ligation of blood vessels.

B. It is usually less severe than after adenoidectomy.

C. Its severity is often reduced when the peritonsillar space is infiltrated with local anesthetic.

D. Its occurrence may be reduced with the intraoperative use of corticosteroids.

E. It is usually related to underlying infection.

**6. A Le Fort III fracture:**

A. passes above the floor of the nose but involves the lower third of the nasal septum

B. crosses the medial wall of the orbit, including the lacrimal bone

C. passes through the base of the nose and the orbital plates

D. is a horizontal fracture of the maxilla

E. always involves a fracture of the cribiform plate of the ethmoid bone

**7. A rigid bronchoscope with an internal diameter of 3.0 mm would have an external diameter of approximately:**

A. 3.5 mm

B. 4.0 mm

C. 5.0 mm

D. 6.0 mm

E. 7.0 mm

**8. The most common site of cervical spine injury in patients presenting with facial fractures sustained in high-velocity trauma is:**

A. C1–C2

B. C2–C3

C. C3–C4

D. C4–C5

E. C6–C7

**9. Which statement(s) about peritonsillar abscesses is/are TRUE?**

A. They are located below the laryngeal inlet.

B. They usually interfere with ventilation by mask.

C. They usually impair vocal cord visualization.

D. They often require surgical intervention.

# MCQ : Mon. / 14 / Mar. / 2022

## Dr. DAWOOD

**1-Hypotension during subarachnoid block may be due to**

1- قد يكون انخفاض ضغط الدم أثناء الإحصار تحت العنكبوتية ناتجًا عن
أ- الحصار اللاإرادي للعقدة
ب- تضيق الوريد.
ج - كتلة من الجذور الظهرية
د- تنشيط المركز الحركي.
هـ- فرط حجم الدم

- **a-** Preganglionic autonomic blockade
- **b-** Venoconstriction.
- **c-** Block of the dorsal roots
- **d-** Stimulation of the vasomotor centre
- **e-** Hypervolemia

**2-During one lung anaesthesia in the lateral position, $Pa0_2$ depends up the following except:**

2-خلال تخدير الرئة في الوضعية الجانبية ، يعتمد Pa02 على ما يلي باستثناء:
ا. مستوحى 02
ب- النتاج القلبي
ج- نضح الرئة عديمة التهوية.
د- الهيماتوكريت
ه- العودة الوريدية

- **a-** Inspired $0_2$
- **b-** Cardiac output
- **c-** Perfusion of the unventilated lung.
- **d-** Haematocrit
- **e-** Venous return

**3-The following is generally accepted method used to reduce suxamethonium muscle pain**

3-تعتبر الطريقة التالية مقبولة بشكل عام وهي تستخدم لتقليل آلام عضلات السوكساميثونيوم
أ- تخدير عميق قبل الاستخدام
ب- جرعة صغيرة مسبقة من مرخيات العضلات غير المزيلة للاستقطاب
ج- مسكن غير ستيرويدي سابق
د- الاستخدام المتزامن للمورفين
هـ- الإعطاء بجرعة كبيرة

- **a-** Deepening anaesthesia before use
- **b-** A prior small dose of non depolarizing muscle relaxant
- **c-** A prior non steroidal analgesic
- **d-** Concurrent use of morphine
- **e-** Administration by large dose

**4-During anaesthesia, signs of mismatched transfusion include**

4-أثناء التخدير ، تشمل علامات نقل الدم غير المتطابق
أ- ارتفاع الضغط الشرياني
ب- انقطاع النفس
ج- زرقة
د- بيلة دموية
ه- نمشات ملتحمة

- **a-** Raised arterial pressure
- **b-** Apnoea
- **c-** cyanosis
- **d-** Haematuria
- **e-** Conjunctival petechiae

**5-Oliguria postoperatively is associated with**

5-قلة البول بعد الجراحة يرتبط مع
أ- تخدير ميثوكسي فلوران
ب- ارتفاع الحرارة
ج- انخفاض حرارة الجسم
د- نقص سكر الدم.
هـ- نقص حجم الدم

- **a-** Methoxyflurane anaesthesia
- **b-** Hyperthermia
- **c-** Hypothermia
- **d-** Hypoglycaemia.
- **e-** Hypovolaemia

**6-The following give an early and reliable indication of the occurrence of air embolism**

6- ما يلي يعطي إشارة مبكرة وموثوقة لحدوث الانسداد الهوائي
أ- تخطيط القلب
ب- مراقبة ضغط الدم.
ج- ثاني أكسيد الكربون في نهاية المد.
د- مقياس التأكسج النبضي.
هـ- تسمع المريء

- **a-** ECG
- **b-** BP monitoring.
- **c-** End-tidal $CO_2$
- **d-** Pulse oximeter
- **e-** Oesophageal auscultation

**7-During anesthesia in a patient with glomerulonephritis for laparotomy**

- **a-** Mannitol 1.5 g/kg should be given
- **b-** Droperidol should be avoided as it decreases renal blood flow
- **c-** Halothane should be avoided because it is nephrotoxic
- **d-** A sympathomimetic should be given to increase glomerular filtration rate (GFR)
- **e-** Alteration in plasma protein concentrations may affect neuromuscular blocking activity

7-اثناء التخدير لمريض مصاب بالتهاب كبيبات الكلى من اجل فتح البطن
أ- يجب إعطاء مانيتول 1.5 جم / كجم
ب- يجب تجنب دروبيريدول لأنه يقلل من تدفق الدم الكلوي
ج- يجب تجنب هالوثان لأنه سام للكلى
د- يجب إعطاء محاكيات الودي لزيادة معدل الترشيح الكبيبي (GFR)
ه- قد يؤثر التغيير في تركيزات بروتين البلازما على نشاط الحجب العصبي العضلي

**8-Cardiac arrhythmias during halothane anesthesia with the following except**

- **a-** Are less frequent during light anesthesia
- **b-** Are more frequent during hypercapnia
- **c-** Can be terminated using a beta-blocker
- **d-** Are more frequent in the presence of hyperkalaemia.
- **e-** May result in a reduction of blood pressure

8-عدم انتظام ضربات القلب أثناء تخدير هالوثان باستثناء ما يلي
أ- تكون أقل تكرارا أثناء التخدير الخفيف
ب- تكون أكثر تكرارا أثناء فرط ثنائي أكسيد الكربون
ج- يمكن إنهاؤها باستخدام حاصرات بيتا
د- تكون أكثر تكرارا في وجود فرط بوتاسيوم الدم.
هـ- قد يؤدي إلى انخفاض ضغط الدم

**9-Control of intraocular pressure during induction of anaesthesia**

- **a-** Concerns the same factors as those controlling intracranial pressure
- **b-** Can be achieved safely with ketamine
- **c-** May indicate the need for suxamethonium.
- **d-** Is important to minimise pulmonary aspiration.
- **e-** Is necessary during squint surgery

9- التحكم في ضغط العين أثناء التخدير
أ- تتعلق بنفس العوامل مثل تلك التي تتحكم في الضغط داخل الجمجمة
ب- يمكن تحقيقه بأمان مع الكيتامين
ج- قد يشير إلى الحاجة إلى السوكساميثونيوم.
د مهم لتقليل الطموح الرئوي. ضرورية أثناء جراحة الحول

**10-Postoperative vomiting with the following except**

- **a-** Is always accompanied by nausea
- **b-** Is less frequent when hyoscine is given as part of premedication
- **c-** Increases the risk of postoperative pulmonary atelectasis
- **d-** Is more likely if opioid analgesics are given postoperatively.
- **e-** Is more common with spinal anesthesia

10-القيء بعد العملية الجراحية مع ما يلي ما عدا
ا-الالتهاب الرئوي المصحوب دائمًا بالغثيان
ب-يكون bcde أقل تواترًا عند إعطاء الهيوسين كجزء من العلاج التحضيري
ج-يزيد من خطر الإصابة بانخماص الرئة بعد الجراحة
د- ويكون أكثر احتمالًا إذا تم إعطاء المسكنات الأفيونية بعد الجراحة.
ه - هو أكثر شيوعا مع التخدير النخاعي

**11-Central cyanosis in a patient in the immediate postanaesthetic recovery period may be due to the following except**

- **a-** Shivering
- **b-** Replacement of blood by crystalloid fluid.
- **c-** Malignant hyperthermia
- **d-** Diffusion hypoxia
- **e-** Low cardiac output

**12-A young healthy adult presents for simple thyroidectomy,**

- **a-** Preoperative thyroid function testing is indicated.
- **b-** Thoracic inlet X-rays are indicated preoperatively
- **c-** Preoperative beta-blockers should be indicated
- **d-** Lugol's iodine should be given preoperatively to reduce vascularity
- **e-** Postoperative respiratory obstruction may occur due to tracheal collapse

11- الزرقة المركزية في المريض في فترة النقاهة بعد التخدير مباشرة قد تكون بسبب ما يلي باستثناء
أ- الارتعاش
ب- استبدال الدم بسائل بلوري.
ج- ارتفاع الحرارة الخبيث
د- نقص الأكسجة المنتشر
ه- انخفاض النتاج القلبي

**13-Inhalational induction may be used in the following circumstences:**

- **a-** Acute epiglottitis
- **b-** A patient with a 'full stomach',
- **c-** Cesarean section
- **d-** Tension pneumothorax
- **e-** Maxillary fracture

12-شاب بالغ يتمتع بصحة جيدة لاستئصال الغدة الدرقية البسيط ،
أ- يستطب اختبار وظائف الغدة الدرقية قبل الجراحة.
ب- يتم الإشارة إلى الأشعة السينية لمدخل الصدر قبل الجراحة
ج- يجب الإشارة إلى حاصرات بيتا قبل الجراحة.
د-يجب إعطاء اليود لوجول قبل الجراحة

13-لتقليل الأوعية الدموية. الظروف التالية:
أ- التهاب لسان المزمار الحاد
ب- مريض "امتلاء المعدة"
ج- عملية قيصرية
د- استرواح الصدر الضاغط
هـ- كسر الفكين

**14-Nasotracheal intubation is contraindicated in the following**

- **a-** Fractured base of skull
- **b-** Exodontia
- **c-** Neonates.
- **d-** Gulllain-Barre syndrome

14- التنبيب الرغامي هو بطلان في الحالات التالية
أ- كسر قاعدة الجمجمة
ب- خروج الأسنان
ج- حديثي الولادة.
د- متلازمة جوللين باريه

هـ- احتشاء عضلة القلب غير المصحوب بمضاعفات

**e-** Uncomplicated myocardial infarction

**15-When administering anaesthesia to a patient suspected of being susceptible to malignant hyperpyrexia (MHS),**

**a-** Premedication with morphine and atropine is acceptable
**b-** Pancuronium is the only good choice of muscle relaxant
**c-** Nitrous oxide should be avoided
**d-** Dantrolene should be immediately available
**e-** Regional blockade is avoided

15-عند إعطاء التخدير لمريض يشتبه في تعرضه لفرط الحمى الخبيث (MHS) ،
أ- التخدير مع المورفين والأتروبين مقبول
ب- البانكورونيوم هو الخيار الوحيد الجيد لمرخي العضلات
ج- يجب تجنب أكسيد النيتروز
د- يجب أن يكون دانترولين متاحًا على الفور. ه- تجنب الحصار الإقليمي

**16-Severe pulmonary barotrauma may be avoided by**

**a-** A compliant reservoir bag
**b-** Supplying gas by pipeline rather than by cylinder
**c-** Use of non-interchangeable breathing system connections.
**d-** Use of a blow off valve at 33 kPa in the inspiratory limb
**e-** Insertion of bilateral chest tube

16- يمكن تجنب الصدمات الرئوية الشديدة
أ- كيس خزان متوافق
ب- إمداد الغاز عن طريق الأنابيب بدلاً من الاسطوانة
ج- استخدام وصلات نظام تنفس غير قابلة للتبديل.
د- استخدام صمام تفريغ بقوة 33 كيلو باسكال في الطرف الشهيق.

**17-The following would be noticed within 10 minutes of intubation of the right main bronchus**

**a-** Hypetension
**b-** ECG
**c-** High ventilation pressure
**d-** Hypotension
**e-** Collapse of left lung

17- يمكن ملاحظة ما يلي في غضون 10 دقائق من تنبيب القصبة الهوائية الرئيسية اليمنى
أ- ارتفاع ضغط الدم
ب- مخطط كهربية القلب
ج- ارتفاع ضغط التهوية
د- انخفاض ضغط الدم
هـ- انهيار الرئة اليسرى

**18-Ruptured pulmonary alveolus may cause**

**a-** Pneumopericardium
**b-** Superior vena cava syndrome
**c-** Pneumoperitonium
**d-** Subcutaneous emphysema
**e-** Hypothermia

18- تمزق الحويصلات الهوائية الرئوية قد يسبب ذلك
أ- التهاب الرئة
ب- متلازمة الوريد الأجوف العلوي
ج- الالتهاب الرئوي
د- انتفاخ تحت الجلد
هـ- انخفاض حرارة الجسم

**19-Regurgitation of gastric contents is likely**

**a-** When the lower oesophageal barrier pressure is increased
**b-** In the absence of anticholinergic drugs
**c-** In a patient with a hiatus hernia
**d-** If the patient with an empty stomach
**e-** With regional anesthesia

19- احتمالية حدوث ارتجاع في محتويات المعدة
أ- عند زيادة ضغط الحاجز المريئي السفلي ب-في حالة عدم وجود أدوية مضادات الكولين
ج في مريض يعاني من فتق فجوة
د إذا كان المريض يعاني من معدة فارغة
هـ- مع التخدير الموضعي

**20-With epidural anesthesia the following are true except**

**a-** May be performed at any vertebral level
**b-** Expands the capacity of the intravascular compartment.
**c-** Eliminates the risk of vomiting and regurgitation
**d-** Is associated with urinary retention
**e-** Bupivacaine 0.75% is a suitable agent

20- مع التخدير فوق الجافية فإن ما يلي يكون صحيحًا باستثناء
أ- يمكن إجراؤها على أي مستوى فقري
ب- يوسع من سعة الحيز داخل الأوعية الدموية.
ج- يزيل خطر القيء والقلس المرتبط باحتباس البول
ه- بوبيفاكائين 0.75٪ عامل مناسب

**21-After suxamethonium 50 mg, apnoea persists after one hour**

**a-** Treatment with stored blood is indicated
**b-** Probably an atypical cholinesterase is present

21- بعد سوكساميثونيوم 50 مجم ، يستمر انقطاع النفس بعد ساعة واحدة
أ- يستطب العلاج بالدم المخزن.
ب- ربما يوجد إنزيم الكولينستريز غير النمطي

c- Treatment with cholinesterases is indicated
d- This may be due to high serum K+ concentration
e- Screening of the patient's family is mandatory

ج- يشار إلى العلاج بالكولينستريز
د- قد يكون هذا بسبب ارتفاع تركيز مصل K
ه- فحص أسرة المريض إلزامي

**22-In patient with hypokalemia**

a- Muscle weakness is not present
b- The ECG shows tall T waves
c- Alkalosis exacerbates the hypokalaemia
d- The replacement should be oral only
e- Digoxin therapy should be withdrawn

22- مريض يعاني من نقص بوتاسيوم الدم
أ- عدم وجود ضعف في العضلات
ب- يظهر مخطط كهربية القلب موجات T طويلة
ج- القلاء يؤدي إلى تفاقم نقص بوتاسيوم الدم د- يجب أن يكون البديل عن طريق الفم فقط.
ه-يجب إيقاف العلاج بالديجوكسين

**23-In day case anaesthesia**

a- Only patients of ASA grade III are accepted
b- Propofol is a suitable induction agent
c- Spinal anesthesia is the best technique
d- Tracheal intubation is mandatory
e- Local anaesthetic nerve blockade is contraindicated because long lasting paralysis

23 في حالة التخدير اليوم
أ- يتم قبول المرضى من الدرجة الثالثة فقط ب- البروبوفول هو عامل تحريض مناسب
ج- التخدير النخاعي هو أفضل تقنية
د- التنبيب الرغامي إلزامي.
هـ- يمنع استخدام التخدير الموضعي لحصار العصب بسبب شلل طويل الأمد

**24-Injection of thiopentone and suxamethonium is followed by muscle stiffness within 15 s This may be due to**

a- Atypical cholinesterase
b- Drug interaction
c- Familial periodic paralysis.
d- Malignant hyperpyrexia
e- Dystrophia myotonica

24- حقن ثيوبينتون وسوكساميثونيوم متبوع بتصلب عضلي خلال 15 ثانية وهذا قد يكون بسبب
أ- الكولينستريز اللانمطي
ب- التفاعل الدوائي
ج- الشلل الدوري العائلي.
د- فرط الحمى الخبيث
ه- dystrophia myotonica

**25-In outpatient dental anaesthesia**

a- Inhalational induction with high (> 80%) concentrations of nitrous oxide is a useful method
b- A gauze throat pack should be used if intubation is mandatory.
c- Hypertension is common
d- Intravenous induction of anesthesia may be undertaken with the patient seated in the dental chair
e- Profound narcotic analgesia is useful

25-تخدير الأسنان في العيادات الخارجية
أ يعد الاستنشاق باستخدام تركيزات عالية (> 80٪) من أكسيد النيتروز طريقة مفيدة
ب- يجب استخدام عبوة شاش إذا كان التنبيب إلزاميًا.
ج- ارتفاع ضغط الدم شائع
د-قد يتم إجراء التخدير في الوريد مع جلوس المريض على كرسي الأسنان.
ه- المسكنات المخدرة العميقة مفيدة

**26-During rapid sequence induction of anesthesia, the following are true except**

a- The patient must be on a tipping trolley or table
b- Suction must be immediately available
c- 100% oxygen is breathed for at least 15 minutes before induction
d- The cricoid cartilage should be compressed
e- Thiopentone is given at a rapid rate .

26-أثناء التحريض المتسلسل السريع للتخدير ، يكون ما يلي صحيحًا باستثناء
أ- يجب أن يكون المريض على عربة أو طاولة
ب- يجب أن يكون الشفط متاحًا على الفور
ج- يتم تنفس الأكسجين بنسبة 100٪ لمدة 15 دقيقة على الأقل قبل التحريض
د- يجب ضغط الغضروف الحلقي. .
هـ- يتم إعطاء ثيوبينتون بمعدل سريع

**27-Postoperative hypoxaemia may occur as a result of**

a- Mild hypercapnia
b- Hypertension
c- Central depression of ventilation.
d- Decreased V/Q mismatch
e- Hypoglycemia

27-قد يحدث نقص تأكسج الدم بعد الجراحة نتيجة
أ- فرط ثاني أكسيد الكربون الخفيف.
ب- ارتفاع ضغط الدم.
ج- انخفاض مركزي في التهوية.
د- انخفاض عدم تطابق V / Q e
ه- نقص السكر في الدم

**28-The neuromuscular blocking drugs in clinical use**

- **a-** Are all metabolised by acetylcholine
- **b-** Exhibit tetanic fade if the block is depolarising
- **c-** Produce phase II block when curare-like drugs are used.
- **d-** Not produce post-tetanic facilitation with curare-like drugs
- **e-** Produce initial fasciculation when the drug is an agonist

28- أدوية الحصر العصبي العضلي في الاستعمال الإكلينيكي
أ- يتم استقلابها جميعًا بواسطة الأسيتيل كولين.
ب- إظهار التلاشي الكزازي إذا كانت الكتلة مزيلة للاستقطاب.
ج- إنتاج المرحلة الثانية من كتلة عند استخدام أدوية شبيهة بالكوريار.
د- عدم إنتاج تسهيلات ما بعد الكزاز باستخدام الأدوية الشبيهة بالكاراري.
هـ- إنتاج التحزُّم الأولي عندما يكون الدواء ناهضًا

**29-After massive inhalation of gastric acid the following may result except**

- **a-** Lung abscess
- **b-** Hypercapnia
- **c-** Bacteraernia
- **d-** Hypervolaemia
- **e-** Destruction of surfactant

29-بعد استنشاق كميات كبيرة من حمض المعدة قد ينتج عن ذلك ما عدا
ا-خراج الرئة
ب- فرط ثنائي أكسيد الكربون
ج- البكتيريا
د- فرط حجم الدم
ه- تدمير الفاعل بالسطح

**30-Antagonism of neuromuscular block**

- **a-** Can be achieved with edrophonium
- **b-** Is unnecessary if the train-of-four (TOF) ratio is < 0.3
- **c-** Occurs only if atropine is used with neostigmine
- **d-** Is unnecessary if the patient can sustain a head lift for 10 min.
- **e-** Can be achieved with physostigmine

30- معاداة الكتلة العصبية العضلية
أ- يمكن تحقيقه باستخدام edrophonium bls
ب- غير ضروري إذا كانت نسبة تدريب الأربعة (TOF) 0.3>
ج- يحدث فقط إذا تم استخدام الأتروبين مع النيوستيغمين إذا كان المريض يستطيع تحمل د-عملية شد الرأس لمدة 10 دقائق
ه- يمكن أن يتحقق مع فيزوستيغمين

**31-Success of cricoid pressure in prevention of regurgitation of gastric contents depends upon the following except**

- **a-** Absence of a nasogastric tube
- **b-** An intact cricoid cartilage
- **c-** The oesophagus being pressed against the vertebral body
- **d-** Presence of an assistant
- **e-** Preoxygenation for 5 minutes

31-نجاح الضغط الحلقي في منع ارتجاع محتويات المعدة يعتمد على ما يلي باستثناء
أ- عدم وجود أنبوب أنفي معدي
ب- غضروف حلقي سليم
ج- ضغط المريء على الجسم الفقري
د- وجود مساعد
ه- الأكسجة الأولية لمدة 5 دقائق

**32. Which of the following is a contraindication for using a laryngeal mask airway ?**

a) When inhalational anaesthesia is required
b) Large obstructive lesion in the oropharynx
c) Maintaining airway during difficult intubation
d) Emergency management of airway in failed intubation
e) Regional block with light general anesthesia

32. أي مما يلي هو موانع لاستخدام قناع الحنجرة؟
أ) عندما يكون التخدير الاستنشاقي مطلوبًا ب) آفة انسداد كبيرة في البلعوم
ج) الحفاظ على مجرى الهواء أثناء التنبيب الصعب
د) إدارة طارئة للمجرى الهوائي في حالة فشل التنبيب
هـ) كتلة إقليمية مع تخدير عام خفيف

**33. The following are anticholinesterases:**

a) lidocaine
b) neostigmine
c) prilocaine
d) ranitidine
e) atropine

33- وفيما يلي مضادات الكولين:
أ) ليدوكائين
ب) نيوستيغمين
ج) بريلوكائين
د) رانيتيدين
هـ) أتروبين

**34. Dopamine antagonists cause:**

34. Dopamine antagonists cause:

a) renal artery vasodilatation
b) hyperthermia
c) antiemetic effects
d) a rise in heart rate
e) a rise in the apnoeic threshold for $CO_2$

34. مضادات الدوبامين تسبب:
أ) توسع الأوعية الدموية في الشريان الكلوي ب) ارتفاع الحرارة
ج) تأثيرات مضادة للقيء
د) ارتفاع في معدل ضربات القلب
هـ) ارتفاع عتبة انقطاع التنفس بالنسبة لثاني أكسيد الكربون

**35. Headache after spinal anaesthesia:**

a) is less likely with a 26G than with a 22G needle
b) is due to an increase in cerebrospinal fluid pressure
c) is unlikely to develop after 24 hours
d) may be accompanied by hypertension
e) is more frequent in the elderly

35. صداع بعد التخدير النخاعي:
أ) أقل احتمالا مع 26 جم من إبرة 22 جم ب) يرجع إلى زيادة ضغط السائل النخاعي
ج) من غير المرجح أن يتطور بعد 24 ساعة
د) قد يكون مصحوبًا بارتفاع ضغط الدم
هـ) أكثر شيوعًا عند كبار السن

**36. Tracheal deviation to the right can be caused by the following except :**

a) a large left pleural effusion
b) right upper lobe fibrosis
c) a right pneumothorax
d) a retrosternal goitre
e) a previous right pneumonectomy

36. يمكن أن يحدث انحراف القصبة الهوائية إلى اليمين بسبب ما يلي باستثناء:
أ) الانصباب الجنبي الأيسر الكبير
ب) تليف الفص العلوي الأيمن
ج) استرواح الصدر الأيمن
د) تضخم الغدة الدرقية خلف القص
هـ) استئصال الرئة الأيمن السابق

**37. The following should decrease the risk of severe barotrauma except:**

a) a compliant reservoir bag
b) a pressure relief valve set at 70 cm $H_20$
c) non-interchangeable connections in a circle system
d) draw-over anaesthesia
e) use of cylinders rather than piped gas supplies

37. ينبغي أن يقلل ما يلي من خطر الإصابة بالرضح الضغطي الحاد باستثناء:
أ) كيس خزان متوافق
ب) تم ضبط صمام تنفيس الضغط عند 70 سم ارتفاع 20
ج) وصلات غير قابلة للتبديل في نظام دائري د) تخدير السحب
هـ) استخدام أسطوانات بدلاً من إمدادات الغاز عبر الأنابيب

**38. In the myasthenic syndrome there is the following except**

a) Sensitivity to depolarising muscle relaxants
b) Sensitivity to non-depolarising muscle relaxants
c) Post-tetanic potentiation
d) Improvement with repeated muscle activity
e) Decreased voltage on the EMG

38. في متلازمة الوهن العضلي هناك ما يلي باستثناء
أ) الحساسية لمرخيات العضلات المزيلة للاستقطاب
ب) الحساسية لمرخيات العضلات غير المزيلة للاستقطاب
ج) تقوية ما بعد الكزاز
د) التحسن مع نشاط العضلات المتكرر
هـ) انخفاض الجهد الكهربي في مخطط كهربية العضل

**39. In phaeochromocytoma treated with beta blockers, there is:**

a) Postural hypotension
b) Decreased heart rate
c) Miosis
d) Cold peripheries
e) Increased systolic blood pressure

39. في ورم القواتم المعالَج بحاصرات بيتا:
أ) انخفاض ضغط الدم الوضعي
ب) انخفاض معدل ضربات القلب
ج) تقبض الحدقة
د) الأطراف الباردة
هـ) ارتفاع ضغط الدم الانقباضي

**40. In a patient with jaundice, the following suggest obstruction:**

a) No urobilinogen in urine
b) Increased stercobilinogen
c) Raised aspartate transaminase
d) Normal acid phosphatase
e) Normal alkaline phosphatase

40- في حالة مريض اليرقان ، يشير ما يلي إلى وجود انسداد:
أ) لا يوجد urobilinogen في البول
ب) زيادة ستيركوبيلينوجين
ج) الأسبارتات ترانساميناز المرتفع
د) الفوسفاتيز الحمضي العادي
هـ) الفوسفاتيز القلوي الطبيعي

**41. Prolonged irrigation of the bladder with isotonic saline for transurethral resection TUR is associated with:**

a) Hyperkalemia
b) Hypernatraemia
c) Hyponatraemia
d) Reduced osmolarity
e) Haemolysis

41. الري المطول للمثانة بمحلول ملحي متساوي التوتر من أجل استئصال البروستاتا عبر الإحليل يرتبط بما يلي:
أ) فرط بوتاسيوم الدم
ب) فرط صوديوم الدم
د) انخفاض الأسمولية
هـ) انحلال الدم

**42. In a patient who has had a traumatic quadriplegia for one week, the following are true except**

a) Intermittent positive pressure ventilation can cause hypotension
b) Suxamethonium sensitivity occurs
c) Retention of urine occurs
d) Increased tendon jerks occur
e) Steroids improve prognosis

42. في مريض يعاني من شلل رباعي رضحي لمدة أسبوع واحد ، يكون ما يلي صحيحًا باستثناء
أ) يمكن أن تتسبب التهوية بالضغط الإيجابي المتقطع في حدوث انخفاض ضغط الدم
ب) حدوث حساسية لسوكساميثونيوم
ج) يحدث احتباس للبول
د) حدوث زيادة في هزات الأوتار
هـ) تحسن الستيرويدات من التشخيص

**43-The following are intracellular buffers except**

a- bicarbonate
b- hydroxyapatite
c- albumin
d- carbonic acid
e- haemoglobin

43- فيما يلي مخازن مؤقتة داخل الخلايا باستثناء
أ- البيكربونات
ب- هيدروكسيباتيت
ج- الألبومين
د- حمض الكربونيك
ه- الهيموجلوبين

**44-Cardiac output is increased during**

a- tension pneumothorax
b- stimulation of sympathetic cardiac nerves
c- sleep
d- hypovolaemic shock
e- stimulation of the sinus nerve

44-زيادة النتاج القلبي أثناء
أ- استرواح الصدر التوتر
ب- تحفيز الأعصاب القلبية الودية
ج- النوم
د- صدمة نقص حجم الدم
ه- تحفيز العصب الجيوب الأنفية

**45-In the control of respiration**

a- hypoxic drive originates in the peripheral chemoreceptors
b- there is no significant hypoxic drive in a normal subject breathing air at sea level
c- the response to $CO_2$ is only in hypercarbia
d- the increased drive in exercise is due to incomplete oxygen equilibration in the pulmonary capillaries
e- the gasping respiration of shock is a baroreceptor reflex

45- التحكم في التنفس
أ- محرك ناقص التأكسج ينشأ في المستقبلات الكيميائية الطرفية
ب- لا يوجد دافع ناقص الأكسجين في الجسم الطبيعي الذي يتنفس الهواء عند مستوى سطح البحر
ج- الاستجابة لثاني أكسيد الكربون تكون فقط في حالة فرط الكربون
د- الدافع المتزايد في التمرين يرجع إلى عدم اكتمال موازنة الأكسجين في الشعيرات الدموية الرئوية
ه- التنفس اللهاث للصدمة هو انعكاس لمستقبلات الضغط

**46-Gas content of blood:**

a- the normal venous $PO_2$ is (70 mm Hg)
b- the normal venous oxygen saturation is 75%
c- at sea level and breathing air, 0.6 ml oxygen are dissolved in 100 ml blood containing 15 gm haemoglobin/dl
d- nitrogen is not carried in arterial blood .
e- at a $PCO_2$ of 5.2 kPa (40 mm Hg) and at sea level, 47 ml $CO_2$ are combined with haemoglobin at a concentration of 15gm/dl

46-محتوى الغاز في الدم:
أ- PO2 الوريدي الطبيعي هو (70 مم زئبق) ب- تشبع الأكسجين الوريدي الطبيعي 75٪
ج- عند مستوى سطح البحر وهواء التنفس ، يذوب 0.6 مل من الأكسجين في 100 مل من الدم يحتوي على 15 جم من الهيموجلوبين / دل
د- نيتروجين هو لا تحمل في الدم الشرياني.
هـ- عند PCO2 يبلغ 5.2 كيلو باسكال (40 مم زئبق) وعند مستوى سطح البحر ، يتم دمج

**47-The following can be found in normal arterial blood**

a- 5-10% carboxyhaemoglobin
b- 4% methaemoglobin
c- 2% free haemoglobin
d- 2% foetal haemoglobin
e- 25% reduced haemoglobin.

47- يمكن العثور على ما يلي في الدم الشرياني الطبيعي
أ- 5-10٪ كربوكسي هيموجلوبين
ب- 4٪ ميثيموجلوبين
ج - 2٪ هيموجلوبين خال
د- 2٪ هيموجلوبين جنيني
ه - 25٪ هيموجلوبين مخفض.

**48-In hypoxic hypoxia the following is true except**

a- can be caused by defective pulmonary oxygen transfer
b- can be caused by reduction in inspired $PO_2$
c- can be caused by depression of the respiratory centre
d- is unaffected by alveolar carbon dioxide concentration
e- is exacerbated by hypothermia.

48- في حالة نقص الأكسجة ، يكون ما يلي صحيحًا باستثناء
أ- يمكن أن يكون ناتجًا عن خلل في نقل الأكسجين الرئوي
ب- يمكن أن يكون ناتجًا عن انخفاض في PO2
ج- يمكن أن يكون سببه اكتئاب مركز الجهاز التنفسي
د- لا يتأثر بتركيز ثاني أكسيد الكربون السنخي
هـ- يتفاقم بسبب انخفاض حرارة الجسم.

**49-The effect of hypercarbia upon the oxyhaemoglobin dissociation curve is the following except**

a- shift the curve to the left
b- reduce the affinity of haemoglobin for oxygen
c- temperature dependent
d- masked by decreases in 2,3-DPG
e- enhanced in anaemia

49-تأثير فرط كاربيا على منحنى تفكك أوكسي هيموجلوبين هو كالتالي
أ- تحويل المنحنى إلى اليسار
ب- تقليل تقارب الهيموجلوبين للأكسجين
ج- المعتمد على درجة الحرارة
د- مقنع بالنقصان في 2،3DPG
ه- المعزز في فقر الدم

**50-Thiopentone**

a- at normal plasma pH, is only 25% bound to plasma proteins
b- is a thiosubstituted succinylurea
c- in 2.5% solution it has a pH greater than 10
d- after re-distribution, it is rapidly metabolised in the liver
e- its excretion is usefully accelerated by a forced alkaline diuresis

50-ثيوبنتون
أ- عند الرقم الهيدروجيني للبلازما العادي ، يكون 25 ٪ فقط مرتبطًا ببروتينات البلازما
ب- هو مادة سوكسينيل يوريا المستبدلة
ج- في محلول 2.5٪ يحتوي على درجة حموضة أكبر من 10
د- بعد إعادة التوزيع ، يتم استقلابه بسرعة في الكبد
ه- يتم تسريع إفرازه بشكل مفيد عن طريق إدرار البول القلوي القسري



## *Answers*

**1) a**

**2) e**

**3) b**

**4) d**

**5) e**

**6) c**

**7) e**

**8) a**

**9) a**

10) e

11) b

12) a

13) a

14) a

15) d

16) a

17) c

18) d

19) c

20) d

21) b

22) c

23) b

24) e

25) b

26) c

27) c

28) e

29) d

30) a

31) e

32) b

33) b

34) c

35) a

36) c

37) e

38) e

39) a

40) a

41) c

42) e

43) c

44) b

45) a

46) b

47) d

48) e

49) a

50) c