The Larynx

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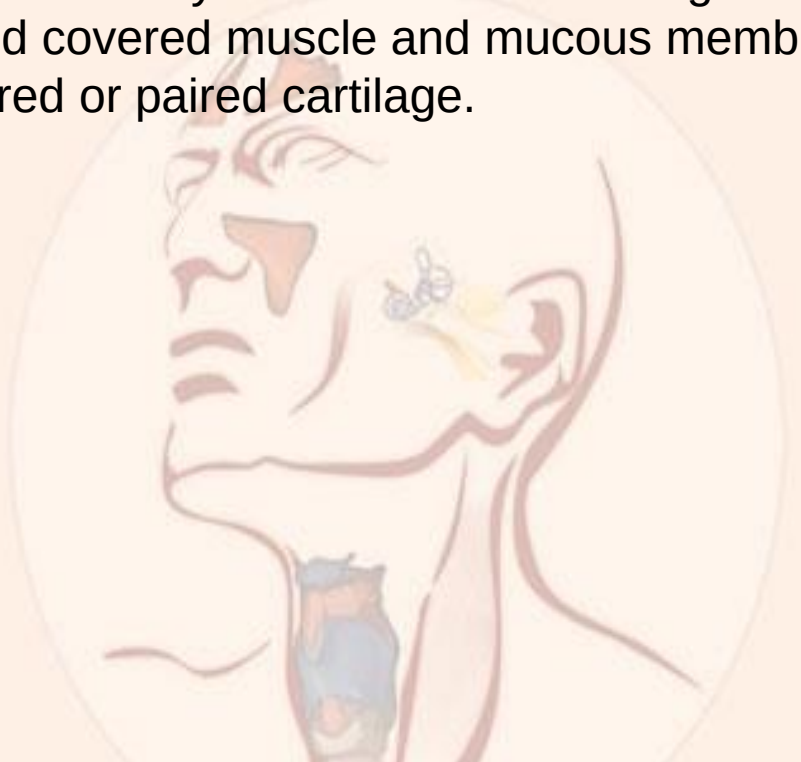
car. The larynx is an integral part of the respiratory system and is the organ of voice production .The larynx consists of a cartilaginous framework bound together by ligaments and covered muscle and mucous membrane. The cartilage of the larynx is either unpaired or paired cartilage.

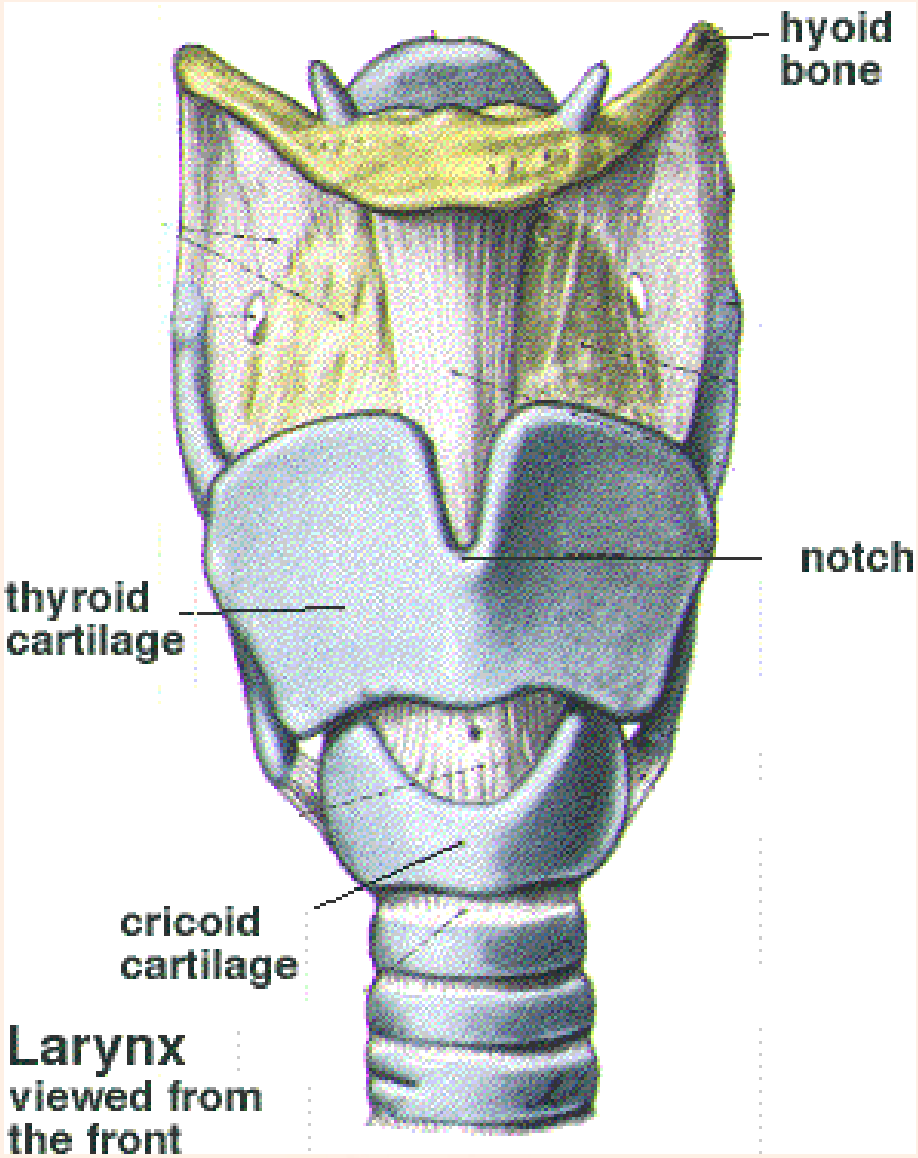
Unpaired cartilages:

1.Thyroid cartilage
2.Cricoid cartilage

Paired cartilages:

1.Arytenoid car.
2.Corniculate car.
3.Cuniform




hyoid bone
notch
thyroid cartilage
cricoid cartilage
Larynx
viewed from the front

Laryngeal Muscles:

Are of 2 types:

۞ **Intrinsic muscle of larynx:**

◙Abducors(opens):

It is one muscle (posterior cricoarytenoid muscle)paired muscle

◙ Adductors(closes)

●Lateral cricoarytenoid muscle,paired also.

●● interarytenoid muscle which is unpaired

◙Muscle adjust the tension of vocal cord

● Thyroarytenoid muscle with its specialized free edge portion,**vocalis** muscle

◙ Muscle adjust the length of vocal cord

● Cricothyroid muscle (the only intrinsic muscle which lies on the out side)

۞**Extrinsic muscle of larynx:**

◙Strap muscle of the neck

●Sternothyroid muscle

●●Sternohyoid muscle

●●●Thyrohyoid muscle

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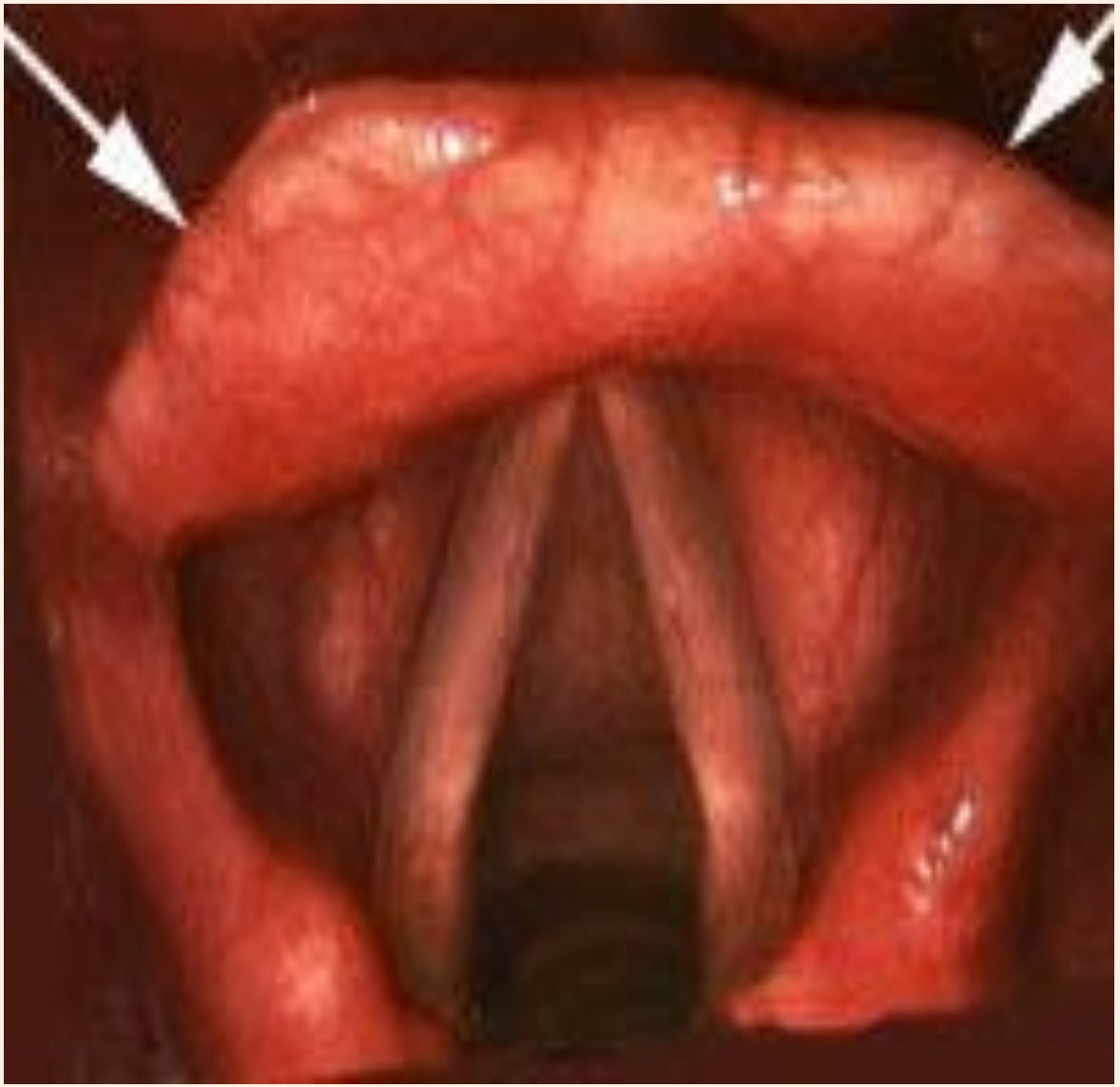

Nerve supply:

All above muscle are supplied by recurrent laryngeal nerve except cricothyroid muscle which is supplied by external laryngeal nerve which is branch of superior laryngeal nerve.

Recurrent laryngeal nerve is branch of vagus that has different courses on each side.

In the left side it passes under the aortic arch and ascend in the tacheo-oesophageal groove, entering the larynx underneath the inferior constrictor muscle.

Right recurrent laryngeal nerve is shorter than the left looping around the subclavian artery , because of its long intrathoracic course,the left recurrent laryngeal is more likely to be involved in cases of bronchogenic carcinoma

The recurrent laryngeal nerve is sensory to the mucosa below the vocal cord .while the internal laryngeal nerve is sensory to the mucosa of the larynx above the vocal cords.

Blood supply:

The larynx above the vocal cords is supplied and drained by the superior laryngeal artery and vein which enter the larynx through the thyrohyoid membrane the region below the cords is supplied and drained by the inferior laryngeal artery and vein branches of inferior thyroid artery.

Lymphatic drainage:

The vocal cords have no lymph drainage,

the supraglottis drains upwards via the superior laryngeal lymphatic pedicle which ends in the upper deep cervical chain.

The subglottics drain to both the prelaryngeal and paratracheal nodes and also directly to the lower deep cervical chain and the mediastinum.

Histology:

The larynx is lined by two different types of epithelium: squamous over the true vocal cords and the upper quarter of posterior surface of epiglottis and columnar ciliated over the rest of the larynx which commonly undergoes squamous metaplasia in response to air pollution and smoking.

Functions of the larynx:

- Phonation

  Vocal cords act as vibrator

- Protection of respiratory tract by:
  - Laryngeal elevation
  - Epiglottis
  - Sensory nerve supply(cough)
  - Vocal cords

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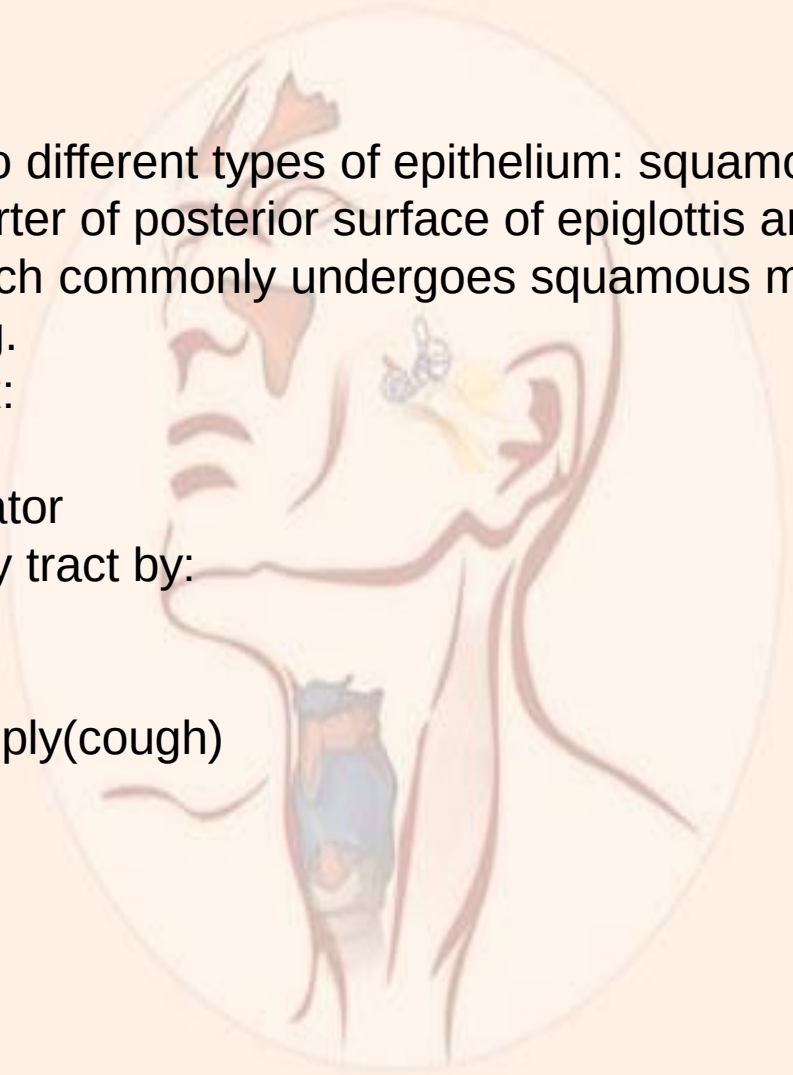


Laryngomalacia:

Characterized by flaccidity of supraglottic structures, it is the commonest laryngeal tridor (60%-70%).

Pathology:

●Softness or flabbiness and lack of consistency of the larynx.

●●Thinning and hypocellularity of the laryngeal cartilage.

●●●Wrinkled loose mucosa especially over the arytenoids cartilage.

Clinical features:

●Stridor is high pitch inspiratory stridor which is present at birth and become obvious when the child become active or have URTI.The stridor start to increase at the first 8 months and become maximum at 9-12 months,it is intermittent, during feeding or crying and more obvious during sleep especially when the child lies on his back, on hyperextension of the neck the stridor will decrease.

●●Long and narrow epiglottis prolapsed backwards with omega shape (**Ω**)

●●●Small,lax laryngeal inlet lead to sucked together by each inspiration.

●●●●The suprsglottis is deepened and narrow and the vocal cords are difficult to see

●●●●Elongated arytenoids car.covered by loose redundant mucosa and on inspiration. Crossing one over the other.

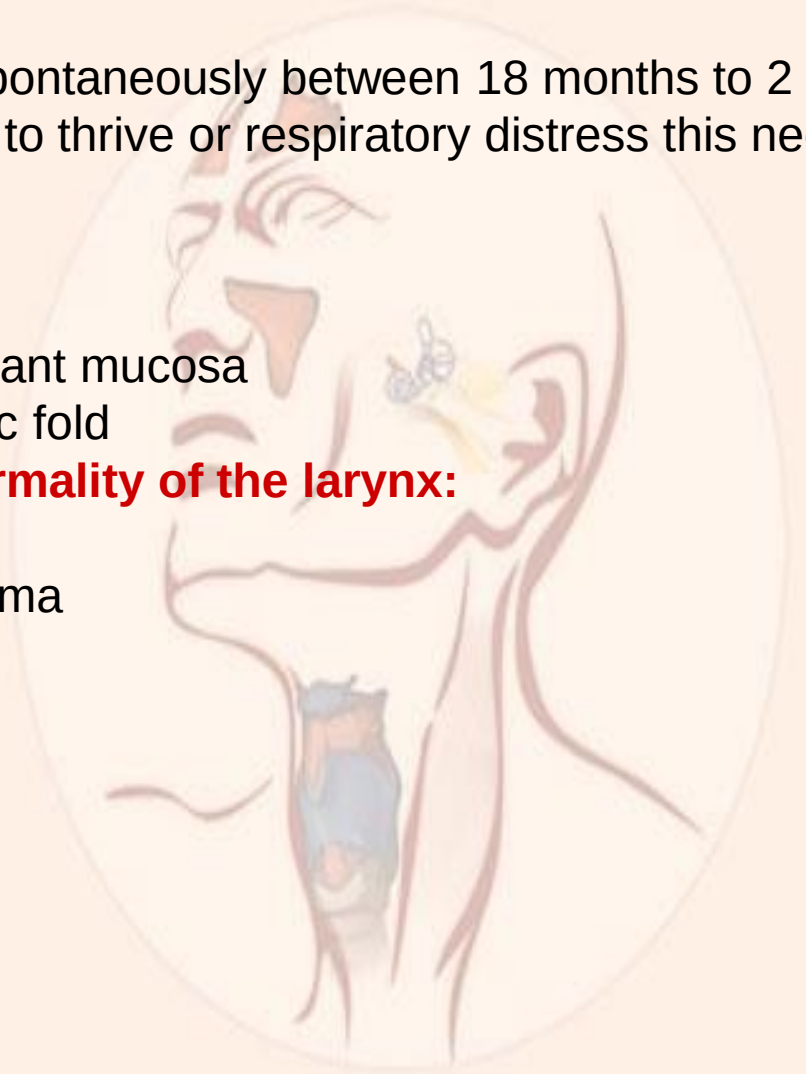
Treatment:

Most cases disappear spontaneously between 18 months to 2 years, if the child is with feeding difficulty. Failure to thrive or respiratory distress this needs active treatment which is:

- Tracheostomy
- Excision of the redundant mucosa
- Division of aryepiglotic fold

Other congenital abnormality of the larynx:

- Subglottic stenosis
- Subglottic haemangioma
- Laryngeal web
- Laryngeal cyst



Intubation granuloma

This injury mostly occur in patient mostly have a traumatic intubation due to rough intubation,prolong intubation,or use of large size tube.

Clinical features:

Patient presented with hoarseness of voice few days or weeks after an operation, and rarely presented with stridor.

On examination by indirect laryngoscope or by endoscope, large fleshy granuloma arising from one arytenoids if not treated may lead to fibrosis.

Treatment:

- Voice rest
- Endoscopic removal of granuloma

Vocal cord nodule (Singer's nodule):

It is due to misuse of voice and bad voice production common in school children.teacher, singers and actors, often in the presence of inflammation.

Pathology:

Localised hard thickening on the edge of each vocal cord at the junction of anterior thirds and posterior two third of vocal cord,it is usually bilateral.

Clinical features

Hoarseness of voice, with voice fatigue

Treatment

- voice rest
- Removal of any inflammatory focus
- Speech therapy often lead to resorption of the nodules
- Finally, precise localised removal is curative

Laryngeal infections

Acute laryngitis

Aetiology:

1. Viral infection of URT, adenovirus or influenza virus, but secondary bacterial infection may supervene.
2. Voice abuse
3. Exposure to fumes, air pollution, smoking and alcohol abuse.

Clinical features:

1. Hoarseness of voice
2. Pain and laryngeal discomfort
3. Cough
5. Flu like symptom

On examination:

May reveal a pharyngitis, the larynx will be red and swollen with thickened vocal cords .

Treatment:

1. Voice rest
2. Humidification by steam inhalation
3. Avoidance of irritants
4. Analgesia and local soothing agent
5. Antibiotic like Amoxicillin

Recurrent acute laryngitis with incomplete resolution may predispose to chronic laryngitis.

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Any ?

Thank you

Acute epiglotitis:

A special form of acute laryngitis in which the inflammatory changes affect mainly the loosly attached mucosa of the epiglottis.

Pathology:

Localised oedema may obstruct the airway,H.influenzae is usual causative organism

On examination:

Examination is diagnostic but may be delayed until the facilities for intubation and tracheostomy are available so no attempts to depress the tongue or indirect laryngoscopy as this can cause laryngospasm.

Clinical features:

1.Dyspnoea may be progressive and alarming especially in children in which lead to sever stridor and death within few hours.

2. The child may be critically ill, toxic, flushed appearance, and high temperature (38-40)

Treatment

Admission to hospital

Establish the airway by passing endotrachial intubation

I.V line,fluid,sedation,AB

Swab and blood culture

Proper antibiotic(chloramphenicol(100mg\kg\24hours)as up to 30% of haemophilus strains are resistant to penicilline,Third generation of cephalosporins are alternative because of side effect of chloramphenicol

Nasogastric tube should be inserted for feeding

Acute laryngotracheobronchitis(croup)

It is less common dangerous than eiglottitis, it is usually viral infection by parainfluenza virus type one. It occur in children under three years age, Its onset is slow usually 48 hours after previous attach of URTI.It cause barking cough,stridor,but no dysphagia ,the child is feverish,lying on back,struggling,restlessness,horseness of voice, no drooling of saliva with small cervical lymph nodes.

Treatment:

- observation
- reassurance
- humidification
- Oxygen with or without adrenaline, with or without steroid
- steroid
- antibiotic for secondary bacterial infection

Stridor

Stridor is the most common manifestation of paediatric airway disease. It is the audible result of turbulent air flow in the larynx or trachea. Its phase during respiratory cycle and its characteristics can help locate the site of an obstruction.

Supraglottic stridor is classically inspiratory.

Glottic or subglottic is biphasic.

Tracheal is expiratory.

Stridor must be distinguished from stertor, which is generated by pharyngeal obstruction.

Causes of stridor in children

- Congenital anomalies:
  - Laryngomalacia
  - Laryngeal web
  - Laryngeal cysts
  - Subglottic stenosis
  - Vascular ring
  - Congenital laryngeal tumours as haemangioma

◙Acquired causes of stridor

●Foreign body

●●Trauma

●●●inflammatory causes:

1.Acute laryngitis

2.Acute Epiglottitis

3.Acute laryngotracheobronchitis

4.Tumour as benign multiple laryngeal papilloma

5. Neurogenic diseases as bilateral vocal cord palsy

6.spasmodic laryngitis

Tumours of the larynx

Benign tumour

Papillomas

1. Single papilloma: seen in adult arise usually from the vocal cord as a sessile or pedunculated mass, May have recurrence after removal and have risk of change to malignancy.
2. Multiple papillomas are the usual type in children may be due to human papilloma virus; no risk of malignancy but recurrence is common, regression occur at puberty.

There is no histological difference between two types.

Clinical features:

Either silent or present with hoarseness of voice or stridor.

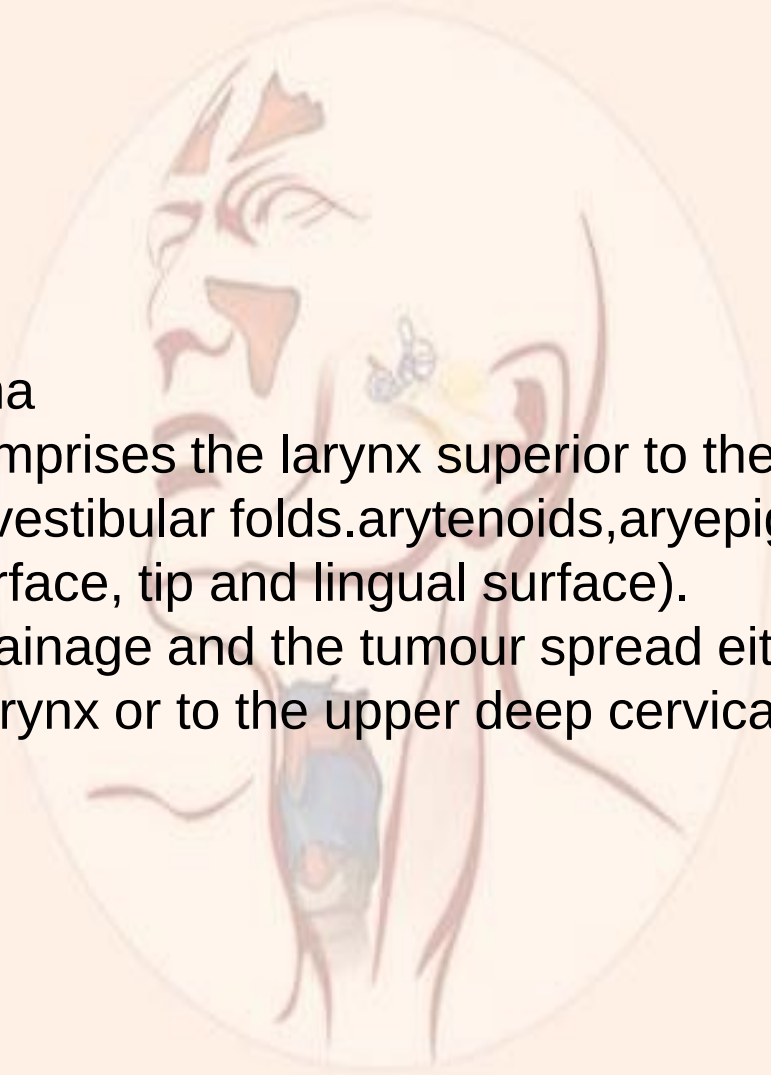
Malignant tumour

Mostly squamous cell carcinoma others may include adenocarcinoma,or connective tissue tumour.

Squamous cell carcinoma:

Grading; well differentiated ,moderately differentiated and poorly differentiated

Clinical types, ulcerative or proliferative



Types:

- Supraglottic carcinoma

Area of supraglottis comprises the larynx superior to the apex of ventricle .It includes the ventricle, vestibular folds.arytenoids,aryepiglottic folds and the epiglottis (laryngeal surface, tip and lingual surface).

It has rich lymphatic drainage and the tumour spread either locally to base of tongue, glottis and pharynx or to the upper deep cervical lymph nodes.

◙ Glottic carcinoma

This comprises the vocal cords and the posterior and anterior commissures.

Spread either locally to subglottis or supraglottis and rarely to lymph nodes (4%) because no lymph drainage in this area.

◙Subglottic carcinoma

This extends from the inferior border of the glottis to the lower border of the cricoid cartilage.

Spread locally to vocal cords, trachea, and circumferential spread, or to the lower deep cervical LN.paratracheal and mediasinal LN.

Risk factors:

Male, smoker, alcoholic, 5th-6th decade of life and chronic laryngitis.

Clinical features:

●Hoarseness of voice
●●Stridor
●●●Neck mass due to LN or the tumour mass
●●●●Pain locally in the neck or referred otalgia
●●●●●Dysphagia
●●●●●●Cough
●●●●●●●General symptom like cachexia and anorexia

Investigations

●Radiological plain x-ray ,CT, MRI
●●Haematological
●●●Biochemical
●●●●Laryngoscopic examination and biopsy

Staging

TNM classification of sq.cell carcinoma

T primary tumour

N lymph nodes

M distant metastasis

Primary tumour

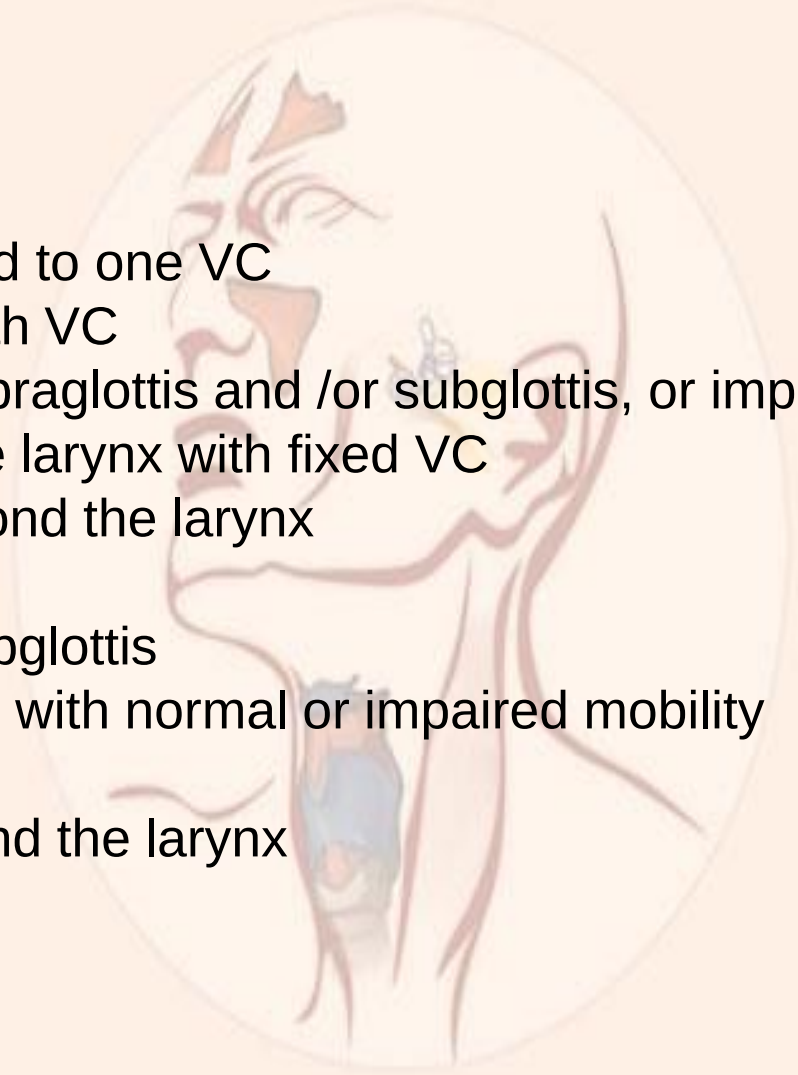
Supraglottic

T1 Tumour limited to one subsite of supraglottis like aryepiglottic fold or arytenoids

T2 Invasion of more than one subsite of supraglottis or glottis or adjacent region outside the supraglottis like mucosa of tongue base

T3 Limited to the larynx with fixed vocal cord or invades the postcricoid area, pre-epiglottic tissue, base of tongue

T4 Extends beyond the larynx



Glottis

T1a tumor limited to one VC
T1b Involves both VC
T2 Extend to supraglottis and /or subglottis, or impaired VC mobility
T3 Limited to the larynx with fixed VC
T4 Extends beyond the larynx

Subglottis

T1 Limited to subglottis
T2 Extend to VC with normal or impaired mobility
T3 VC fixation
T4 Extend beyond the larynx

Lymph nodes

N0 No LN
N1 Ipselateral single LN equal yo or less than 3cm
N2 LN 3-6cm unilateral or bilateral
N3 many LN more than 6cm
Metastases
M0 No distant metastasis
M1 Distant metastasis

Treatment

Palliative→to decrease the patient suffering but no cure like pain relief and tracheostomy
Curative→the aim is to cure the patient

- Radiotherapy

It preserves the function of the larynx
Or given when the patient refuse surgery
Can be given pre or post operative in advance cases

- Surgery

External approach as total and partial larygectomy
Endoscopic approach as microlaryngoscopy and laser surgery

- No Ca larynx has been cured by chemotherapy

Tracheostomy

Creation of surgical opening in the trachea and converting this opening to asthma on the skin surface.

Indications:

1-releife of upper airway obstruction

- ◙Congenital
  - ●Bilateral choanal atrasia
  - ●●Laryngomalacia
  - ●●●Laryngeal web
  - ●●●●Subglottic stenosis
- ◙Traumatic
  - ●Either external trauma as in gun shot or stab wound (cut throat), or internal trauma as inhalation of irritating fumes, swallowing of corrosives, forign body.
- ◙ Infections
  - ●Acute epiglottitis
  - ●●Acute laryngotracheobronchitis
  - ●●●Diphtheria
  - ●●●●Ludwig's angina

◙ Tumours

Of the tongue,larynx,pharynx,thyroid:

●In advance stage

●●If oedema from radiotherapy embarrasses respiration

●●●As adjuvant to surgery

◙ Bilateral recurrent nerve palsy

●After thyroidectomy

●●Bulbar palsies

2, Protection of tracheobronchial tree, this achieved by:

● Provide good aspiration

●● Protect from inhalation of saliva, food or blood

●●● Clear the airway from stagnation of bronchial secretion

These conditions include:

●Coma due to head injury, poisoning, cardiac arrest

●●Burn of the face, neck

●●●Multiple fractures of the mandible

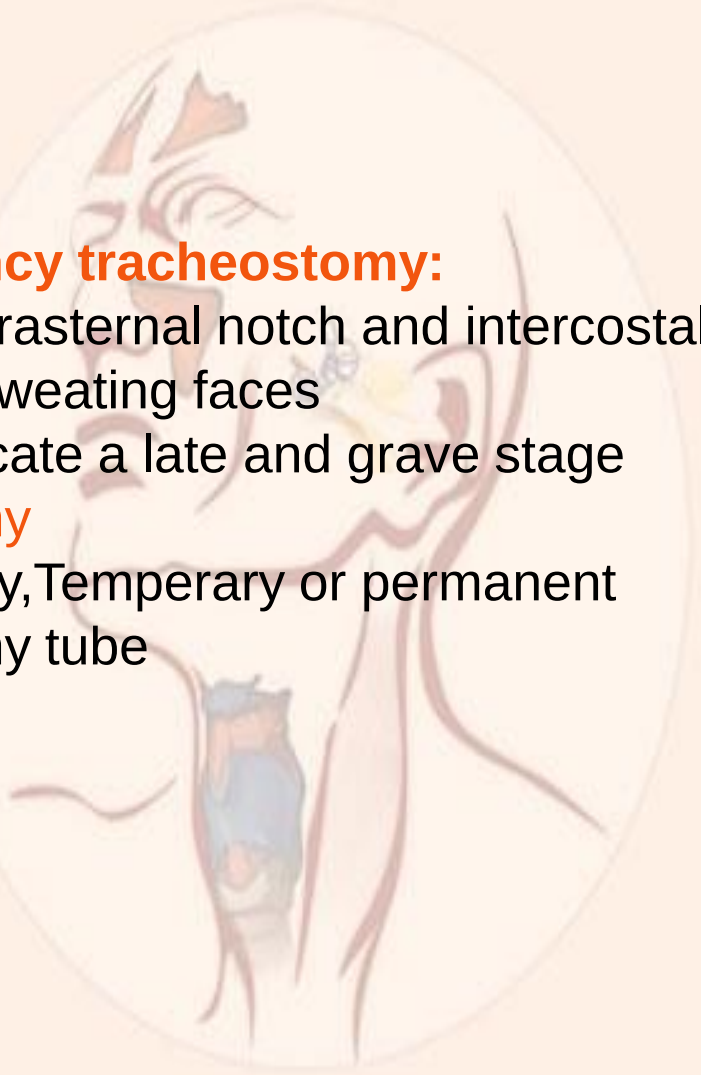
●●●●Neurological diseases as myasthenia gravis, tetanus, cervical cord lesions or injury

3. Tretment of cases lead to respiratory insufficiency as in

- ● All above conditions
- ●● Pulmonary diseases as
  - ►Chronic bronchitis and emphysema
  - ►Post operative pneumonia
- ●●●Severe chest injury (flail chest)
- ●●●●Neuromuscular in coordination
- ●●●●●Need for intermittent positive pressure respiration IPPR

Aims of tracheostomy

- ◙Relief upper airway obstruction(By-passing)
- ◙◙Reduce the dead space (30-50%)
- ◙◙◙Allowing easy toilet of bronchi
- ◙◙◙◙Using of mechanically assisted ventilation PPV



Criteria for emergency tracheostomy:

- ●Recession of suprasternal notch and intercostals space
- ●●Anxious, pale, sweating faces
- ●●●Cyanosis, indicate a late and grave stage

Types of tracheostomy

Elective or emergency,Temperary or permanent

Types of tracheostomy tube

- ●Metalic
- ●●Non metallic

Technique of tracheostomy

- Anaesthesia either local or general
- Position extension of the head
- Incision either vertical or horizontal ,vertical always used in emergency midline from the level of cricoid cartilage to the suprasternal notch ,horizontal incision about 2 fingers breadth above the suprasternal notch
- Midline separation of strap muscle using blunt dissection scissor vertically with haemostasis of all bleeding points
- Thyroid isthmus either divided or separated
- Trachea exposed and opened ,tracheal incision is at 2nd,3rd and fourth tracheal rings
- Insertion of the tube
- Closure of the wound loosely and dressing

Post-operative care

●Nursing, constant attention for first 24 hours

●●Position upright position in bed

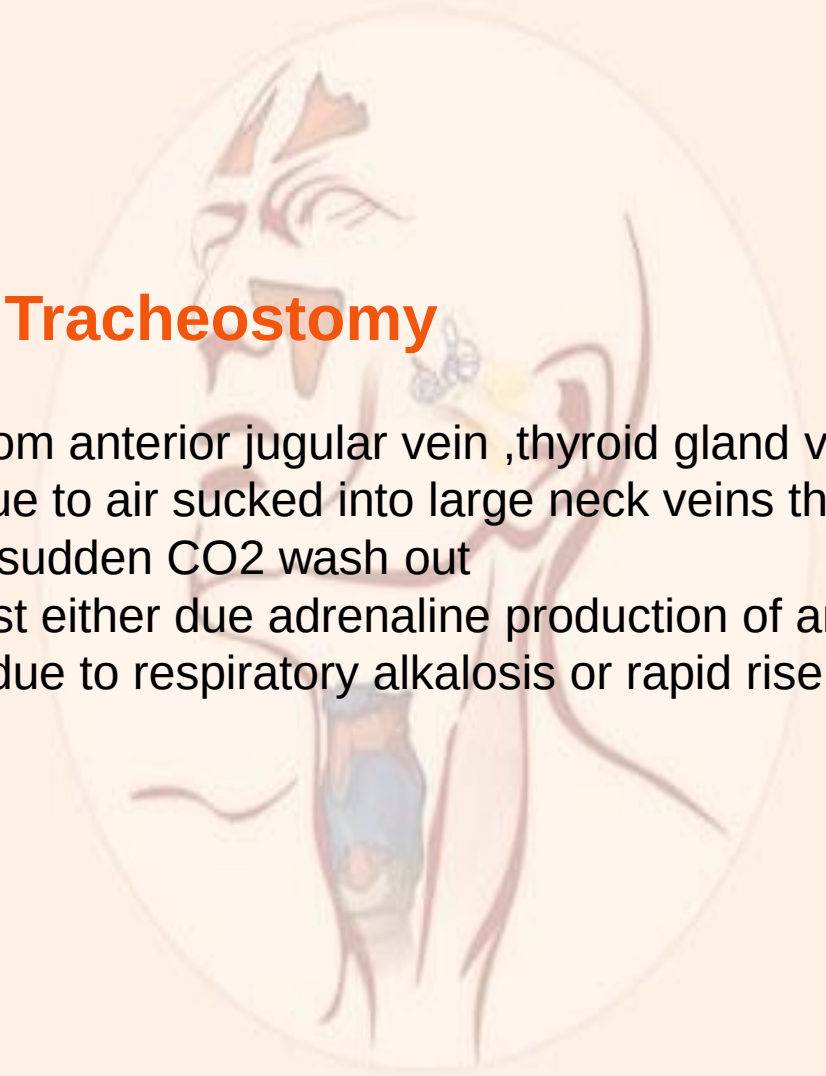
●●●Humidification of inspired air

●●●●Suction applied regularly

●●●●●Fixation of the tube by silk suture to the skin and tape tied around the neck

●●●●●●Care of the wound by dressing and antibiotic

●●●●●●●Change the tube at least after 36-48 hours and in children it should be done at least one week after surgery



Complication of Tracheostomy

- Immediate
  - ●Haemorrhage from anterior jugular vein ,thyroid gland vessels
  - ●●Air embolism due to air sucked into large neck veins that may be opened
  - ●●●Apnea due to sudden CO2 wash out
  - ●●●●Cardiac arrest either due adrenaline production of anxious patient,hyperkalaemia due to respiratory alkalosis or rapid rise in PH as aresult of rapid CO2 wash

◙Intermediate complications

●Displacement or dislodgment of tube

●●surgical emphysema

●●●Pneumothorax and pneumomediastinum

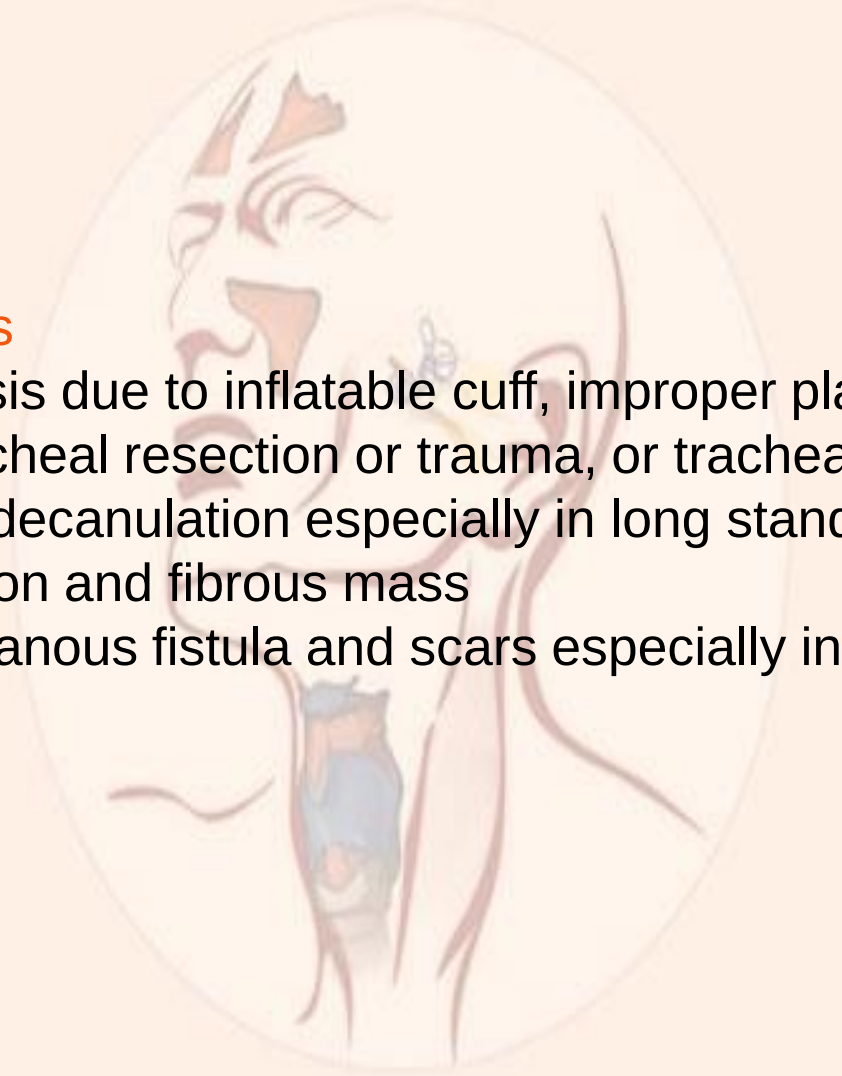
●●●●Obstruction of tube by crusts

●●●●●Infections of the wound

●●●●●●Tracheal necrosis due to over size of tube,improper curve of tube or pressure of the cuff on the trachea

●●●●●●●Tracheoarterial fistula and tracheo-oesophageal fistula

●●●●●●●●Dysphagiadue to tethering of the larynx,pressure of inflated cuff on the oesophagusor due to original cause of tracheostomy



- Late complications
  - Tracheal stenosis due to inflatable cuff, improper placed insicion, repetitive incision, tracheal resection or trauma, or tracheal infections
  - Difficulty with decanulation especially in long standing tube due to suprastomal granulation and fibrous mass
  - Tracheocutanous fistula and scars especially in long standing tracheostomy

Neurological affection of the larynx

Sensory dysfunction

The sensory nerve supply to the supraglottis is from yhe vagus via internal laryngeal nerve.Stimulation produces a cough reflex which prevents food and saliva from entering the airway,thus being very important protective reflex.

Loss of this reflex predispose to aspiration.

Uncontroled aspiration lead to sever pneumonia which is life threatening.

Sensory paralysis is caused by lesions affecting the vagus nerve in the skull base or in the upper neck

Laryngeal spasm

It is most commonly seen postoperatively in the patient with with sensitive larynx that has been irritated by secretion or blood.

The cords become adducted and the patient cannot breath

Laryngeal spasm may present in the clinic with repeated chocking episodes and loss of voice gastroesophageal reflex or postural drip may be the cause

Functional dysphonia

Is form of laryngeal spasm which is often induced by anxiety and panic attach It is most commenly present in young female,who present with aphonia. The vocal cords will de seen lying equidistant from the midline and move normally with deep inspiration but on phonation will not meet in the midline.Patient able to cough and when cough ,the cord will meet in the midline.

Treatment is by reassurance with good speech therapy.

Vocal cords paralysis

It can be unilateral or bilateral and can be adductor or abductor paralysis

Abductor paralysis means loss of power of abduction i.e V.C are in adduction

Adductor paralysis means loss of power of adduction i.e V.C are in abduction

Causes

1.malignancy 25%
2.surgical trauma
3.idiopathic
4.inflammatory T.B of the lung
5.non surgical trauma pressure by atrium enlargement or by aneurysm
6.neurological as DM,CVA
7.other as rheumatoid arthritis
The left nerve affected more because it has longer course