

Larynx

Anatomy: Skeletomembranous framework of larynx:

- Thyroid cartilage (**Adam's apple**)
- Cricoid cartilage
- paired arytenoids cartilage
- Epiglottis
- Hyoid bone

- **Thyroid cartilage (single):**
 - Shield like (closed anteriorly but open posteriorly)
- **Cricoid cartilage (single) :**
 - Signet ring shaped.
 - The only complete skeletal ring for the airway. 'IMP' because;

if there is edema in this area, cricoid cartilage will be the reason for airway obstruction! Cause thyroid cartilage is open post. So it can extend there with no obstruction

- ◆ Both thyroid and cricoid cartilage ▶ hyaline ▶ calcification
 - **Cricothyroid joint**
 - Synovial joint ▶ hinge motion

- **Arytenoid cartilage (above cricoid, paired) :**
 - Pyramidal shaped
 - Apex ,vocal process (**thyroaracinoic muscle attached- vocal ligament**) & muscular process (**Where most of the muscles are attached**).
 - Cricoarytenoid joint
 - Synovial
 - rocking motion :
 - ✓ Anteromedially for vocal fold adduction.
 - ✓ Posteromedially for vocal fold abduction.

- **Corniculate and cuneiform cartilages (paired): insignificant small cartilages!**
- **Epiglottis cartilage(attached to the thyroid cartilage anteriorly, single) :**
 - Leaf like structure
 - Elastic cartilage
 - Thyroepiglottic ligament



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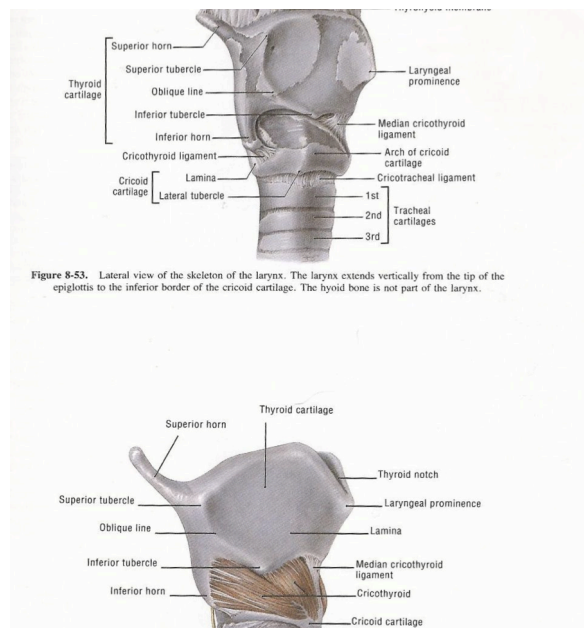


Figure 8-53. Lateral view of the skeleton of the larynx. The larynx extends vertically from the tip of the epiglottis to the inferior border of the cricoid cartilage. The hyoid bone is not part of the larynx.

Posterior view:

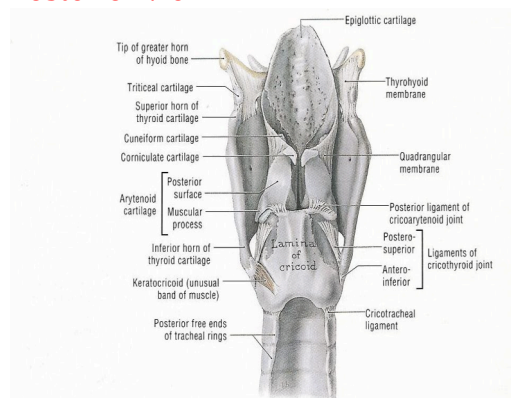
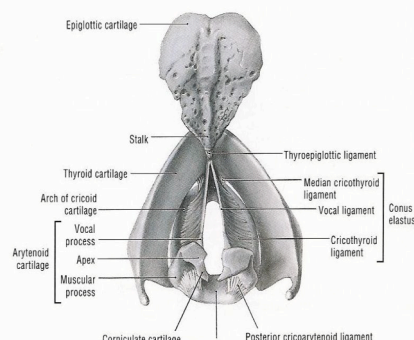


Figure 8-54. Posterior view of the skeleton of the larynx. Observe that the thyroid cartilage shields the smaller cartilages of the larynx. The hyoid bone, although not a part of the larynx, shields part of the epiglottic cartilage.



- Hyoepiglottic ligament
- glossoepiglottic fold ► valleculae
- All cartilages are hyaline, Except EPIGLOTTIS which is elastic,,

• **Laryngeal membranes :**

- **Quadrangular membrane**

Cover all the area. From upper (epiglottis) to lower (ventricular fold "false vocal cord"; above vocal fold) border

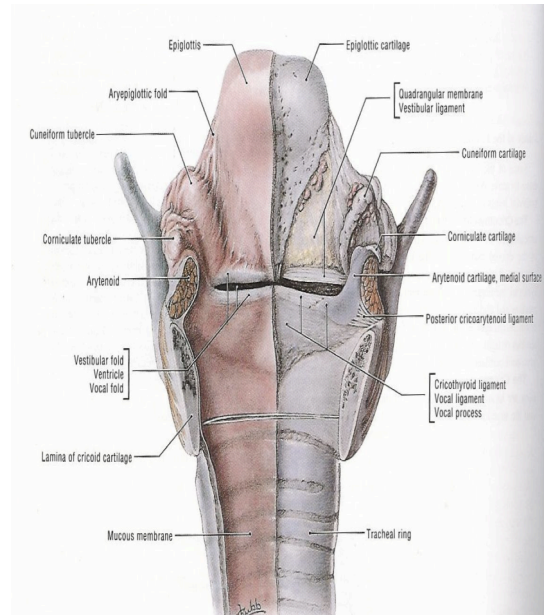
► thickened

- aryepiglottic fold (between epiglottis and arytenoid)
- Vestibular fold

- **Triangular membrane (conus elasticus).**

- Medial and lateral border is free ► thickened ► **vocal ligament (cord, it ends at this level)**

- **Ventricular cleft or ventricles (area without a membrane, weakest area!)**



• **Laryngeal mucosa :**

- All mucosa from trachea to aryepiglottic fold ► **ciliated columnar epithelium.**
- ✳ except vocal cord and aryepiglottic fold ► squamous epithelium
- **Most common tumors in the focal cords (folds) are squamous cell Ca.**

• **Laryngeal musculature:**

- **Extrinsic depressors. (C1-C3) (Swallowing and talking!)**

- Sternohyoid
- sternothyroid
- thyrohyoid
- omhyoid.

- **Extrensic elevators.**

- Genohyoid (C1),
- diagastric (CNV-CNVII)
- mylohyoid (v)
- stylohyoid (VII)

- **Intrinsic musculature**

- **Abductors : for breathing**
 - Posterior cricoarytenoid (PCA) **MCQ**
- **Adductors:** for talking



- Thyroarytenoid (TA)
- Lateral cricoarytenoid (LCA) ,
- Interarytenoid (only single muscle, while others paired)
- **Tensing the cords: for pitch**
 - Cricothyroid
 - **Thyroarytenoid (medial fibers).**

• **Histopathology:**

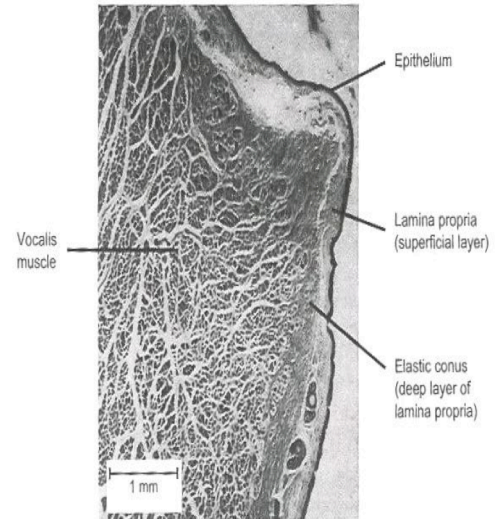
- **Vocal cord 4 layers**

1. Squamous epithelium (**mucosal layer**)
2. Lamina propria
 - » superficial layer
 - » **Reink's space**
 - » Intermediate layer (**I think this is the 3rd layer**).
 - » Deep layer.

- ✓ **Intermediate + deep layers =vocal ligament**
- ✓ **This what gives the whitish color of the cords (it contains fibers and collagen)**

3. "Muscular layer" (**thyroarytenoid muscle = Vocalis**) making this 4th !

- **These layers are not the same as for the false vocal cord,,**



• **Blood supply :**

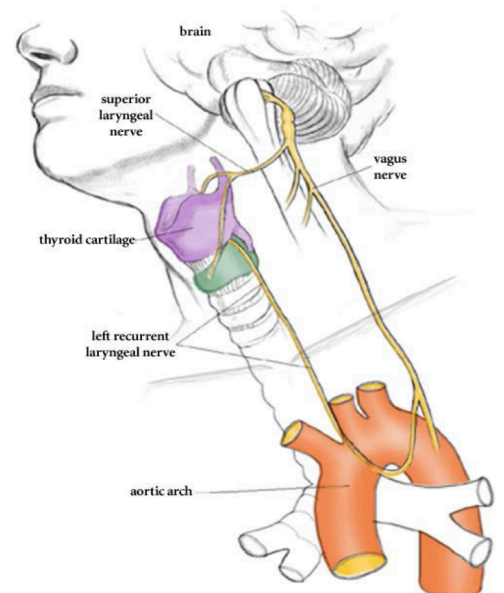
- Superior and inferior laryngeal artery and veins.

• **lymphatic drainage:**

- above vocal cord ► up deep cervical lymph node.
- Below vocal cord lower ► deep cervical node
- **No lymph drainage for the vocal cords making it some how a good tumor (even T2 unless extend supraglottic or infraglottic, but most pt come early) + the striking symptom dysphonia making patients come early,,**

• **Nerve supply:**

- **vagus: this IMP because in the case of a vocal cord paralysis with -ve Hx of trauma or surgery, order CT for head, neck and chest!**
- **Superior laryngeal nerve**



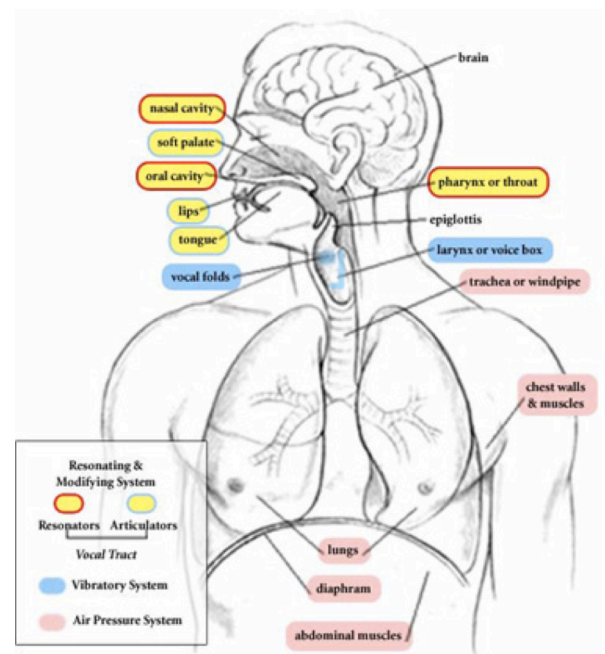
- Internal branch (sensory; **all mucosa above vocal cord**) +superior laryngeal artery .
 - External branch ► **cricothyroid muscle (tens vocal cord)**
 - **Recurrent laryngeal nerve**
 - **RT side:** crosses the subclavian artery
 - **LT side:** arises on the arch of the aorta deep to **ligamentum arteriosum** (longer course) IMP for surgical intervention!
 - it is divided behind the **cricothyroid joint**
 - Motor ► all the intrinsic muscles except ?
 - Sensory : **above the cord and below,,**
- **Pediatric airway anatomy:**
 - The neonates are obligate nasal breathers until 2 months, **because of lack of coordination of oral respiratory function and epiglottis location. Here when they have nasal obstruction refuses feeding!**
 - At birth is omega Ω shaped
 - The epiglottis higher (**u can see it when they open their mouth**)
 - The infants have high larynx C1-C4
 - **1mm of laryngeal edema in neonates can reduce the air flow by 60%**

Applied physiology of the larynx:

- **Protection of the lower air passages**
 - Closure of the laryngeal inlet
 - Closure of the glottis
 - Cessation of respiration
 - Cough reflex (forced expiration is made against a closed larynx)
- **Phonation:**
 - Voice is produced by vibration of the vocal cord (eg. a **COPD patient have difficulty in speech**)
 - Source of energy is the airflow
 - Normal vocal fold vibration occurs vertically from inferior to superior
 - The mouth ,pharynx ,nose ,chest (resonating chambers)
- **Respiration**

Voice mechanism:

- Speaking involve a voice mechanism that is composed of three subsystems.
 1. Air pressure system lung
 2. Vibratory system vocal cord
 3. Resonating system chest, pharynx, nose and others



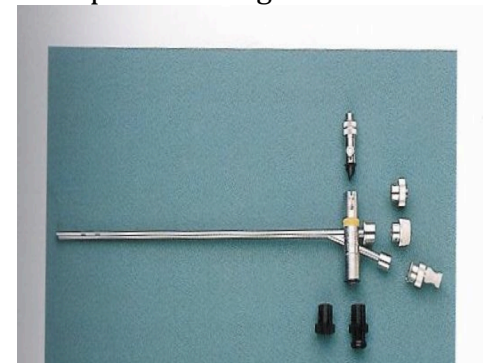
- The “spoken word” result from three components of voice production :
- Voiced sound, resonance, and articulation
- Voiced sound :the basic sound produced by vocal fold vibration “buzzy sound”
- Resonance: voiced sound is amplified and modified by the vocal tract resonators (throat, mouth cavity ,and nasal passages)
- Articulation: the vocal tract articulators (the tongue ,soft palate, and lip) modify the voiced sound
- Vocal fold vibrate rapidly in sequence of vibratory cycles with a speed of about:
 - 110 cycles per second (men)= lower pitch
 - 180 to 220 cycles per second (women)=medium pitch ‘**cricothyroid muscle tensor**”
 - 300 cycles per second (children)= higher pitch
- Louder voice : increase in amplitude of vocal fold vibration.
- **Laryngeal sphincters**
 - ❖ True vocal cord
 - ❖ False vocal cord
 - ❖ Aryepiglottic sphincter

Plz note some differences in the values 427, I kept the ones by Dr.Manal,,

Evaluation of the dysphonic patient:

- **HISTORY**
 - **Dysphonia (hoarseness)**
 - URTI,fever ,cough ,(voice ,tobacco or alcohol abuse), dysphagia ,aspiration , breathing difficulty ,wt lost ,GERD ,trauma,
 - Mass (nasal voice)
 - previous surgery mostly due to intubation,,
 - **Occupation; housewife! Teacher!! And singer,,**
 - Ask for the character, contributing and associated factors.
 - Remember KITTNES for deferential diagnosis:
 - K: Congenital
 - Inflammatory
 - Trauma
 - Tumor
 - Neurogenic
 - Endocrine
- **EXAMINATION**
 - Indirect laryngoscope (mirror)
 - Direct laryngoscope
 - Fibreoptic flexible scope
 - Stroboscopy
 - Acoustic analysis

Bronchoscope (whole at the end) therapeutic & Diagnostic



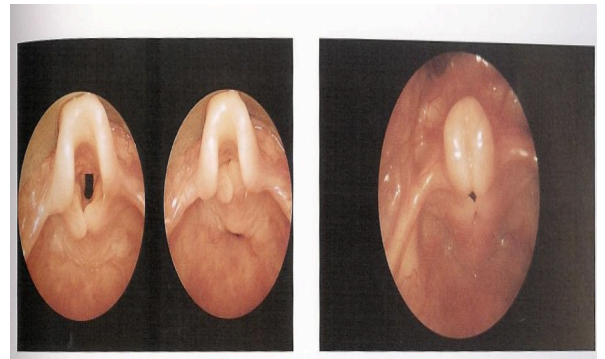
Plz note I skipped the parts from 427 that will be on speech lecture!

Disease of the larynx

- **Congenital abnormalities of the larynx:**

1. **Laryngomalacia: weakness! Present later**

- ✓ Most common laryngeal anomaly
- ✓ Most common cause of stridor in neonate and infants
- ✓ Hx: prone position makes it better, no cyanosis/ affect on feeding,,
- Laryngeal finding:
 - ✓ Inward collapse of aryepiglottic fold (**short**) into laryngeal inlet during inspiration.
 - ✓ Epiglottis collapses into laryngeal inlet.
- SSX:
 - ✓ Intermittent inspiratory stridor that improve in prone position .
- DX:
 - ✓ HX and **flexible fibroptic** (endoscopy)
- RX:
 - ✓ observation (mostly)
 - ✓ Epiglottoplasty: **when sever Causing growth retardation**
 - ✓ Tracheostomy: **just to relief Cyanosis,,**



Sever omega shape, epiglottis moves forward anteriorly (closing)

Case1: 6 weeks baby, VD, mother is saying that her baby is breathing with noisy sound!?

Stridor!: biphasic or monophasic!

If its in the inspiratory phase : supraglottic or glottic !

Biphasic : subglottic, glottic or trachea !

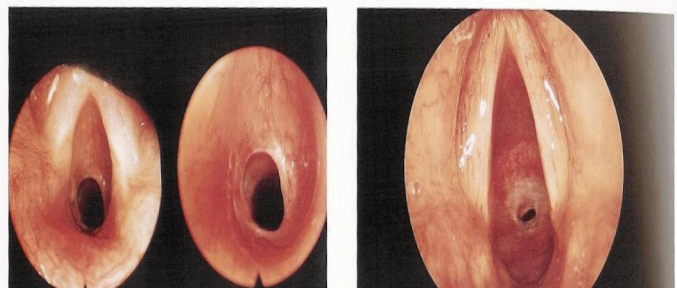
But if its expiratory phase: intrathoracic tracheal part!

You have to ask about cyanosis? And if it affects feeding? Cause management differ!

2. **Subglottic stenosis: below vocal cord, present earlier**

Incomplete recanalization, small cricoid ring < 4mm in newborn

- **Types:**
 - ✓ membranouse
 - ✓ Cartilaginous
 - ✓ mixed
- **Grades:**
 - I <70%
 - II 70-90%
 - III 91-99%
 - IV complete obstruction
- **SSX** :biphasic stridor ,failure to thrive .
- **DX**: flexible endoscope (**sometimes they can't see stenosis**) so do chest and neck X-ray (**high voltage x-ray**)
- **RX**: tracheotomy



✓ **grade I - II ;**
endoscope (CO2 or laser excision with dilation) may need more than one procedure

✓ **Grade III -IV:**

Open procedures:

Tracheostomy then 2 types of surgeries; cause in this case laser will cause adhesions and back to stenosis:

1. Ant cricoid split
2. Posterior cricoid split
3. LTR (**laryngo**tracheal reconstruction) use rib cartilage OR CTR (**cri**cotracheal reconstruction) end-to-end anastomosis.
4. laryngofissure

✓ **Even with surgery tracheostomy still there, till the healing process takes place then take it out,,**

✓ **NOTE: narrowest part of airway in a child is SUBGLOTIC AREA while in adult it's the EPIGLOTIC AREA.**

3. Laryngeal web: remember congenital

- incomplete decanalization
- Types:
 - Supraglottic (2%)
 - Glottis (75%)
 - Subglottic (7%)
- SSX:
 - weak cry at birth ,variable degrees of respiratory obstruction (**stridor**)
- DX: flexible endoscope
- Rx :
 - no treatment
 - laser excision (**by endoscopy**)
 - open procedure+ tracheostomy (**if its huge/recurrent then external approach**)

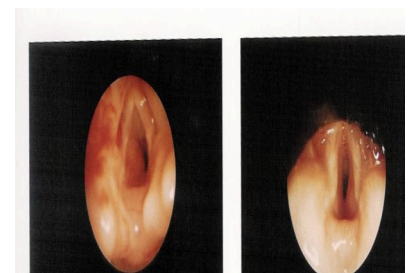


Figure 14.6
Vocal fold adhesion. Simultaneous removal of vocal



4. Subglottic haemangioma:

- **Most commonly in subglottic space**
 - 50% of subglottic hemangiomas associated with cutaneous involvement
- **Types:**
 - capillary (typically resolve)
 - Cavernous
- **SSX:** biphasic stridor
- **DX:** endoscope
- **RX:**
 - Observation (small , not affecting respiration)
 - Corticosteroid (followed by endocrinology) **Now they start using Beta-blockers**



- CO2 LASER (don't like it because; **end up with scar!**)

5. Tracheomalacia:

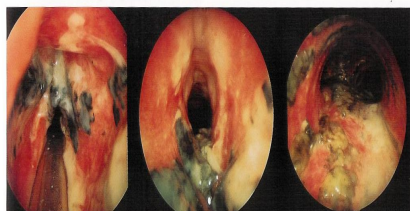
- **Less common**
- **Immature laryngeal cartilage**
- **SSx: expiratory stridor**
- **Dx: Bronchoscopy to see a -----check 427---- area**
- **Rx: observation**

▪ **Other congenital laryngeal defects:**

- ✓ **Vascular rings.**
- ✓ **Cri du chat Syndrome**
- ✓ **Posterior laryngeal clefts**
- ✓ **Laryngotracheophageal cleft**

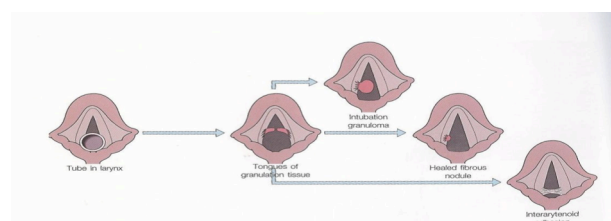
• **Traumatic conditions of the larynx:**

- ✓ Direct injuries (blows)
- ✓ Penetration (open)
- ✓ Burns (inhalation, corrosive fluids)

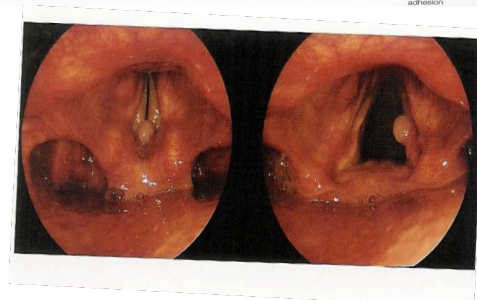


▪ **Antibiotics one of the treating modalities for inhalations**

- ✓ Inhalation foreign bodies
- ✓ Intubations injuries: **most IMP**
 - Prolonged intubation
 - Blind intubation
 - Too large tube



- ✓ pathology :
 - Abrasion ► granulomatous formation **leading to** subglottic stenosis
 - SSX; hoarseness, dyspnea
 - RX:
 - Voice rest (**small**)
 - Endoscopic removal/**laser (big)**
 - Prevention



Granuloma usually on Posterior border, be careful its not a polyp,,

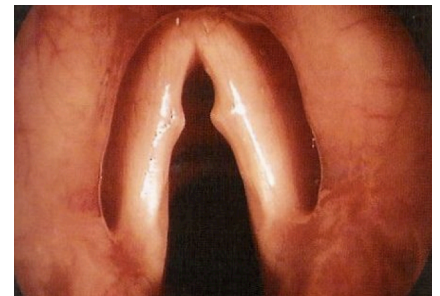


- ❖ Remember: **Granulomas** not only caused by intubation injuries, it can be due to:
 1. Reflux (**laryngopharyngeal reflux**) these patients usually complain of foreign body in the throat and hoarseness,
 2. Smokers,
 3. Voice Abusers (**teachers!**)

• **Vocal fold lesions secondary to vocal abuse and trauma:**

1. **Vocal nodules (singer's nodules) Teachers!**

- ✓ At junction of ant 1/3 and mid 1/3 (**most movable part of the fold**)
- ✓ Chronic course, start unilateral but presents later **with hoarseness (as any mass in the vocal cord) when it becomes bilateral!**
- ✓ **Not a polyp or cyst, mostly bilateral,**
- ✓ **RX:**
 - i. Voice therapy (**70% will improve**), **teach them abdominal breathing, drinking water more, etc.,**
 - ii. Surgical excision (**large non-responsive**)



2. **Vocal fold polyp:**

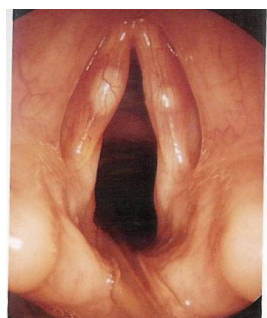
- ✓ Middle and ant 1/3 , free edge , unilateral
- ✓ Mucoid , hemorrhagic (**Angiomatoma; due to sudden voice abuse**)
- ✓ **Ring polyp:** in smokers, affect the whole cord except the bony part, treated with an incision down the vocal fold to drain the fluid,,
- ✓ **RX :**
- ✓ Surgical excision (**with all laryngeal surgeries at least 3 days voice rest! to keep the mucosal layer cause once its gone, lamina propria will release fibroblast resulting in scar formation, leading to permanent hoarseness!)**



*** Remember granuloma posteriorly**

3. **Vocal fold cyst:**

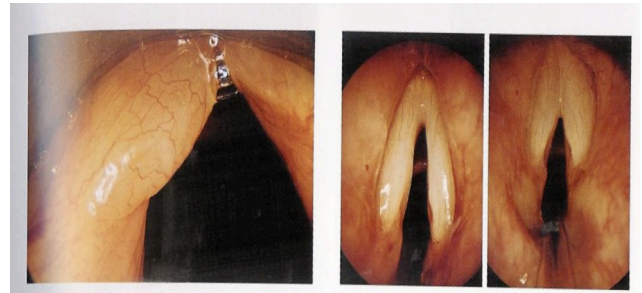
- ✓ congenital dermoid cyst
- ✓ mucus retention cyst
- ✓ **RX:**
 - surgical excision



4. Reinke's Edema:

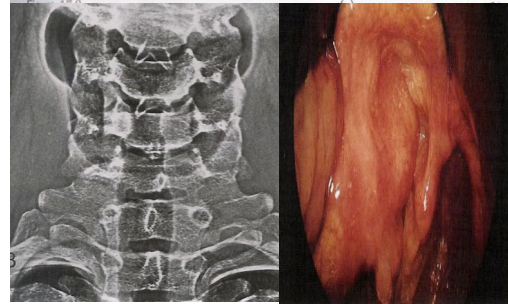
- **RX:**
 - Voice rest ,stop smoking
 - Surgical excision

✓ Can be caused by voice abuse and reflux,



5. Laryngocele:

- Air filled dilation of the appendix of the ventricle ,communicates with laryngeal lumen
- Congenital or acquired
- **types :**
 - External : through thyrohyoid membrane
 - Internal :
 - Combined
- **Rx :** marsupialization = **remove it,,**



Can be either Uni/bilateral!

• Vocal cord paralysis:

Points to remember:

Anterior 2/3 of the vocal fold: Movable

Posterior 1/3 of the vocal fold: bony 'not movable'

▪ Causes:

○ Adult (In order)

✓ Neoplastic (eg. Vocal cord (stage 3),Thyroid, and carotid body tumor

✓ Iatrogenic:

- the **most common surgery is thyroidectomy**, here if a pt comes post-op with changed voice don't jump to conclusions unless the surgeon confirmed that it was scarified, wait for 6 months, then intervene (to correct it surgically)!

- For documentation and as a regular routine, they usually scope patients **before thyroidectomy**, to make sure that the vocal folds are ok,,

- Other causes: cervical disc prolapse repair (if approached anteriorly), lung lobectomy, etc,,

✓ Idiopathic

- **If everything is -ve and to call it idiopathic they have to do brain, neck and chest CT**

✓ Trauma

✓ Neurological

✓ Infectious



- ✓ Systemic diseases
 - ✓ Toxins
 - **Children**
 - ✓ Arnold chiari malformation
 - ✓ Iatrogenic:
 - Birth trauma (**forceps delivery**)
 - **In infants the most common surgery is the repair of patent ductus arteriosis, they ligate the nerve with it!**
 - ✓ Infection
 - ✓ Vascular abnormalities
 - ✓ Idiopathic (most common)
 - **How to evaluate patients with fold paralysis:**
 - Hx and Physical Examination.
 - Ancillary test.
 - Vocal cord positioning:
 1. RLN paralysis paramedian vocal folds
 2. SLN paralysis: bowing deformity
 3. RLN and SLN= cadaveric: intermediate vocal folds
 4. Bilateral vocal cord Paralysis: typically near midline.
 - **SSX:**
 - ✓ Dysphonia (**small gap, due to air escaping**)
 - ✓ Chocking (**big gap, the other cord not adducting**)
 - ✓ Stridor (so once again most common causes of infantile stridor in order:
 1. **Laryngomalacia**
 2. **Vocal cord paralysis**
 3. **Subglottic stenosis**
 - **Rx : Must determine if self-limiting or permanent**
 - Self limiting or permanent paralysis
 - **For Unilateral; medialization :**
 - Vocal cord injections (Injection laryngoplasty; **temporary**)
 - ✓ Gelfoam, fat, collagen, Teflon.
 - ✓ **Usually start treating with this one then go for permanent,,**
 - Thyroplasty (**permanent procedure**)
 - **For Bilateral; lateralization:**
 - Cordotomy (**laser**)
 - Thyroplasty
 - Tracheotomy (**Gold standard method**)
 - Arytenoidectomy
- ✚ 427 mention 3 more for medicalization but I kept what's on the slides,,

• **Inflammation of the larynx (Laryngitis):**

1. **Reflux Induced laryngitis:**
Leads to chronic inflammation,



- SSx:
Dysphonia, cough,,
- Laryngeal findings: increased saliva; compensating for the acidity,,
- Rx:
 - Avoidance of aggravating factors: Smoking, chocolate etc,,
 - Elevation of head during sleep
 - If no improvement try PPI/H2- blockers,,

2. Acute viral laryngitis:

Rhinovirus(most comon), parainfluenza

- SSX:
dysphonia , fever cough
- Rx:
conservative

3. Acute epiglottitis : **IMP**

Haemophilis influenzae B

2-6 years

- SSx:
fever , dysphagia ,drooling ,dyspnea,
sniffing position , no cough, normal voice.

- DX :
x-ray (**thumbprint sign**) **edema** →

- Rx:
Do not examine the child in ER (May
Lead to death)

Intubation in OR

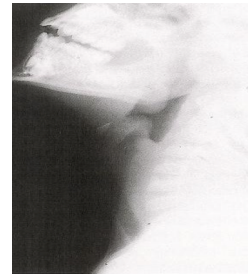
IV abx

corticosteroid to reduce edema

sometimes its very severe so they do tracheostomy,,



Closed Epiglottitis



4. Adult Supraglottitis:

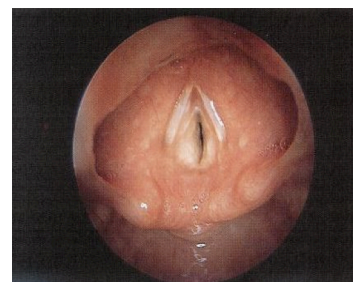
H. influenza(common), S. pneumoniae , staph. Aureus and beta-hemolytic strept.

- SSx: Stridor, dysphonia, airway collapse
- Rx:
 1. Evaluate the airway
 2. Humidification
 3. Parenteral antibiotics

5. Croup (**laryngotracheobronchitis**)

- ✓ Primary involves the subglottic
- ✓ Parainfluenza 1-3
- ✓ 1-5 years , fall and winter seasons,
- ✓ 427 most common cause of stridor in children! I think **what the dr. meant in lec neonates and infants**, still make sure yourselves plz,

- **SSX:**



- **Inspiratory** or biphasic stridor, **low grade** fever , brassy cough , hoarseness , no dysphagia (**gradual onset**)
- **DX:**
 - x-ray ,steeple sign
- **RX:**
 - humidified oxygen,racmic epinephrine ,steroid

6. Diphtheritic laryngitis:

- Causes:
 - **Corynebacterium diphtheriae**
- Ssx:
 - Cough ,**stridor** ,dysphonia , fever
 - **Greyish -white membrane**
- Treatment:
 - **Antitoxin injection**
 - Systemic pencillin
 - Oxygen
 - **Tracheostomy, sometimes.**

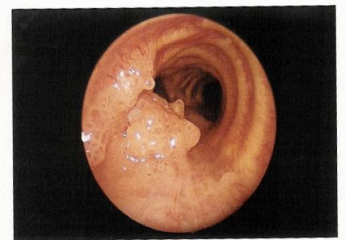
7. Fungal laryngitis:

- Immunocompromised
- candidiasis ,aspergillosis
- Ssx:
 - dysphonia ,cough odynophagia
- RX:
 - antifungal regimen

8. Recurrent respiratory papillomatosis: **IMP**

- 2/3 before age 15
- rarely malignant change
- HPV 6-11
- **2nd most common cause of hoarseness in children.**
- **Wart like, irregular exophytic.**
- Risks:
 - younger first time mother (**condyloma acuminata**)
 - Lesions: wart like (cluster of grapes)
 - Types :
 - Juvenile ***More aggressive; some of them may have 20 surgeries/ year; so combine it with local antiviral to reduce the recurrence.**
 - Senile
- SSX:
 - Hoarseness
 - stridor
- RX;
 - Laser excision ,microdebrider (**Shaver**)

Make sure **not to mix** it with Cancer! **Grapes like** + Hx; child, recurrent, **several surgeries**; go for **Papilloma**



- Avoid tracheotomy; create new lesions (remember koebner's phenomenon)
- Adjunctive therapy: acyclovir , interferon ...

9. Chronic laryngitis:

- Causes:
smoking, irritants, reflux and post. nasal drip.
- SSx:
hoarsness, pain, chronic cough,
- Dx:
R/O other causes,
- Eg. Of specific causes of chronic:
 - TB
 - Scleroma
 - Syphilitic
 - Leprosy
 - Perichondritis
 - Sarcoidosis
 - Wegner's granulomatousis
 - Amyloidosis
 - Arthritis of cricothyroid joint

Malignant neoplasms of the larynx: (**she didn't stress on it**)

- 1-5 % of all malignancies
- All are squamous cell carcinomas ;
- Ssx:
 - Hoarseness ,aspiration, dysphagia , stridor , wight lost
- risks:
 - Smoking ,alcohol ,radiation exposure .
- Classification :
 - Supraglottic :
 - 30-40-% of laryngeal Ca
 - 25-75% nodal metastasis
 - Glottic:
 - 50-75%
 - Limtted regional metastasis
 - Subglottic :
 - Rare
 - 20% regional metastasis
- Staging of glottis tumor:
 - T1: primary tumor, limited to vocal folds,,
 - T2: primary tumor involves supglottis/supraglottis
 - T3: vocal fold fixation
 - T4: Invades Thyroid cartilages or beyond larynx
- Pathology:
 - Squamous Ca
 - Verrocus Ca



- Adenocarcinoma
- others
- RX:
 - Radiotherapy
 - hemilaryngectomy . Total laryngectomy + neck dissection
- by 427:
 - Early supraglottic Ca (T1-T2):
Tx by single modality,,(Surgery/radiation)
 - Advanced supraglottic Ca (T3-T4):
Tx with combined modalities (both)
 - Early glottic Ca (T1-T2):
Tx by single modality
 - Advanced glottis Ca (T3-T4):
Tx with combined
 - Subglottic Ca.:
Tx with combined !
- When they ask you in the OSCE for the next step, always mention biopsy because it's a must to make a diagnosis,,

***OSCE;** When you see white membrane, its Leukoplakia; could be fungal, cancer ,etc depending on the Hx :

