Posterior glottic stenosis
Introduction

- larynx: 3 distinct anatomical sites
  - Supraglottis
  - Glottis
  - Subglottis
  - Subglottic stenosis is the most common form of laryngeal stenosis.
  - Glottic stenosis may accompany subglottic stenosis or be diagnosed as a separate entity.
- Glottic stenosis → congenital or acquired
Anatomy

The glottic segment of the larynx: true vocal cords, the anterior and posterior commissures, and the vocal processes of the arytenoid cartilages.

The posterior glottis:
posterior 1/3 of the vocal cords, posterior commissure with interarytenoid muscle, the cricoid lamina, the cricoarytenoid joints, the arytenoids, and the overlying mucosa.

The anterior glottis: lined with squamous epithelium, while the posterior glottis shares respiratory epithelium with the subglottis.
Posterior glottic stenosis

- Narrowing of the airway at posterior aspect of the glottic space
- Most common cause: trauma from endotracheal intubation
- Usually scar tissue → impairment of mobility of one or both arytenoid cartilage
- Incidence: as high as 14% in patients intubate > 10 days
Posterior glottic stenosis mechanism

- Post displacement of endotracheal tube by tongue base
- Post angulation of the trachea
- Respiratory epithelium is less likely to withstand any type of trauma
Posterior glottic stenosis mechanism

- Glottic injury: 3 phases
- Acute: inflammation and ulceration of posterior commissure mucosa
- Chronic: granulation tissue and ulceration with exposure and destruction of arytenoid and cricoid cartilage
- Healing
Posterior glottic stenosis mechanism

- Majority post glottic injury will heal after extubation with reepithelialization and no scar formation
- 6-14% → result in posterior glottic stenosis
- Pathogenesis is similar to subglottic stenosis
- Predisposing factor: duration and frequency of intubation, tube size, tube shape, systemic disease (DM...)
Bogdasarian et al. 1980 classified the extent of posterior glottic stenosis into 4 types
- Type I  interarytenoid synechia
- Type II  posterior commissure stenosis
- Type III  posterior commissure stenosis with one cricoarytenoid joint ankylosis
- Type IV posterior commissure stenosis with bilateral cricoarytenoid joint ankylosis

Posterior glottic stenosis

A, Interarytenoid synechia with sinus tract posterior to band.

B, Posterior glottic web with mobile arytenoid cartilages.

C, Fixation of one arytenoid cartilage with posterior web.

D, Fixation of both arytenoid cartilages with posterior.

Posterior glottic stenosis classification-2

- Whited classified 2 types
- Type I: scarring pattern in the interarytenoid plane and inferiorly along the internal surface of cricoid lamina
- Type II: fibrous band between vocal processes

Intubation

- Prolong or traumatic intubation leads to post glottic stenosis.
- Increase risk: traumatic intubation, prolonged duration of intubation, multiple extubation and intubation, large size endotracheal tube, motion of endotracheal tube, local infection, DM, gastroesophageal reflux disease.
Intubation

- Symptoms appear late, often weeks or months after extubation
- Scar forms and slowly occlude the post glottis → impair the motion of arytenoid cartilage
Systemic disease

- Rheumatoid arthritis, juvenile rheumatoid arthritis → fixation of cricoarytenoid joint → laryngeal stenosis
- SLE, gout → arthritis of cricoarytenoid joint
Granulomatous disease

- tuberculosis, sarcoidosis, rhinoscleroma, or Wegener granulomatosis
- TB of larynx: most common, associated with pulmonary disease
- Most common site: inter-arytenoid space, arytenoid cartilage, post. Surface of true vocal cords, laryngeal surface of epiglottis
- If no treated, chondritis and necrosis → destroy the larynx with scar and fibrosis
Recurrent respiratory papillomatosis (RPR)

- Recently, post. Glottic stenosis \(\rightarrow\) associate with treatment of recurrent respiratory papillomatosis
Recurrent Respiratory papillomatosis may involve all sites of larynx, include posterior glottis

Excision of these lesions → wound cross ant and post commissures → web formation

Post glottic stenosis is reported in the literature after CO2 laser resection of RPR
One posterior glottic web in 22 RPR patients underwent CO2 laser resection. Prevent this complications: preserving a strip of intact mucosa, decrease power density and exposure time of CO2 laser.

Radiation therapy

- Radiotherapy for laryngeal malignancy → induce inflammatory response
- Tissue recover → fibrosis → affect cricoarytenoid joint → post glottic stenosis
- Airway obstruction: present very late (months or years)
Radiation therapy - chondronecrosis

- 1-5% of patients undergoing radiotherapy may develop radiation-induced chondronecrosis.
- Risk factors for chondronecrosis: smoking, tumor invasion, postoperative infection, trauma, and the radiation technique.
- Age, sex, tumor grade, and previous laryngeal surgery do not appear to increase the risk for chondronecrosis.
History and Physical examination

- Stridor
- Voice change
- Use of accessory muscle of respiration
- Retraction at supra-sternal notch
- Respiratory distress
- Exam neck (old surgical scar or mass)
- Cranial nerve exam
- Exam hands (signs of rheumatoid or osteoarthritis)
Diagnostic tool

- **Indirect laryngoscope** or **fiberoptic laryngoscope** → check vocal cord mobility

- **Direct laryngoscope** or **bronchoscope** → check larynx and distal airway, cricoarytenoid joints
Diagnostic tool

- **Pulmonary function test**: helpful in documenting the severity of the obstruction, to monitor change after treatment

  - Image study: **CT or MRI** →
    1. length and thickness of glottic stenosis and subglottic stenosis
    2. Useful for laryngeal framework evaluation in patients with laryngeal trauma

- **Electromyogram (EMG)**: differentiate posterior glottic stenosis from bilateral vocal fold paralysis. Evaluate the function of the intrinsic muscles of the larynx.
Diagnostic tool

- **Lab data**: for granulomatous disease (sarcoidosis, Wegener granulomatosis) or systemic disease (amyloidosis, rheumatoid arthritis) is suspected the cause
- **Biopsy**: for tuberculosis, sarcoidosis, Wegener granulomatosis
- Identify causative organism
- **pH monitor**: for gastroesophageal reflux
Prevention

- Prevention of glottic stenosis
- appropriate airway management in terms of duration of intubation
- tube size
- sedation.
- avoidance of inappropriate dissection or overzealous use of the laser in endolaryngeal surgery.
Treatment

- Treatment for post glottic stenosis classified into categories
- 1. Medical
- 2. Intralesional injections
- 3. Endolaryngeal procedure
- 4. Open surgery procedure
**Treatment-medical**

- Infection or inflammatory disorder → appropriate antibiotics, corticosteroids, or both is important.

- **Systemic steroids** in glottic stenosis is controversial. Tend to decrease scar formation but may delay wound healing.
  
  Treatment should be individualized.

- **Inhalational steroids** are sometimes used to reduce granulation tissue formation after stent removal.
Treatment-medical

- **Steroid injection** into the posterior glottic scar may be useful in cases of inflammation during the very early stages. Technically difficult, and cartilage resorption may be a serious complication.

- Supportive therapy: humidified oxygen and close airway monitoring in a supervised setting.

- Treat gastroesophageal reflux
Mitomycin-C

- Mitomycin-C:
- antineoplastic antibiotic
- alkylating agent inhibiting DNA and protein synthesis.
- inhibit cell division, protein synthesis, and fibroblast proliferation
  - endoscopic CO2 laser excision → topical application of 0.5 cc of 0.4 mg mitomycin-C per milliliter of saline for 4 minutes at the surgical site → follow-up of 15 months (10-20) Result: all patients had clinical improvement of their airway and resolution of their preoperative symptoms.
History

- Tracheotomy is the oldest surgical treatment of PGS.
- 1922, Chevalier Jackson: removed the entire vocal fold and ventricle→ provided an excellent airway but caused a severe breathy dysphonia and aspiration.
- 1939, The King procedure is an open operation in which a mobilized arytenoid is fixed laterally. Kelly and Woodman provided further modifications of the King procedure.
History

- 1948, Thornell described the first endoscopic arytenoidectomy
- 1972, Whicker and Devine reported an initial success rate of 82% in a series of 147 patients treated with Thornell's technique, which improved to 92% when some of the failures underwent a contralateral procedure. They reported a 96% voice preservation rate.
History

- 1968, Dedo and Sooy: aryepiglottic fold mucosal flap.
- 1984, endoscopic use of the laser for mild posterior commissure stenosis and described the creation of a trapdoor flap.
- 1973, Montgomery: superiorly based advancement mucosal flap from the interarytenoid area.
- 1993, Zalzal described an anterior laryngofissure technique with posterior cricoidotomy and cartilage grafting.
- Biavati et al successfully used, in 5 children, a single-stage procedure for the repair of congenital laryngeal webs that were associated with subglottic stenosis.
- Recent work: endoscopic techniques for repair topical mitomycin C for prevention of restenosis.
Endoscopic surgery

- Simplest case of post glotic stenosis → lysis of band with cold instrument or laser
- Avoid trauma to post commissure mucosa
- Post-operative antireflux medication: advisable
- Placement of simple keel, such as Silastic sheet
- Simple posterior glottic web with normal or mildly reduced vocal fold mobility
- Incision and dilatation with cold instrument and laser
- Placement of keel after lysis of post glottic web to increase success rate
Fig 3. Angiocatheter is introduced through cricothyroid membrane in midline.

Fig 4. Angiocatheter is introduced above thyroid notch through thyrohyoid membrane and angled inferioiy through petiole to enter midline of airway.

Fig 5. Silicone keel is secured to skin with Prolene over silicone buttons.

Fig 6. After web lysis, keel was sutured in place.
Endoscopic techniques for enlarging posterior glottic airway ➔ excision of tissue at or anterior to arytenoid
1983, Ossoff classic CO2 laser arytenoidectomy and partial cordectomy

Vaporization of mucosa overlying arytenoid cartilage, the cartilage itself, portion of posterior aspect of membranous vocal fold

1991, Ossoff report 86% rate of decannulation in a series of 28 patients
- Modified Ossoff’s technique: preserving the mucosa along the medial aspect of the arytenoid cartilage
- Preserved medial mucosa → endoscopically sutured laterally after resection of arytenoid cartilage
- Others: resect varying portion of arytenoid cartilage, preserve the mucosa and suture it laterally
Figure 2  Resected part of the vocal process and body of arytenoid anterior to the cricoid cartilage (PAC).
Fig 1. A, Horizontal view of stenosis at the level of the glottis. B, Surgical procedure. sc, Scar; s, skin and platysma; m, prelaryngeal muscles; lt, laterofixing suture; st, skin suture; va, vaporized area.
- 2000, Goldberg: endoscopic postcricoid advancement flap (EPAF)
- Place vascularized mucosal flap between arytenoid to prevent restenosis
- Candidates for EPAF: type II or type III stenosis, with at least one mobile cricoarytenoid joint
Fig. 1. View of a larynx with posterior glottic stenosis by direct laryngoscopy. Note interarytenoid scarring and a narrowed airway.

Fig. 2. Diagram of elevation of the inferiorly based postcricoid flap. Here, the flap is reflected posteriorly. Incision for arytenoid separation is shown with dashed lines.

Fig. 3. Endoscopic view of the larynx with the incision for arytenoid separation. The incision is being held open by two probes for demonstration purposes.
Fig. 4. Diagram of the inset of the mucosal flap into the gap created by the arytenoid separation.

Fig. 5. Endoscopic view of the larynx from 1 week after surgery, demonstrating improved airway, improved arytenoid abduction, and recreation of the interarytenoid space. The flap is visible between the arytenoids.
Open surgery

- Post glottis may be approach through anterior laryngofissure
- Anterior thyroid cartilage must be divided exactly in the midline at anterior commissure to avoid ant vocal fold injury
- Lysis post glottic scar tissue ➔ flap or graft or stents
1973, Montgomery: midline ant larynghostissure ➔ post web excised ➔ mucosal flap is elevated from interarytenoid space and post cricoid region
1988 Goodwin et al: graft the exposed area with either skin, mucosal, perichondrocutaneous grafts

- Stenting is used for 1-6 weeks
Conclusion

- Post glottic stenosis: most common cause: trauma from endotracheal intubation
- Treatment based on patient’s condition, presentation
Reference