TRACHEOSTOMY and CRICOTHYROIDOTOMY

by Dr. Amr Allama

Assistant professor of Cardiothoracic Surgery
Faculty of Medicine
Taibah University
Learning objectives

By the end of the lecture you should:

1) Know the indications of tracheostomy.
2) Describe different types of tracheostomy tubes.
3) Describe the techniques tracheostomy.
4) Understand how to decannulate the patient.
5) Know complications of tracheostomy.
6) Describe the indications and technique of cricothyroidotomy.
Definition

- Tracheostomy indicates an opening in the trachea, either temporary or permanent.
- Tracheotomy refers to an incision in the trachea during the course of an operation.
Indications

1) Upper airway obstruction
2) Prolonged mechanical ventilation
3) Management of secretions
4) Neuromuscular disorders
5) Chronic aspiration
6) Preexisting tracheal disease
1) **Upper airway obstruction**

- Tracheostomies for acute upper airway obstructions too dangerous to manage by standard intubations or other techniques are not controversial.

**A) Trauma:**

- Complex fracture of the midface
- Mandibular fractures
- Laryngeal trauma
- Burns
B) Infection:
- Epiglottitis
- Diphtheria
- Abscess

C) Tumors

D) Foreign body

E) Vocal cord paralysis

F) Tracheomalacia
Prolonged mechanical ventilation

- Long-standing translaryngeal intubation causes scarring of the glottic commissures and the subglottic space.

- The earliest injury occurs in the posterior glottic commissure as early as 5 days after intubation and increases in severity over time.
Other important reasons favoring tracheostomy are:

- Greater patient comfort
- A more secure airway
- Lower airway resistance, and
- A lower threshold to wean and disconnect the patient from the ventilator.
3) Management of secretions

- Abundant respiratory secretions, weakness of cough, or both during recovery from operation or illness may require tracheal access.

- If mechanical ventilation appears likely, a regular tracheostomy is selected. Otherwise, a minitracheostomy may be considered.
4) Neuromuscular disorders

- Ventilator dependence in these patients occurs as a result of profound weakness of respiratory muscles.

- Tracheostomy may be considered during the acute symptoms (Guillain-Baree syndrome), and for chronic long-term support (Duchenne muscular dystrophy).
5) **Chronic aspiration**

- The inflated cuff of a tracheal tube may prevent tracheal aspiration of gastric contents.

- However this is imperfect as the sole barrier and additional measures, including nasogastric decompression or gastrostomy drainage may be used for short-term control.
6) **Preexisting tracheal disease**

- Tracheal stricture is a rare indication for tracheostomy.

- The placement of the stoma must be selected to preserve as much normal trachea as possible and not to extend the preexisting injury.

- In emergency cases, rigid bronchoscopic dilatation and placement of the stoma at the level of the stricture is a safe approach.
Open or percutaneous tracheostomy?

- Standard tracheostomy is being replaced in many centers by percutaneous tracheostomy. This shift is expected to continue.

- The open method has the advantage of lower cost and more secure airway. The percutaneous technique has the advantage of short time and lower rate of early postoperative complications.
Tracheostomy tubes

**Metal tubes:**

- Metal tubes are rigid, expensive, do not connect to a ventilator, and are not fitted with a cuff.

- They are still used because they can be sterilized repeatedly and are durable.
Plastic tubes:

- Polyvinyl chloride tubes, which conforms to the airway at body temperature.
- Silicon tubes, which are softer but does not change shape with temperature.
Tube dimensions are expressed as outer diameter (OD), inner diameter (ID), length, and curvature.

The inner diameter matters because it, together with tube length, determines airway resistance.

The outer diameter determines the ease of insertion through the stoma and the residual tracheal lumen when the cuff is deflated.
Tubes are available as a single cannula or double cannula. The inner cannula is changed easily but narrows the inner diameter and adds to airway resistance.

The tube shape is either curved or angled. The curved design has the advantage of easier insertion and a straighter lumen. Angled tubes often provide a better fit to the trachea.
Tracheostomy tubes are made in standard and extra length.

The extra-long segment of the angled tube is either proximal, to fit the long stomal tract of obese patients, or distal, to place the tip of the tube below tracheal abnormalities.

The most commonly used tracheal cuff has a low-pressure, high-volume design to lower the pressure applied to the tracheal mucosa.
Standard open tracheostomy

- The patient is positioned with extension of the neck and elevation of the shoulders.

- After skin preparation, the trachea is approached by transverse skin incision between the palpable cricoid and manubrium.

- Bleeding from anterior jugular veins is rarely observed and division of the veins is usually unnecessary.
Injection midway between cricoid and sternal notch.
The strap muscles are separated with a hemostat.
The tracheal stoma is created at the level of the second and third tracheal rings, leaving the first ring intact to protect the cricoid from pressure necrosis by the tube.

A low tracheostomy, below the third ring, is undesirable because it exposes the superior mediastinal contents to pressure.
The surgical creation of a window in the anterior tracheal wall leads to tissue loss at the stoma and predisposes to stricture.

The tracheotomy is therefore oriented in a vertical manner and no portion of the wall is excised.

The tracheotomy is spread and a tracheostomy tube of appropriate size is gently introduced.
The new tracheostomy tube is best secured with two sutures to the two corners of the skin wound, allowing ample drainage of secretions along the tube.
Percutaneous dilational tracheostomy

- The procedure is performed in intubated patients under general anesthesia and may be supplemented by infiltration of the anterior tracheal wall with local anesthesia and luminal local anesthesia.

- Pediatric patients, extubated patients, and the presence of a neck mass are contraindications to its use.
The use of bronchoscopy for guidance of needles and guidewires is strongly recommended.

The patient is preoxygenated and the tip of the endotracheal tube is positioned in the subglottic space, so, the anterior tracheal wall became visible by the bronchoscope.
A short transverse skin incision is made below the cricoid cartilage.

With bronchoscopic guidance and palpation, an introducer needle is inserted in the midline between the first and second, or the second and third, tracheal rings.
A J-tipped guidewire is advanced through the needle and a dilator is inserted over the guidewire into the tracheal lumen to begin dilation under bronchoscopic control.

Tracheal dilation is undertaken with a single progressively tapered dilator or multiple graded dilators.

The tracheostomy tube is then inserted.
Decannulation

- After complete weaning from ventilatory support, the tracheal tube is first downsized and then removed.

- Down-sizing and closure of the tube orifice while the cuff remains deflated lower the tube-related resistance, decrease tracheal injury, and minimize aspiration, while allowing the patient to demonstrate his or her independence from mechanical ventilation.
Complications

1) Operative
2) Early postoperative
3) Late postoperative
Operative complications

1) Hypoxia:
   - Occurs as a result of tracheal secretions and responds to suctioning.

2) Hemorrhage:
   - May be due to injury of the anterior jugular veins, the divided tracheal isthmus, and small tracheal arteries.
Bleeding vessels should be individually ligated and avoid electrocautery after tracheotomy to prevent airway fire.

3) **Pneumothorax:**

- A rare complication which may be due to extensive dissection.
- Once identified, a chest tube is inserted.
Early postoperative complications

1) Minor hemorrhage:

- May occur especially in patients receiving antiplatelets or anticoagulation.
- Packing of the wound will be effective for bleeding from the tracheal edges.
- If bleeding is brisk, the patient is returned to the OR for control of bleeding vessels.
2) **Accidental decannulation:**

- This is an airway emergency.
- Control of the airway is established by oral intubation.
- Prolonged effort to reinsert through the fresh stoma must be avoided.
- The tube may be inadequate and needs to be replaced with a better-fitted one.
3) **Wound infection:**

- It is rare if the skin closure around the tube is loose.
- Air-tight closure causes infection of the contaminated closed space.
Late postoperative complications

1) Tracheal stenosis:
- Its incidence decreased significantly with the use of compliant low-pressure cuffs.

2) Tracheo-innomonate artery fistula:
- It is a rare life-threatening complication.
- High position of the artery and low tracheal stoma favor its occurrence.
Massive bleeding requires temporary control by compression and immediate sternotomy with division of the artery.

3) **Tracheoesophageal fistula:**

- Result from the pinching action of a stiff nasogastric tube and the tracheal tube cuff with necrosis of the interposition membranous portion and esophageal wall.
- The presentation is usually sudden as air escaping from the mouth and distending the stomach.
- Aspiration of esophageal contents may lead to pneumonia.
- This complication is prevented by replacement of the nasogastric tube with gastrostomy soon after tracheostomy.
4) **Persistent tracheal stoma:**

- Resulting from epithelial coverage of the stomal tract after prolonged intubation.
- Healing of the tract is thus impossible.
- The stoma is closed by separation of the tract from the skin and interposition of strap muscle between the closures of the tract and the skin.
This procedure is relevant to obtain emergency airway access only and could not be regarded as an alternative to tracheostomy.

The procedure is properly described as a laryngostomy, so, an airway tube resting in the larynx longer than absolutely necessary risks damage to both thyroid and cricoid cartilages.
Needle cricothyroidotomy

- In a needle cricothyroidotomy, a syringe with a needle attached is used to make a puncture hole through the cricothyroid membrane.

- After the needle has reached the lumen, a catheter is passed over the needle into the windpipe and attached to a bag-valve device.
The airway is established with an incision above the cricoid ring.

A small clamp is used to expose the cricothyroid membrane.

An opening is made in the membrane by a scalpel.

The surgeon’s finger is inserted into the opening, followed by endotracheal tube.
The tube is inserted for no more than 5 cm, to prevent intubation into the main stem bronchus.

Because a stricture in this location is more difficult to treat than a similar injury in the trachea, the stoma is closed with sutures after creation of a tracheostomy.
Mini-tracheostomy

- Mini-tracheostomy is the same like tracheostomy but for a short term period and with a smaller tube for suction of airway secretions.

- The purpose of mini-tracheostomy is to prevent conventional endotracheal intubation in spontaneously breathing patients.
The procedure may be performed at the bedside and without bronchoscopic guidance, however its use is much safer.

Once the tube is inserted, the airway may be suctioned with a small catheter.

If the need for suctioning persists for more than 6 to 8 weeks, a regular tracheostomy may be considered.