Tracheostomy Course
Definitions

- Cricothyrotomy
- Tracheostomy
Definitions

- Cricothyrotomy
  - Created in **cricothyroid membrane**
    - below thyroid cartilage
    - **above cricothyroid** cartilage
  - Emergent airway

- Tracheotomy / Tracheostomy
  - Created in the **trachea**
    - below the **cricothyroid** cartilage
    - between tracheal ring 2 and 3 or 3 and 4
  - Definitive airway
Anatomical Placement

- Why are tracheotomies placed between the 2nd and 3rd or 3rd and 4th tracheal rings?
  - Placing higher → ↑ risk subglottic stenosis
  - Placing lower → ↑ risk tracheal-innominant artery fistula
Two different categories of tracheostomy placement

- Surgical Tracheostomies
  VS
- Percutaneous Tracheostomies
Anatomical Placement

**Surgical**
- Incision in tracheal wall
- in OR
- Direct visualization of trachea
- Stay sutures to help keep tract open

**Percutaneous**
- Needle insertion, guide-wire placement and serial dilatations
- in ICU
- Blind procedure
- No stay sutures
Tracheostomy Maturity

- The first tracheostomy change is timed to minimize risk of tissue constriction around the tract.

- Tracheostomy changes performed prematurely could result in loss of the stoma.
  - Percutaneous trachs are more risky given lack of stay sutures.

- Surgical tracheotomies are considered “mature” (or less likely to constrict) after 5-7 days.
Bypassing the oropharynx results in a series of physiologic changes.

An animation demonstrating these changes can be found in the educational animation series produced by Passy-Muir, Inc.

- “Clinical Complications of Tracheostomy”
Physiologic Changes

- **Beneficial**
  - ↓ anatomic dead space by up to 50% → ↑ lung ventilation
  - ↓ airway resistance

- **Detrimental**
  - Loss upper airway warming and humidification
  - Impaired speech
  - Diminished cough
  - ↑ Esophageal pressure → diminished swallowing (usually mild)
  - Possible loss of taste/smell
  - Loss of filtering
    - Loss of ciliary function
    - Bacterial colonization

1. *Care of the Critically Ill Medical Patient*, Stephen Bonner, Mark Carpenter, Emilio Garcia; Churchill Livingston, 2007
Indications for Tracheostomy

- Upper airway obstruction → provide safe airway
  - Cancer
  - Sleep Apnea

- Prevent aspiration
  - Decreased consciousness w/ absent cough reflex
  - Neuromuscular disorders

- Chronic Respiratory Failure
  - Prolonged Intubation
  - Assist with PPV
  - Facilitate mechanical ventilation wean (reduces dead space)
  - Reduce sedation requirements

- To help facilitate clearing of secretions
Many complications of prolonged intubation including

- Vocal Cord Edema
- Vocal Cord Granulomas
- Subglottic Stenosis
- Laryngomalacia
Contraindications for Tracheostomy

- Absolute Contraindications
  - None

- Relative Contraindications
  - Ongoing infection around airway site
Parts of a Tracheostomy Tube
Parts of a Tracheostomy Tube

- **Faceplate** (Neck flange)
  - Anchor for sutures/ties
  - Identification markings (trach brand & size)

- **Outer cannula**
  - Inserts into trachea

- **Inner cannula**
  - Removable cannula
  - Maintain airway hygiene

- **Obturator** (or **Pilot**)
  - Insertion assist device

- **Cuff** (or balloon)
  - Cuff is inflated in trachea to seal airway

- **Pilot balloon** – inflates cuff
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Parts of a Tracheostomy Tube

- **Obturator**
  - Closed end preventing mucous plugging trach during insertion
  - Smooth, rounded end reducing tracheal injury

- **Inner Cannula**
  - Smooth, rounded end reducing tracheal injury
  - Flat edge prone to tracheal injury
Identifying a Tracheostomy Tube
Identifying a Tracheostomy Tube

- Identifying markers are on faceplate.

- Example Shiley designations
  - **DCT** = dual cannula, cuffed
  - **DCFS** = dual cannula, cuffless
  - **CFS** = single cannula, cuffless

- **I.D.** = Inner Diameter
- **O.D.** = Outer Diameter

- Example
  - 4 CFS
    - size 4
    - single cannula, cuffless

    - I.D. 5.0 mm
    - O.D. 9.4 mm
Identifying a Tracheostomy Tube

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Types of Tracheostomies
Differences Among Tracheostomies

- Material?
  - Hard plastic
  - Soft plastic
  - Metal

- Cuffed vs. Uncuffed

- Fenestrated
  - With or Without

- Single vs. Dual Cannula

- Size

- Length

- Brand
  - Shiley
  - Jackson
  - Montgomery
  - Bivona

- Custom?
Tracheostomy Categories

- **Uncuffed Trach**
  - Air travels into trachea through two different routes:
    - through tracheostomy
    - from upper airway around trach into trachea
  - Does not seal airway → patient needs to have effective cough and gag reflex
  - Allows speech and traditional cough
  - ↓ esophageal pressure → swallowing easier
  - Less trauma to surrounding airway
### Types of Tracheostomies

- **Cuffed Trach**
  - Permits air travel through trach only
  - **Allows for positive pressure ventilation**
  - Seals off upper airway
  - Deflated cuff is functionally an uncuffed trach
  - Can cause local trauma over time
**Types of Tracheostomies**

- **Fenestrated Trach**
  - Small hole(s) are present in back
    - ↑ airflow to upper airway
    - Improved breathing
    - Improved speech
  - Transitional trach tube prior to removal
  - Multiple vs. single fenestration(s)
Types of Tracheostomies

- **Single vs. Double** cannula tracheostomy
  - Double cannula trach has **inner** and **outer** cannula

- **Inner cannula**
  - makes cleaning and removing tube obstructions easier
  - may or may not be disposable
    - Shiley Cuffed Tube → Disposable
    - Shiley **Uncuffed** Tube → **NOT** Disposable
  - may be required to connect to respiratory equipment / ventilator
Types of Tracheostomies

- **Length** *(Standard vs. Extended Length)*
  - Extended length (XLT) tubes
    - **Proximal Extensions** – used in patients with increased skin to tracheal wall distances (usually *obesity*)
    - **Distal Extensions** – used to bypass tracheal defects such as *tracheal stenosis* and *tracheal malacia*.
Brands of Tracheostomies

- Brands of Tracheostomy Tubes (among others)
  - Shiley - PVC
  - Jackson – Metal
  - Montgomery - Silicone
  - Bivona - Silicone
Types of Tracheostomies

- **Shiley Trach**
  - Made of PVC
  - Cuffed and uncuffed
  - MRI compatible
Types of Tracheostomies

- **Jackson Trach**
  - Older, less common
  - Made with Silver
    - non-reactive to human tissue
  - Low profile → comfortable
  - Can’t attach respiratory equipment
  - **NOT** MRI compatible
Types of Tracheostomies

- Montgomery Trach (Stent)
  - Acts more as a stent
  - Soft, silicone → comfortable
  - Low Profile
  - Can’t attach to respiratory equipment
Types of Tracheostomies

- **Bivona Trach**
  - Silicone with **Internal wire coil**
  - Softer, more flexible
  - Tight to shaft technology
  - Some have **cuffs inflated with sterile water**
  - **NOT MRI compatible**
Accessory Equipment
Accessory Equipment

- **Passy Muir valve function**
  - One-way valve

  - Increased upper airway flow → allows for vocal cord function → speech

- **Function**
  - Opens during inspiration
  - Closes automatically at the end of inspiration
  - No expiratory effort needed for closure
  - Exhaled air exits around the trach tube and out through the upper airway
  - Closing at the end of inspiration traps a column of air in the trach tube
    - Acts as a buffer against secretions
    - Assist with redirecting airflow around the trach tube and up through the upper airway
  - Valve remains closed throughout the respiratory cycle
Accessory Equipment

- An animation demonstrating Passy-Muir valve function can be found in the educational animation series produced by Passy-Muir, Inc.
  - “Cuff Deflation and Placement of the Passy-Muir Valve”
Accessory Equipment

- **Passy Muir or swallowing/speaking valve**
  - Patients may need to gradually adjust to the valve

- Air has to be able to flow around tube to upper airway
  - Trach tube can be too big!
  - Patients with significant subglottic stenosis can’t tolerate
  - Hint: Passy-Muir Valve cannot ever be used with an inflated cuff!

Benefits of Passy-Muir Valve

- Improved Voice/Speech
- Improved Cough / Secretion management
- Possible improvement in taste/smell
- Closer to physiologic norm
Accessory Devices

- Trach Collar
  - Fits around tracheostomy
  - Provides humidified oxygen
Accessory Devices

- Heat and Moisture Exchanger (HME)
  - “Artificial nose”
  - Improves air temperature and humidification
    - Ciliary activity is ideal at normal body temperature and 100% humidity
  - Filters Particles and Microbes
Laryngectomy
Laryngectomy

- **Total Laryngectomy**
  - complete removal of larynx
  - trachea is transected and then the open end is stitched onto the front of the neck.
  - diverts trachea to skin
  - patient will never be able to use the upper airway again
  - *can not undergo endotracheal intubation*

- Superficially, Tracheostomies and Laryngectomies look similar but, in actuality, are very different
Indications for Laryngectomy

- Cancer
  - Bulky, destructive tumors
  - Salvage after radiation
- Dysfunctional Larynx
  - Trauma
  - Previous chemo/radiation
  - Chronic Aspiration
Speech with Laryngectomy
- **Tracheo-esophageal Puncture (TEP)**
  - Artificial communication between Trachea and Esophagus
  - One-way valve is placed in TEP →
    - air shunted from trachea to esophagus →
    - air travels through pharynx → pharyngeal vibration → esophageal speech
  - One-way valve prevents aspiration
Laryngectomy

- Recommended video
  - An animation demonstrating the physiology of voice production using a TEP in Laryngectomy can be found in the educational animation series produced by Polygon Medical Animation.
Speech in Laryngectomy

- **Electrolarynx**
  - Artificially creates vibrations
  - Device held to mouth/throat → vibrations travel to mouth → modified with mouth → speech
  - Two different versions
Speech in Laryngectomy

VERSION 1
- Device held up to neck
- Vibrations transmitted to soft tissue of neck → Vibrations transmitted to oropharynx → Vibrations are manipulated with mouth producing speech

VERSION 2
- Device held up to mouth
- Vibrations transmitted into mouth → Vibrations transmitted to oropharynx → Vibrations are manipulated with mouth producing speech
Recommended video

Examples of the different methods of speech production in laryngectomy can be found in the Total Laryngectomy Education videos produced by University of Kansas Medical Center
Laryngectomies

- If mature, often simple open stomas
- Can have wide variety of other appliances
- Physical exam clues – look closely
  - Neck scars
  - Sunken skin around the stoma
  - Tracheal rings inside the stoma
  - Presence of a Tracheo-esophageal puncture (TEP) inside the stoma

Know patient’s history

Ask the patient!
Laryngectomy Equipment
Laryngectomy Equipment

- **Larytube**
  - Silicone tube, often pliable
  - Helps to keep the laryngectomy airway open in the presence of any post-operative swelling that may exist.
  - Similar appearance to Nasopharyngeal Airway
Laryngectomy

- Heat and Moisture Exchanger
  - Some larytubes can be used with a HME (Heat Moisture Exchanger) cassette
  - same function as in tracheostomy
Tracheostomy Emergencies
Tracheostomy Emergencies

- Red Flags
  - Typical signs of respiratory compromise
    - Hypoxemia, Respiratory distress
  - Whistling noise when breathing
  - Vocalizing when cuff should be up
  - Cuff requires excessive air to maintain seal
  - Combative patient
Three major categories of tracheostomy emergencies

- Hemorrhage
- Tube Decannulation
- Tube Obstruction
Bleeding from Tracheostomy
Bleeding from Tracheostomy

- Hemorrhage as a complication: ~5% overall.¹
  - Death rate: ~0.25%²

- Small amount of bleeding to be expected in certain situations
  - After initial surgery
  - After first tracheostomy change

- Large bleed/Hemorrhage is not expected

- Literature definitions of a minor bleed vary
  - Generally ≥ 25 mL is considered worse than minor

Bleeding from Tracheostomy

- Many different causes of bleeding
  - Post-surgical trauma
  - Trauma from suctioning
  - Granulation tissue
  - Tracheitis
  - Fistulas

Granulation Tissue

- Multiple risk factors
  - ↑ cuff pressures
  - Excessive tube motion
  - Sepsis / Stomal infection
  - Steroids

- Initially soft → variable bleeding

- Becomes firm/fibrosed over time → can cause stenosis

**Tracho-innominate artery fistula**
- Rare, but often catastrophic → patient can die within minutes
- Caused by *pressure necrosis* from tracheostomy tube

- Often the result of
  - High-lying innominate arteries
    - Normal – crosses trachea @ 9th tracheal ring
    - Variant – crosses trachea as high as 6th tracheal ring
  - Low lying tracheostomies
  - Excessive cuff pressures

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Indicators of possible TI fistula

- Massive hemorrhage
- “Sentinel bleed” or “Herald bleed”
  - Early, less severe bleed which predicts a massive hemorrhage
  - Usually pre-dates massive hemorrhage by 2 hours - 4 days
  - Present in up to 50% of cases
- Pulsation of tracheostomy (w/ heart beat)

Bradley PJ. Bleeding around a tracheostomy wound: what to consider and what to do? 
Tracheo-innominate artery fistula

Method for Bleeding Control

1. Over inflation of Tracheostomy cuff → Tamponade wall defect

2. Endotracheal Intubation + Direct compression of wall defect with finger
Bleeding from Tracheostomy

- **Timing of bleed from tracheostomy**
  
  - **Differential Diagnosis**
    - Early hemorrhage (≤ 48 hours)
      - Anterior jugular/inferior thyroid vein injury from procedure
      - Coagulopathy
      - Injury secondary to suctioning
      - Tracheitis
    
    - Late hemorrhage (> 48 hours)
      - Granulation tissue
      - Tracheitis
      - Tracheoinnominate artery fistula
      - Other (malignancy)

Bleeding from Tracheostomy

- In general
  - Blood tinged secretions – probably okay
  - Moderate blood – probably granuloma
  - Major bleed – concern for fistula

- Intensity of bleed is important
  - 10-20 mL over 24 hours → probably not fistula
  - 10-20 mL over 1 hour → concern for possible fistula

According to Bradley

- Any hemorrhage (brisk bleed) between 48 hours and 6 weeks → tracheo-innominate artery fistula until proven otherwise.

- Investigate any bleed that is > 10 mL and > 48 hours post-tracheostomy
  - May not be fistula, but needs to be investigated

Unplanned Decannulation
Unplanned Decannulation

- Stomas begin to close when tube is removed
  - the newer the stoma, the faster it closes

- Decannulation
  - New Trach (≤ 7 days old) – emergency
  - Established Trach (> 7 days old) – typically routine
**Unplanned Decannulation**

- **New tracheostomy (≤ 7 days)**
  - Tissue tract closes quickly → re-insertion of tube will be difficult

- Order of interventions
  1. Don’t panic! -- **Positive pressure ventilation to face**
  2. **Call surgical service**
  3. If possible, insert small catheter into old tract to keep patent
  4. Transoral intubation if needed (and possible)
Unplanned Decannulation

- **Mature** tracheostomy (> 7 days)
  - Tissue tract closes slowly (takes hours) → routine re-insertion of tube

- Order of interventions
  1. Replace old tube
  2. If #1 doesn’t work, try next smaller size (easy fix)
  3. ETT to stoma if both fail
  4. Last resort, trans-oral intubation (if possible)
Complications from Re-cannulation

- False passage
  - Typically re-cannulation of new trach
  - Dangerous complication
- Repercussions
  - Loss of airway
  - Air tracks along tissue plane → subcutaneous emphysema → pneumomediastinum → pneumothorax
Tracheostomy Obstruction
Tracheostomy obstruction

- Presentation
  - Respiratory distress
  - Agitation

- Causes
  - *Mucous plugging* – most common
  - Trach against tracheal wall
  - False passage
  - Obstruction with granuloma
Respiratory distress → Remove inner cannula → clean and return

Will suction catheter pass?

No → No → Tube obstruction
Tube against tracheal wall
False passage

Deflate cuff

No → No → Tube obstruction
False passage

Yes → Yes → Tube against tracheal wall

Yes → Partial obstruction?
If suction catheter won’t pass and deflating cuff doesn’t help → Tube needs to be replaced

- If trach is mature
  - Replace tube

- If trach is new
  - Call surgeon
  - Keep cuff deflated
  - Oxygen / PPV to face
  - Transoral endotracheal intubation

- If upper airway is obstructed -- change tube ASAP
ACLS in Neck Breathers
ACLS in Neck Breathers

- Partial Neck Breather
  - Connection to mouth and nose remains
    - Tracheostomy

- Complete Neck Breather
  - No mouth/nose connection
    - Total Laryngectomy
    - Tracheostomy w/ complete obstruction of upper airway
ACLS in Neck Breathers

- **Circulation**
  - evaluate the same way
  - carotid pulse maybe difficult 2/2 radiation fibrosis
  - many have only one radial artery if used for free flap

- **Airway**
  - check stoma
  - remove filter
  - clear mucous
  - may need to remove any trach tube
  - avoid removing stoma’s housing/voice prosthesis unless obstructing airway

- **Breathing**
  - look, listen and feel over stoma
CPR in Complete Neck Breathers

- CPR generally the same

- Ventilate through stoma -- Mouth to mouth is useless!
  - Mask to stoma
    - Infant / Toddler Mask
    - Adult mask turned 90 degrees
    - LMA to stoma
  - Tracheostomy tube
    - Use shorter tube
  - Endotracheal tube
    - Use small tube
    - Insert just inside stoma, able to see cuff

- Chest may fail to rise if trach tube blocked
ACLs in Neck Breathers

- CPR in Partial Neck Breathers
  - Evaluate both airways!
  - If using stoma, seal off mouth/nose
  - If using mouth/nose, seal off stoma
Routine Trach Care
Trach Suctioning

- Fresh trachs
  - *Suction often!*
  - *every 2 hours and as needed*

- Established trachs
  - *Acts as normal airway*
  - Only suction *as needed*
Routine Trach Care

- Secretions cause skin irritation
  - Copious secretions? → frequent dressing changes

- Mobilization of secretions
  - Adequate hydration
  - Maintain physical mobility
  - Removal of secretions
    - Frequent suctioning
    - Need adequate cough
Routine Trach Care

- Patients and families should be able to perform routine care including trach changes

- Every patient should have a “Go Bag” with home tracheostomy supplies
  - Replacement trach -- same size
  - Replacement trach -- next size smaller
  - Water soluble lubricant
  - AMBU bag
  - Stethoscope
  - Gloves
  - Scissors
  - Saline
Routine Trach Care

- **Routine Trach Changes**
  - Prevent granulation tissue formation
  - Differs based on material

- **Cleaning tubes**
  - vary based on material
  - check manufacturer’s instructions