Complications of Tracheostomy

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Tracheostomy

- Indications: relief of airway obstruction, pulmonary toileting, and facilitation of prolonged ventilatory support.
- Advantage over endotracheal intubations are improved patient comfort, decreased requirements for sedation, more effective pulmonary toilet, and increased airway security.
First tracheostomy was performed by Asclepiades in 124 B.C. but successful tracheostomies were rare until the 19th century.

In 1833 Trousseau described a tracheostomy for diphtheria with a 25% success rate.
In the early 1900s, Chevalier Jackson performed a tracheostomy and established it as a safe, simple and effective procedure.

Jackson advocated entry into the trachea at the 2\textsuperscript{nd} or 3\textsuperscript{rd} tracheal ring.

In 1960, Bjork modified the technique whereby an inferiorly based flap of a portion of the 3\textsuperscript{rd} tracheal ring is sutured to the skin of the neck.
Complications

- Overall mortality rate of tracheostomy is 2.2%.
- Complication rate as high as 65% in some studies.
- Most common complication is wound infection.
- Complications may be intraoperative, early postoperative and late postoperative.
Intraoperative complications are rare, but include damage to the great vessels (carotid artery/jugular vein), injury to the posterior wall of the trachea and esophagus, and injury to the cupula of the lung, resulting in pneumothorax.
Early postoperative complications include tube occlusion by dried secretions, and tube dislodgement with loss of airway.

Postoperative care should include use of humidified air to prevent crusting and obstruction of the tracheostomy tube.
If the tracheostomy tube becomes dislodged or must be changed within the first 1-2 weeks postop, must be ready for endotracheal intubation or emergency cricothyroidotony.

The track between the skin and the tracheal stoma is not established for a variable number of days after the operation.
If premature decannulation occurs, the tracheal stoma typically retracts deep into the neck where it is extremely difficult to find.

Place patient in recumbent position with a sheet underneath the shoulders to extend the neck.
Subcutaneous emphysema may be avoided if the tissues are not sutured too snugly against the tracheostomy tube.

There may be air leakage between the trachea and the tracheostomy tube.

If air is allowed access to the outside, subcutaneous emphysema does not occur.
Late complications are most likely related to tracheal stenosis or collapse, or to excessive granulation tissue.

At the site of a tracheal stoma, granulation tissue can form a bulky obstruction.

Bronchoscopy can be used to resect granuloma or treated with endoscopic laser ablation.
Ischemic necrosis at the site of the tube cuff or the tube tip can produce a segment of ischemic stricture, tracheomalacia with functional obstruction during exhalation, or erosion and fistula formation with the esophagus or innominate artery.

Patients often present with symptoms long after the tracheal intubation (months or years).
Tracheobronchomalacia is a rare long-term complication of tracheostomy.

- Usually occurs focally in the intrathoracic trachea and is due to ischemia and destruction of the tracheobronchial cartilage.
- There is loss of airway support structure and the now compliant airway collapses on expiration leading to air trapping, retained secretions, recurrent infection, hypoxemia, hypercarbia, and respiratory failure.
Bronchoscopy verifies the diagnosis.
Treatment is conservative.
In severe cases, management options include stent placement, tracheal resection with end-to-end anastomosis, tracheostomy placement, tracheoplasty with cartilage or DuraGraft, and aortic or innominate artery suspension.
Suprastomal stenosis, stomal stenosis, cuff stenosis, and stenosis at the tip of the cannula also due to ischemia caused by excessive cuff pressures.

Risk factors include stomal infection, sepsis, an oversized tracheostomy tube, hypotension, and corticosteroids.
If the tracheal incision is made in the area of the 1\textsuperscript{st} ring or cricoid cartilage, there is a high risk of subglottic stenosis after the tracheostomy tube has been removed.

Opening in the trachea heals by cicatrization incurring a risk of mild narrowing of the trachea at the site of the tracheostomy.
Strictures at the stomal level may be minimized by making the incision in the trachea as small as possible.

If a patient who has undergone a period of mechanical ventilation with a tracheostomy tube ever develops signs of an upper airway obstruction (stridor, wheezing, shortness of breath), a stricture should be strongly suspected.
Patients are often asymptomatic until the stenosis has reduced the original tracheal lumen diameter by 50% to 75%, or the actual diameter is less than 5 mm.

Lateral x-ray of the neck, CT scan, MRI, fluoroscopy or laryngotratcheoscopy can be used to evaluate extent of stenosis.
Most patients remain asymptomatic and never require treatment.

Suprastomal lesions are generally corrected by resection of the necrotic cartilage with hyoid bone interposition and stenting.

Stomal lesions will often require removal of necrotic tissue and granuloma with T-tube stent placement.
Infrastomal stenosis is usually resected with end-to-end tracheal anastomosis without stenting.

Distal tracheostenosis is usually managed with intraluminal laser excision of the stenosis with external extraluminal anterior wall support.
Tracheo-esophageal fistula is a rare complication of tracheostomy and occurs in less than 1% of patients.

Usually iatrogenic from perforation of posterior tracheal wall during the procedure, or posterior wall erosion from excessive cuff pressure or tube abrasion.
Presence of a nasogastric tube may also contribute to the erosion between the trachea and esophagus.

Symptoms include copious secretions, dyspnea, aspiration of food contents, cuff leak and gastric distension.

Diagnosis with CT scan and barium swallow.
Definitive repair requires closure of the esophageal fistula and resection of the damaged trachea with reanastomosis of healthy tracheal ends and interposition of a pedicle of vascularized tissue between the injured sites.

Double stent placement in the esophagus and trachea may be used in patients who are not surgical candidates.
One of the most feared complications of surgical tracheostomy is trachea-innominate artery fistula.

This occurs at the level of the tip of the tracheostomy tube and has been linked to an excessively low tracheostomy (below the 3\textsuperscript{rd} tracheal ring) with erosion from a high pressure cuff.
Incidence is 0.6% to 0.7%.

Occurs within 3 to 4 weeks in 80% of cases.

Mortality rate is 100% if untreated.

The innominate artery lies adjacent to the trachea and traverses it most often at the 9th tracheal ring, but can range from the 6th to the 13th tracheal ring.
Patients often present with bleeding around the tracheostomy site or massive hemoptysis.

Warning signs may include a sentinel bleed or pulsating tracheostomy tube.

Bronchoscopy and angiography are often nondiagnostic and should not delay operative repair.
Temporary control of the bleeding can be achieved by immediately inflating the balloon cuff.

If this does not control bleeding, remove tracheostomy tube and insert an endotracheal tube.

Digital control of bleeding can be achieved by passing an index finger into the tracheostomy stoma and occluding the bleeding site against the underside of the sternum.
Emergent operative repair by resection of the innominate artery and ligation of both ends, and resection also of the damaged tracheal segment in some cases.

Well-vascularized adjacent tissue (eg. strap muscles) should be used to protect the ends of the divided innominate artery from the adjacent tracheostomy.
Percutaneous Dilatational Tracheostomy

- Benefits include elimination of need for operating room use or anesthesia, and significant reduction in cost.
- PDT first attempted by Shelden et al in 1955 by gaining airway access with a slotted needle that was then used to guide a cutting trocar into the trachea.
Multiple deaths were reported from trocars lacerating vital structures so initially PDT failed to gain acceptance.

In 1969, Toye and Weinstein introduced a new technique based on a single tapered dilator with a recessed cutting blade.

Experience was good, but still did not gain any more acceptance.
In 1985, Ciaglia introduced a new technique for PDT that consisted of inserting a tracheostomy tube with the use of a guide wire inserted through a cannula into the tracheal lumen followed by serial dilations with sequentially larger dilators.

Ciaglia technique and the Griggs technique which uses a dilating forceps with a metal conus are the most widely used.
There are few studies that directly compare percutaneous tracheostomy with surgical tracheostomy.

Bleeding is the most common perioperative complication of PDT.

Bleeding in PDT is low due to minimal amount of tissue disruption and the stoma tamponade effect by the dilators and the tube.
Kearney et al reported overall complication rate with PDT 15%, and mortality rate 0.6%.

In a prospective randomized trial of PDT with surgical tracheostomy, Friedman et al found no significant difference in intraprocedural complications between the two groups. Post procedural complication rates were 12% for PDT and 41% for surgical tracheostomy.
Dulguerov et al found that percutaneous tracheostomy is associated with a higher prevalence of perioperative complications. Postoperative complication rates were higher with surgical tracheostomy (10% vs 7%).
- Freeman et al. reported no difference in operative complications.
- Wu et al in China reported no difference in complication rates.
- Khalili et al showed no difference in complication rates.
Melloni et al. in Italy showed an early postoperative complication rate of 36% for standard tracheostomy vs. 4% for percutaneous tracheostomy.

Succo et al. in Italy showed fewer complications with percutaneous method.

Still no clear superiority of either procedure.