Acute Care SINS: Surgical Insights for the Non-surgeon

Chapter 3: Head and Neck SINS

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About the Authors

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Summary

“Surgical Insights for the Non-surgeon,” or SINS, is composed of several short chapters intended to cover fundamental surgical knowledge for non-surgeons. The authors focus on surgical pearls, operative insights, and applied anatomy. In Chapter 3 of this series, the authors outline anatomy of the head and neck, tracheostomy, thyroid/parathyroid surgery, and radical neck dissections/operations.

Résumé

L'ouvrage « Surgical Insights for the Non-surgeon » ou SINS (aperçu de chirurgie pour le non chirurgien) se compose de plusieurs courts chapitres conçus pour couvrir les connaissances fondamentales en matière de chirurgie chez ceux qui ne sont pas chirurgiens. Les auteurs se concentrent sur des « trésors de sagesse » tirés de leur expérience personnelle en chirurgie, certaines idées en matière d'interventions, et sur l'anatomie appliquée. Le troisième chapitre porte sur l'anatomie de la tête et du cou, la trachéostomie, la chirurgie thyroïdienne et parathyroïdienne, la dissection radicale du cou et la chirurgie du cou.

A good surgeon must have an eagle's eye, a lion's heart and a lady's hand.

– John Halle, 1529–1568

Anatomy

The **trachea** (aka the windpipe) is a cartilaginous and membranous tube that starts below the **larynx** (at the C6 vertebra) and ends in two **bronchi** (at the T5 vertebra). Bronchoscopically, it is identifiable by anterior rings and a flattened **posterior tracheo-esophageal** membrane (which is thin and vulnerable – see below).

Anterior to the trachea is the **thyroid isthmus**, then the **inferior thyroid veins**, the **sternothyroid** and **sternohyoid** muscles, the cervical fascia, and the superficial **branching anterior jugular veins**. Less than 10% also possess an arterial

Figure 1. Anatomy. Illustration by Rachel G. Khadaroo and Dawne Colwell.

Surgical Pearl: Emergency Criothyroidotomy

In an emergency, a criothyroidotomy is faster, easier, and safer than a tracheostomy* (see figure below):

1. Modified Seldinger kits are available.
2. Digitally landmark the cricothyroid membrane (below the thyroid cartilage and above the cricoid ring).
3. Stabilize the trachea with your thumb and first two fingers.
4. Make a 3–4 cm transverse/midline incision to expose cricothyroid membrane.
5. Cut the cricothyroid membrane.
6. Insert tracheostomy/endotracheal tube (ETT) into the trachea.

*A cricothyroidotomy can be in place for 24 hours but should then be replaced with a formal tracheostomy.

If no scalpel or kit is available, perform needle cricothyroidotomy*:

1. Attach a 3 cc syringe to a 14-gauge angiocatheter.
2. Stab the cricothyroid membrane at a 45° angle and aspirate any air.
3. Remove the syringe plunger.
4. Attach an adapter to the top of a size 7 ETT.
5. Cut a hole in the side of the oxygen tubing where it will attach to the adapter.
6. Connect the adapter to the oxygen tubing (cover the hole for 1 second and release for 4 seconds).
7. Call surgery to arrange for a more permanent airway to be provided.

*Needle cricothyroidotomy is a temporary measure that provides oxygen but rarely removes CO₂. This needs to be converted to a formal tracheostomy within 20 minutes.

Cricothyroidotomy: an incision is made in the cricothyroid membrane to place an endotracheal or tracheostomy tube. Illustration by Rachel G. Khadaroo and Dawne Colwell.

variant that ascends anterior to the trachea and lower thyroid. This can further complicate surgery.

Posterior to the trachea is the **esophagus**. Inferior to the trachea is the **sternum**, remnant **thymus**, **innominate vein**, and **aortic arch** (from which a deadly fistulae can occur weeks after a tracheostomy: see below). Lateral are the common **carotid arteries**, the **thyroid lobes**, and the **inferior thyroid arteries**. In short, head and neck surgery requires an impressive combination of factual knowledge, manual dexterity, and steady nerves (Figure 1).

Tracheostomy

A tracheostomy is a surgical opening made in the trachea, followed by the insertion of a tube that facilitates oxygenation and ventilation. Multiple indications include prolonged mechanical ventilation, upper airway obstruction (e.g., trauma, neck mass), and operations that compromise the upper airway (e.g., oral tumour resections).

Performing a Tracheostomy

- Open technique
 - Surgeon dissects the neck in order to visualize the trachea
 - Done in the intensive care unit (ICU) or operating room (OR)
- Percutaneous technique
 - Dilatation of the trachea typically using a Seldinger technique
 - Done in the ICU or OR

Complications of Tracheostomy

Early complications:

- Bleeding
 - Usually controlled with direct pressure (be careful not to compromise the airway with excess pressure); typically, bleeding is from the skin edges
 - Injection of lidocaine with epinephrine (10–20 cc) beneath the skin and around the stoma
 - A hemostatic agent (absorbable cellulose polymer such as Surgicel) can be placed on the bleeding – it is available from the OR
- Loss of airway
 - Usually follows excess coughing or movement
 - Medical emergency – go to the bedside immediately
 - Avoid reinserting the tracheostomy tube if the tracheostomy is fresh (e.g., <10 days). This is because there is no matured tract, so reinsertion attempts usually go pre-tracheal. Instead, reintubate from above

- (e.g., endotracheal intubation)
 - Stabilize the patient (never ignore the A-B-Cs!)
 - Call a surgeon to redo the tracheostomy (non-urgent once the patient has been reintubated).
 - If a mature tract has developed (typically after 10 days), you can reinsert a tracheostomy tube via the stoma; remember to re-inflate the cuff.
 - Always confirm the correct tube placement (end-tidal CO₂, lung auscultation, saturation monitor).
 - Aspiration
 - Supportive treatment
 - Antibiotics only if there is a frank infection or you are unable to wean the patient from the ventilator
 - Obstruction
 - Can occur from a foreign body, blood, or secretions
 - Suction the tracheostomy tube.
 - Use video bronchoscopy if there is no resolution.
 - If still no resolution, call the surgeon as a new tracheostomy is likely required.
 - Pneumothorax
 - Simple pneumothorax causes desaturation, hypoxemia, and increased airway pressure. Treat using a chest tube. Once in, place on a -20 cm H₂O underwater seal via a pleurovac. Radiograph to confirm the resolution of pneumothorax and the tube placement.
 - Tension pneumothorax causes all of the above plus hypotension. This is a life-threatening emergency! It is inappropriate to await radiographic confirmation: treat immediately! Institute needle decompress with a 14-gauge angiocatheter at the second intercostal space, midclavicular line. Then treat the residual simple pneumothorax with tube thoracostomy.
 - Pneumomediastinum/subcutaneous emphysema
 - The majority resolve spontaneously.
 - If not, there is probable tracheal/bronchopleural damage.
 - Diagnose with bronchoscopy through the tracheostomy tube.
 - Include bronchoscopy via the mouth/nose (to examine the upper airway).
 - Posterior tracheal wall damage
 - Rare, but can result from trauma following intubation or tracheostomy
 - Diagnose as above
 - Typically managed conservatively
 - Occasionally needs surgery (call thoracic department)
 - Tracheo-esophageal fistula
 - Results from overaggressive tube insertion, with an incorrect trajectory
 - Causes a false passage between the posterior trachea and anterior esophagus
 - Recognized via air leaving the oral cavity with ventilation
 - Early repair in the operating room is required.
 - Delayed recognition is a big problem, often requiring esophageal resection.
 - Tracheal fire
 - Never use electrocautery to enter the trachea.
 - The patient is typically on 100% oxygen during the procedure, and electrocautery can spark an explosion.
 - This is a potentially fatal occurrence.
 - Prevention is the best treatment.
 - If a fire is identified, immediately douse the wound with saline or water.
- Late complications:**
- *Massive* bleeding rarely occurs early. Massive bleeding occurring weeks following the operation might be from a fistula between the trachea and innominate artery
 - Surgical emergency; requires median sternotomy and arterial ligation
 - May be temporized with a finger through the tracheostomy incision
 - Pull finger toward the sternum to tamponade the artery against the sternum (Utley's manoeuvre) while en route for stat surgery
 - Tracheal stenosis
 - Obstruction from scar tissue
 - Diagnosis by bronchoscopy
 - Mild stenosis is treated conservatively or with bronchoscopic dilatation
 - Moderate to severe stenosis requires laser ablation, stenting, or surgical resection/reconstruction.
 - Tracheomalacia
 - Collapse of the tracheal cartilage
 - Can occur after removal of the tracheotomy
 - May require stenting (consult your friendly thoracic surgeon)
 - Airway obstruction – see discussion, above
 - Swallowing abnormalities
 - Can occur after long-term tracheostomy
 - Perform swallowing study prior to oral feedings
 - Tracheo-esophageal fistula
 - Can also be seen as a late complication
 - Secondary to tracheal ischemia and pressure from the tracheostomy tube/cuff
 - Presents with recurrent aspiration pneumonia

- Diagnosis by direct visualization (esophagoscopy and bronchoscopy)
- Resection of the involved segment of esophagus is often necessary
- Recurrent laryngeal nerve injury
 - Rare
 - Presents with hoarseness, ineffective cough, dysphagia, and aspiration
 - Diagnosis is by direct laryngoscopy following the removal of the tracheostomy
 - If there is stridor/airway obstruction, reintubation with or without repeat tracheostomy is usually required

Thyroid and Parathyroid Surgery

The thyroid and parathyroid glands exist in close proximity. Therefore, surgical complications are similar following the resection of either. Surgery is most commonly performed via a transverse cervical incision, with important structures nearby. There is plenty of potential for complications: choose your surgeon wisely!

- Thyroid resections
 - Classified as a total/near-total thyroidectomy or a thyroid lobectomy
 - If malignant, the central compartment lymph nodes are often also resected.
- Parathyroid resections
 - Classified by disease type
 - Primary hyperparathyroidism (due to single-gland disease such as a solitary parathyroid adenoma) receives *focused exploration* (the one abnormal gland is explored and removed); *unilateral exploration* (only one side of the thyroid is explored, with the abnormal gland removed and a normal gland biopsied); or *traditional four-gland exploration* (all glands are visualized, an abnormal gland is removed, and the other glands are biopsied).
 - Hyperparathyroidism surgery requires preoperative localization. This is done by nuclear medicine or ultrasonography.
 - Suspected hyperplasia causing primary hyperparathyroidism receives a subtotal/total parathyroidectomy with autotransplantation into muscle. It is similar to the treatment for secondary hyperparathyroidism (i.e., from renal failure).

Complications

- Bleeding
 - Bleeding can be a life-threatening; therefore, for all postoperative neck surgery patients, a tracheostomy tray and scissors/staple removers are required at the bedside.
 - Open the neck incision for any rapidly expanding hematoma. (The surgeon will forgive you: this is an emergency!) Have the nurse call the surgeon immediately. Apply pressure to any bleeding vessel and book stat surgery.
 - With a slower-expanding hematoma (not compromising breathing), call the surgeon and book the OR, but *do not* open the incision unless there is airway compromise.
- Hypoparathyroidism/hypocalcemia
 - Hypoparathyroidism can be deliberate, such as that from a total parathyroidectomy for parathyroid hyperplasia.
 - Hypoparathyroidism can be inadvertent; for example, during exploration, the parathyroid glands may be permanently devascularized or temporarily stunned.
 - It is best prevented by intraoperative parathyroid identification and the use of an experienced surgeon.
 - Calcium falls to normal or below-normal levels within 12–24 hours postoperatively.
- Hungry bone syndrome
 - Calcium level falls despite normal parathyroid function
 - Due to less movement of Ca^{2+} from bone to blood and to increased movement of Ca^{2+} from blood to bone
 - Neuromuscular excitability from low plasma ionized Ca^{2+}
 - Numbness and tingling in the extremities and periorally
 - Central nervous system manifestations: fatigue, confusion, anxiety
 - Muscle cramps/spasms plus electrocardiographic changes (long Q–T interval; T waves)
 - Extreme cases associated with convulsions, bronchospasm, laryngospasm/stridor, and cardiac arrest
 - Treatment in severe cases: 10 mL intravenous 10% calcium gluconate (1 g over 3–4 minutes); can be repeated until the patient is no longer symptomatic.

Follow with calcium infusion 1–2 mg/kg/h, with or without magnesium and vitamin D

- Treatment in less severe cases: oral CaCO_3 (2,500–5,000 mg); it can be useful to give in conjunction with calcitriol 0.25 µg PO qd or bid
- Do not treat asymptomatic postoperative hypocalcemia as this may delay the return of parathyroid function.
- The patient should be monitored as an outpatient with weekly blood work, and the calcium and calcitriol weaned accordingly.
- Temporary hypoparathyroidism lasts up to 6 weeks.
- If hypocalcemia lasts longer, consider it permanent.
- Hypothyroidism
 - Expected following total thyroidectomy (!)
 - Thyroid-hormone replacement; wait 10 days before starting due to the long half-life of the hormone. Dosage: 1.6 µg/kg/d L-thyroxine (average daily dosage 100–150 µg). Recheck thyroid stimulating hormone (TSH) and T4 levels in 4–6 weeks
- Recurrent laryngeal nerve damage
 - Direct injury from traction or division
 - Presents with hoarseness, ineffective cough, dysphagia, aspiration, or airway compromise
 - Diagnosis is by direct laryngoscopy
 - If unilateral, typically there is no surgical repair for 6 months (may be reversible). If needed, vocal cord medialization is performed to improve the voice.
 - If bilateral, may need intubation and tracheostomy
 - If continued airway compromise, may need surgery to remove a portion of a vocal cord
- External laryngeal nerve damage
 - Runs along the superior pole and can be easily damaged during ligation of nearby vessels
 - Results in a weak voice and inability to shout
- Thyroid storm
 - Due to intraoperative manipulation – but can present postoperatively
 - Surgery does not immediately relieve hyperthyroidism due to long hormone half-life
 - Treat with β blockers, propylthiouracil (PTU), steroids, intravenous sodium iodide, a cooling blanket, etc.

Radical Neck Dissections and Operations

Microvascular surgery is leading to more and larger reconstructive neck operations. Radical neck dissections are

typically for regional control of metastatic disease, or staging to determine if adjuvant therapy is indicated. Regardless, many involve flaps; therefore, a rudimentary knowledge is required.

Management of Flaps

Proper care is essential for the survival of the flap. Early detection of problems leads to a higher likelihood of flap salvage.

- Apply minimal pressure/tension/movement to the flap in order to preserve the pedicle/vascular supply.
- Maintain hemodynamic stability to provide good perfusion to the flap.
- Examine the flap. It should be pink and minimally edematous, and there should be capillary refill in <3 seconds.
- Doppler sonography can be used to assess the pedicle flow, or the prick test (see below) can be performed.
- Ask the surgeon if he or she wants acetylsalicylic acid (ASA) or heparin used.
- Check with the surgeon regarding transfusion triggers. (Surgeons are often reluctant to transfuse.)

Complications of Neck Dissection and Flap Reconstruction

- Bleeding
 - Check the coagulation status of the patient.
 - Contact the surgeon.
 - Immediate surgical exploration is usually indicated.
 - Remember, the airway is the priority.
- Infection – antibiotics plus surgical drainage if abscess is present
- Flap failure
 - Venous thrombosis results in a dark blue discoloration (venous congestion). Immediate surgery with thrombectomy and heparinization (with or without leeches!) should be considered for rotational flaps (e.g., pectoralis major flap).
 - Arterial thrombosis is less common and results in a pale, cold flap with no bleeding after pricking. Immediate surgery is needed.

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