Cricothyrotomy: Assisting with

What is Cricothyrotomy?

› Cricothyrotomy (CcT; also called thyrocricotomy, inferior laryngotomy, and emergency airway puncture) is an emergency surgical procedure that is performed to secure a patient’s airway when other methods (e.g., nasotracheal or orotracheal intubation) have failed or are contraindicated. Typically, CcT is performed only when intubation, delivery of oxygen, and use of ventilation are not possible

• What: CcT is a type of tracheotomy procedure used in emergency situations (e.g., when a patient is unable to breathe through the nose or mouth). The two basic types of CcT are needle CcT (nCcT) and surgical CcT (sCcT). Both types of CcTs result in low patient morbidity when performed by a trained clinician. Compared with the sCcT method, the nCcT method requires less time to set up and is associated with less bleeding and airway trauma

• How: Ideally, a CcT is performed within 30 seconds to 2 minutes by making an incision or puncture through the skin and the cricothyroid membrane (i.e., the thin part of the larynx [commonly called the voice box]) that is between the cricoid cartilage and the thyroid cartilage into the trachea

– An nCcT is a temporary emergency procedure that involves the use of a catheter-over-needle technique to create a small opening. Because it involves a relatively small opening, it is not suitable for use in extended ventilation and should be followed by the performance of a surgical tracheotomy when the patient is stabilized. nCcT is the only type of CcT that is recommended for children who are under 10 years of age

– A formal tracheotomy is a more complex procedure in which a surgical incision is made in the lower part of the neck, through the thyroid gland, and into the trachea. The term tracheotomy refers to the operation that is performed, and the term tracheostomy is used to refer to the stoma, or the opening that is created by tracheotomy

– In an sCcT, an incision is made through the cricothyroid membrane into the trachea with a sharp instrument (e.g., preferably a sterile scalpel), after which an endotracheal or tracheotomy tube is passed through the incision into the trachea. The terms tracheotomy tube and tracheostomy tube are used interchangeably

• Where: CcT is often performed in the field (e.g., at the site of an automobile accident, on the battlefield), although under ideal circumstances, CcT should be performed in an emergency department or an intensive care unit

• Who: Under optimal circumstances, CcT should be performed by a trauma specialty doctor, surgeon, anesthesiologist, or advanced practice nurse who has certification in emergency techniques; however, medical students, paramedics, trauma nurses, physicians assistants, and military personnel, especially field medics who are deployed to war zones, are often trained and authorized to perform CcT, depending on local medical protocols. Due to their immature anatomic structures, specialized training is required to perform nCcT safely on a neonate or small infant

What is the Desired Outcome of Cricothyrotomy?

› The desired outcome of CcT is to secure a patient’s airway when attempts to perform an endotracheal or oropharyngeal tracheotomy have failed or are contraindicated, as follows:
• Anatomic anomalies or traumatic shift of anatomic structures (e.g., due to crushing injury of larynx) that result in airway obstruction
• Massive pharyngeal, oral, or glottic area hemorrhage or nasal hemorrhage
• Obstruction of the airway from foreign object or mass (e.g., tumor, polyp, dental plate)
• Burns to the face and neck
• Injury due to ingestion or inhalation of a chemical
• Edema of the oropharynx
• Laryngospasm
• Laryngeal or pharyngeal stenosis
• Unrelenting spasm of masseter muscle (i.e., the primary chewing muscle that covers the sides of the jaw immediately behind the cheeks)
• Clenched teeth

Why is Cricothyrotomy Important?
› CcT is a life-saving procedure and with proper training, can be performed under emergency circumstances without traditional surgical equipment. Unlike tracheotomy, CcT does not require manipulation of the cervical spine, although hyperextension of the neck facilitates performance of the CcT procedure

Facts and Figures
› Overall, CcT has a very low mortality rate, even when performed outside of an acute care medical facility (e.g., at the site of a car accident, on the battlefield) (Gulsen et al., 2010)
› Investigators who conducted a meta-analysis found that success rates for nCcT and sCcT performed prior to hospitalization were 66% and 91%, respectively (Hubble et al., 2010)
› sCcT with gum elastic bougie (i.e., a type of endotracheal tube introducer that is a slender, flexible, hollow cylindrical instrument) has been performed with success and research results suggest that this instrument will simplify and increase the safety of current sCcT techniques (Hill et al., 2010)
› Authors of a study of military medics reported that they were able to complete cricothyroidotomy faster using the CricKey method (i.e. a method using a device that combines the functions of a tracheal hook, stylet, dilator, and bougie with a Melker airway cannula) compared with standard open surgical technique (Mabry et al., 2014)

What You Need to Know Before Assisting with Cricothyrotomy
› Signs and symptoms that may be observed if airway access is compromised include loss of consciousness and, if the patient is conscious, temporary muteness, grabbing at the neck, and/or severe agitation, cyanosis, or apnea
› Individuals who are typical candidates for CcT include those
• who have lost airway access due to
  – inhalation injuries (e.g., burns) to the face, head, or neck
  – trauma to jaw, face, and/or neck (e.g., fractures of nose/cheek bones or jawbone, penetrating injury from car accident)
  – laryngospasm (i.e., uncontrollable closure of the larynx) due to poisoning, allergic reaction, or medication overdose (e.g., wasp venom, drug anaphylaxis)
  – blocked airway due to dislodged teeth, bone fragments, or foreign objects
  – teeth/jaw clamped shut (e.g., lockjaw secondary to tetanus infection)
  – fractured larynx (e.g., trauma/crushing injury; secondary to hanging or strangulation)
• with structural anomalies that result in airway obstruction
› The many blood vessels and nerves located in the neck region make CcT a complicated and highly risky procedure that requires specialized training
• Risks and complications of nCcT include the following:
  – Bleeding
  – Scar secondary to needle puncture
  – Esophageal perforation
• Risks and complications of sCcT include the following:
  – Bleeding
  – Esophageal perforation
  – Subglottic stenosis
Fracture of or injury to the larynx
Large scar secondary to incision
Vocal cord damage resulting in hoarseness or other voice changes, which may be permanent
Pneumothorax
Thyroid cartilage injury
Airway misplacement with subsequent need for a chest tube

Being under 10 years of age is a contraindication for sCcT. Children in this age group require an nCcT because
• the upper part of the trachea is not fully developed
• the small larynx is located much higher in young children, at the C2–3 level instead of at the C5–6 level in adults
• attempts to perform a surgical incision through the cricothyroid membrane have a higher risk for complications in young children; potential complications include subglottic stenosis, which is an abnormally narrow trachea below the level of the vocal cords due to an overgrowth of soft tissue
Subglottic stenosis is often observed in children who were intubated during infancy

Ideally, CcT is performed as a sterile procedure because it involves the airway; however, emergency field conditions rarely permit a sterile field to be maintained

If the patient or family members are unable to complete informed consent documents, a CcT is authorized by medical protocols when required due to an emergency situation. If time permits, preliminary steps that should be performed before assisting with CcT include the following:
• Review the facility/unit emergency protocol for CcT, if available
• Review the treating clinician’s orders, if available; CcT is often performed under emergency conditions and no written order may exist
• Review the patient’s history/medical record, or check if the individual has a medical alert bracelet, for any allergies (e.g., latex, medications, or other substances); use alternative materials if necessary
• Verify completion of facility informed consent documents, if applicable

Gather necessary supplies, which will vary based on the type of procedure being performed and the availability of equipment. Supplies typically include the following:
• Personal protective equipment (PPE; e.g., gloves, goggles, gown, and mask) for yourself and the treating clinician
• Sterile drape
• Sterile tape and gauze
• Antimicrobial swabs (e.g., chlorhexidine, povidone-iodine)
• Catheter-over-needle set-up (12- or 14-gauge for adults; 16- or 14-gauge catheter-over-needle for young children) with attached syringe filled with a small amount of normal saline
• Needles and syringes (3-5 ml) to be used for local anesthetic and for inflating the cuff on the tracheotomy or endotracheal tube
• Local anesthetic solution (e.g., 1% lidocaine)
• Needle for nCcT (12- or 14-gauge for adults; 16- or 18-gauge for young children and infants)
• Scalpel for sCcT (number 11 or 15)
• Hemostat or tracheal spreader to be used to enlarge the opening
• For nCcT, endotracheal tube connector (6–7 mm internal diameter for adults; smaller size for children and neonates depending on size of individual)
• For sCcT, cuffed endotracheal tube (5–6 mm for adults) or tracheotomy tube (4.0–6.0 mm for adults)
• Bag-valve device
• Oxygen source
• Ties for securing the catheter tubing
• Suction equipment

How to Assist During Cricothyrotomy

The emergency nature of CcT often precludes adhering to some of the following steps, which assume optimal circumstances. The initial steps for nCcT and sCcT are similar, and include the following:
• Perform hand hygiene and don PPE, as appropriate
• Identify the patient according to facility protocol
• Establish privacy by closing the door to the patient’s room and/or drawing the curtain around the bed
• Introduce yourself to the patient and family members, if present, and explain your clinical role in CcT. Assess patient/family anxiety and for knowledge deficits regarding CcT
  –Determine if the patient/family requires special considerations regarding communication (e.g., due to illiteracy, language barriers, or deafness); make arrangements to meet these needs, if present
    - Follow facility protocols for using a professional certified medical interpreter, either in person or via phone, when a language barrier exists
• Explain details of the CcT, as appropriate, including its purpose; provide emotional support and additional information as needed
  › Assess the patient to determine if he or she
    • is conscious
    • is in pain
    • is able to feel and/or move extremities (to assess for spinal cord damage prior to hyperextending neck for the CcT procedure)
    • wears dentures or has other oral appliances
    • has objects in the neck or throat or feels something rough in the throat or neck (e.g., tooth fragment, debris from accident, such as glass)
    • is able to open his or her mouth
  –As with all emergency situations, it is critical to communicate to the patient and other clinicians in a calm, reassuring manner. Be mindful that if the patient is conscious or even if the patient’s level of consciousness is unknown, communicating with the patient (e.g., explaining the procedure, offering emotional support and encouragement) throughout the procedure can be beneficial to decreasing anxiety and promoting the patient’s cooperation
    - If patient is conscious but unable to speak, ask questions that can be answered with a simple “yes” or “no.” For example, ask the patient to raise a finger for “yes” and keep the finger down for “no”
  › Position the patient in the supine position unless otherwise directed by the treating clinician
  • Place a rolled towel or, if necessary, improvise by using a piece of clothing behind the shoulders to hyperextend the neck.
  
  **Omit this step if spinal injury is suspected**

› Using sterile technique, don PPE and assist the treating clinician with donning PPE
  › Assist the treating clinician with the following steps as time permits:
    • Create a sterile field by using the sterile drape
    • Cleanse the area at the puncture/incision site using an antimicrobial solution antiseptic (e.g., povidone-iodine or soap and water if nothing else is available) starting at the anticipated site of insertion and working in concentric circles. Repeat this step twice
    • If patient is conscious, inject a local anesthetic in the anterior neck region
    • Palpate the patient’s throat to locate the thyroid cartilage (i.e., Adam’s apple in men)
      –The cricothyroid membrane is located immediately below the thyroid cartilage in the center of the neck and just above the cricoid cartilage. It can be identified by finding a shallow depression and feeling for a softer area that measures about the width of a finger (e.g., 1 cm in length by 2-3 cm across)
      –The thyroid cartilage is less prominent in women, which makes the cricothyroid membrane more difficult to locate, especially in women who have excessive fat tissue around the neck
    –The treating clinician will generally undertake the following steps when performing an nCcT:
      - The catheter-over-needle with syringe attached is advanced through the cricothyroid cartilage at a 30–45° angle until the trachea is reached
      - The syringe is aspirated in order to confirm placement in the trachea
        - Air aspirated through the syringe is evidenced by bubbles in the saline, which verifies proper placement
        - Resistance to aspiration and inability to withdraw air indicates the needle is not in the trachea and should be adjusted accordingly
      - The syringe is removed from the catheter set-up after the tracheal position is confirmed and the saline is emptied from the syringe
      - The catheter is advanced over the needle approximately 5 mm further after which the needle is removed and discarded, leaving the catheter in place
      - To further confirm placement in the trachea, the plunger on the syringe, which has been emptied of saline, is pulled back before it is reconnected to the catheter set-up, and the syringe plunger is slowly depressed
- Resistance or the appearance of subcutaneous blebbing (i.e., a fluid-filled blister on the skin) indicates that the catheter is not in the proper location (e.g., it is embedded into the neck tissues); the catheter should be retracted and adjusted as necessary

- When correct catheter placement is confirmed, the cuff is inflated and an endotracheal tube connector is attached to the catheter and oxygen is connected to the other end

- The patient is placed in a lateral position, if possible, in order to prevent aspiration, and is suctioned gently to clear the airway of mucus, blood, tissue, and other debris

- The catheter/endotracheal tube connector is attached to the bag-valve/oxygen unit

- Oxygen and emergency ventilation is initiated, as necessary

- Secure the catheter/endotracheal tube connector with ties or tape, as appropriate

- If the nCcT was performed in the field, continue close patient observation during transport to the closest emergency facility where a formal tracheotomy will be performed

- As appropriate, educate the patient that an nCcT is typically performed as a temporary strategy and is replaced with a formal tracheotomy tube as soon as the patient reaches a medical facility

- The treating clinician will generally undertake the following steps when performing an sCcT:

  - The thyroid cartilage is steadied, usually with the nondominant hand

  - Using a scalpel, a transverse midline (i.e., crossing from side to side) incision is made across the cricothyroid membrane, through the skin and cricothyroid membrane, and into the trachea

  - Using the scalpel, hemostat, or tracheal spreader, the incision is widened to permit insertion of either a tracheostomy or endotracheal tube

  - A second clinician may be needed to manage a tracheal spreader or hemostat, which is used to hold open the incision during tube insertion

  - The patient is placed in a lateral position, if possible, and is suctioned gently to clear the airway of mucus, blood, tissue, and other debris

  - When placement in the trachea is confirmed, the tube cuff is inflated and the tube is taped or tied in position

  - Continue to monitor a patient with an sCcT for bleeding and airway obstruction; notify the treating clinician if undue bleeding or other complications are observed

  - As appropriate, educate the patient that sCcT is an emergency temporary strategy that is performed in place of a formal tracheotomy

› Discard used materials, remove PPE, and perform hand hygiene

› Document the following information in the patient’s medical record:

  • Date and time of procedure

  • Description of the procedure

  • Administration of analgesia or other medications

  • Patient assessment information, including vital signs, oxygen saturation, level of consciousness, and other clinical assessment findings before and after procedure

  • Patient’s response to the procedure

  • Any unexpected patient events or outcomes

  • Amount and description of suctioned material

  • All patient/family education, including topics presented, response to education provided, plan for follow-up education, barriers to communication, and techniques that promoted successful communication

**Other Tests, Treatments, or Procedures That May be Necessary Before or After Cricothyrotomy**

› The emergency nature of CcT usually precludes preoperative diagnostic assessment or tests

› When the patient is stabilized and after transport to an emergency medical facility, if the CcT was performed in the field, typically:

  • a formal tracheotomy will be performed

  • a chest X-ray will be ordered to confirm tube placement

  • ABGs will be performed to assess for adequate gas exchange

  • antibiotics will be prescribed to reduce the risk for infection

› Consultation with specialists (e.g., trauma/critical care, otolaryngology, neurology, neurosurgery, ophthalmology, plastic surgery) may be considered if the patient has injuries to face and neck or other injuries
Tracheostomy care (e.g., suctioning, cleaning and/or changing the inner cannula, daily skin care at the entry site, monitoring cuff pressure) should be instituted as soon as possible. (For information, see *Nursing Practice & Skill … Tracheostomy Care: Providing* )

**What to Expect After Cricothyrotomy**

- The patient’s airway will be secured and the patient will be adequately oxygenated and ventilated
- The CcT will be placed correctly with minimal trauma to the patient and no adverse effects will be experienced (e.g., infection, tube dislodgement, skin breakdown)
- CcT should not be attempted under the following circumstances:
  - Anterior neck infection or hematoma
  - Coagulation abnormalities
  - Tracheal transection (i.e., removal of part of the trachea such as in the case of tracheal cancer)
  - Possible fractured larynx

**Red Flags**

- Improper placement of CcT can cause **asphyxia** and/or **aspiration**
- Potential complications include pneumothorax, vocal cord paralysis, mediastinal emphysema, tracheomalacia (i.e., a condition in which the tracheal support cartilage is flaccid), persistent stoma (i.e., condition in which the incision or puncture performed during the CcT does not completely heal), and esophageal laceration

**What Do I Need to Tell the Patient/Patient’s Family?**

- Educate the patient and family, if applicable, that the CcT procedure is an emergency medical intervention that is performed to secure or maintain an adequate airway. Explain that a CcT is a temporary strategy until the patient is stable enough for a surgeon to perform a tracheotomy, which will provide a more durable airway. Educate that although every patient situation is unique, the airway in most patients is eventually restored, the tracheostomy tube is removed, and the stoma heals
- Educate that following the CcT procedure, it may be necessary to receive supplemental oxygen via stoma mask (e.g., blow-by oxygen) or by ventilator
- If laboratory testing or other diagnostic procedures are ordered following CcT, explain how these tests and/or procedures are performed and when the results will likely become available

**References**