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Percutaneous Cricothyrotomy

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Overview

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A surgical airway procedure is indicated when other forms of endotracheal intubation have failed and ventilation is worsening or not possible. This is the feared "can't intubate, can't ventilate" scenario, and in the emergency setting, cricothyrotomy is the surgical procedure of choice.

Cricothyrotomy is preferred over tracheotomy because of the lower risk of complications, the predictable anatomy of the cricothyroid membrane, and the comparative rapidity with which the procedure can be performed—even by less experienced practitioners. Cricothyrotomy traditionally has been done in an "open" form; however, percutaneous cricothyrotomy using standard Seldinger technique has been advanced as a more successful approach when identification of the relevant anatomic landmarks is more difficult. Seldinger technique involves the introduction of a device into the body through the use of an introducer needle and a guide wire. The needle is used to locate the target; a guide wire is then fed through the thin-walled needle into the target, acting as a "placeholder" for the device, which is fed over the guide wire and into the target.

In the case of percutaneous cricothyrotomy, the practitioner first identifies the cricothyroid membrane by physical landmarks and makes a small vertical skin incision. A thin-walled 18-gauge needle (attached to a syringe) pierces the membrane, and the airway is positively identified when air is aspirated in the syringe. A guide wire is then fed through the needle. Standard cricothyrotomy sets include an airway catheter (similar to a tracheostomy tube) with a stiff dilator within its lumen. The catheter/dilator combination is fed onto the guide wire and the catheter/dilator is placed within the airway. The dilator and guide wire are subsequently removed, and the catheter is attached to a bag-valve device for ventilation.

Procedure

1. Patient positioning and preparation for the procedure

1. The patient in this situation has likely undergone attempted endotracheal intubation and should already be lying supine.
2. Extend the patient's neck to better assess anatomic landmarks.
3. The cricothyroid membrane is located below the laryngeal prominence ("Adam's apple") and is palpated as a soft indentation in the midline on the anterior neck. The superior thyroid arteries anastomose in the midline inferior to the cricothyroid membrane. The thyroid gland is located inferior to the superior thyroid arteries.
4. Gather supplies, including chlorhexidine, a needle cricothyrotomy kit, and airway management supplies (bag-valve-mask device, supplemental oxygen, and suction).
5. There are several pre-packaged percutaneous cricothyrotomy kits available. Standard kits include an introducer needle, a 5mL syringe, a scalpel, a guide wire, a dilator, and an airway catheter, which may be cuffed or uncuffed.
6. Open the needle cricothyrotomy kit and attach the introducer needle to the syringe. Assemble the airway catheter/dilator, prepare the guide wire, and lay out the scalpel for easy access.

2. Protocol

The context of this procedure is often the truly emergent situation. In this event, there may not be time for local anesthesia (if the patient is awake) or skin preparation with chlorhexidine. As with all emergent procedures, true sterile technique is sacrificed for rapidity. For example, it is unlikely that the situation that calls for an emergent cricothyrotomy would allow for sterile gowning and gloving.

1. Stand at the head of the bed and identify the patient's anatomy by palpating the laryngeal prominence and moving your fingers inferiorly into the depression below, the cricothyroid membrane.
2. Grab the paratracheal structures and move them around to be certain you can identify the midline. They will move as a unit. It is in the midline of this depression that the practitioner will make the incision and insert the needle.
3. If time allows, the area should be cleaned with chlorhexidine. Ideally, the exam gloves that the practitioner is wearing should be traded for sterile gloves.
4. Make a small (5mm) vertical incision with the scalpel in the midline previously identified.
5. Advance the introducer needle into the neck through the skin incision and through the cricothyroid membrane at a 45° angle toward the patient's feet, withdrawing on the plunger as you advance.
6. When the needle enters into the airway, you will be able to aspirate air. Note that some practitioners prefer to have 2-3 cc saline in the syringe prior to attaching the needle, to aid in identifying the aspiration of air by creating bubbles when the plunger is withdrawn.
7. Remove the syringe from the needle, taking care to keep the needle within the air-filled lumen identified. This is best done by bracing the hand against the patient's neck, so that there is no migration of the needle tip.
8. Advance the guide wire through the needle approximately 15 cm, so that the guide wire is well within the airway.
9. Remove the needle, keeping the guide wire in place.
10. Thread the catheter/dilator assembly over the distal end of the guide wire, and advance along the wire.
11. Push the catheter/dilator assembly through the skin, anatomically oriented with the airway such that the curve of the catheter matches the curve needed from its entry point into the trachea. Keep pushing until the catheter is fully in place, which means the plastic flange is against the neck.

12. If the catheter is cuffed, fill cuff with air by injecting several milliliters of air into it. Typically 10 mL of air is required. Check the pilot balloon to be sure the cuff is inflated.
13. Remove the dilator and wire from the assembly
14. Attach the catheter to the bag-valve manual resuscitator; auscultate for breath sounds, monitor end-tidal CO₂, and obtain chest X-ray
15. Secure airway catheter with appropriate necktie.

3. Alternative approach for percutaneous cricothyrotomy using Seldinger technique if pre-assembled kit is unavailable

1. Place the patient in supine position as above, with the neck extended.
2. Open central venous catheter tray. Separate out the 5 mL syringe, the introducer needle, the guide wire, and the scalpel.
3. Gather a tracheostomy tube.
4. Attach the introducer needle to an empty 5mL syringe (again, adding water to the syringe first is unnecessary and not advocated by this author).
5. Prepare the guide wire by retracting it in its sheath and straightening out the J tip.
6. Prepare the neck with chlorhexidine if time allows
7. Identify the laryngeal prominence and palpate the depression just caudal to this, the cricothyroid membrane.
8. Grab the laryngeal structures as a unit to be certain the midline is identified.
9. From your position at the head of the bed, advance the introducer needle into the patient's neck, at the point just identified as the cricothyroid membrane. The needle is directed at a 45° angle from the horizontal, in a caudal direction, applying gentle pressure to the plunger of the syringe.
10. Once air is easily aspirated into the syringe, the airway has been identified.
11. Holding the needle steady with your non-dominant hand, remove the syringe with your dominant hand.
12. Advance the guide wire through the introducer needle, to a depth of 15 cm
13. With a #11 scalpel blade, make a 2 cm horizontal incision at the level of the needle. This incision is a complete incision, through both skin and cricothyroid membrane, a depth of approximately 2 cm.
14. The needle is removed with the guide wire left in place
15. Prior to advancing the tracheostomy tube through the neck, it will help if the incision made by the scalpel is dilated open. This can be facilitated with the handle of the scalpel.
16. Retract the blade of the scalpel and advance the handle of the scalpel through the incision
17. With the handle firmly in the incision, rotate the handle 90° so the handle is oriented parallel with the patient's neck and perpendicular to the horizontal incision. This will hold the incision aperture open and allow for easier passage of the tracheostomy tube.
18. Advance the tracheostomy tube over the guide wire. This will assure that the tube follows the correct tract into the airway previously identified by the syringe with air aspiration.
19. Advance the tracheostomy tube into position.
20. Remove the guide wire.
21. Inflate cuff of tracheostomy tube (if cuffed).
22. Attach to appropriate ventilator device as above and secure with neckties.

Summary

Percutaneous cricothyrotomy using Seldinger technique is a critical and life saving procedure. It was first described by Melker and is also referred to as "Melker technique." The decision to place a surgical airway must be made quickly. The procedure itself should be completed in less than a minute. Percutaneous cricothyrotomy with needle and guide wire has been advocated over open cricothyrotomy because the potential complications in an open cricothyrotomy can prove disastrous for the patient.

The benefit of Seldinger technique in performing cricothyrotomy is that the airway is located with a needle, and its access is "held" with the guide wire until the airway catheter is in place. If the cricothyroid membrane is not encountered with the first needle insertion, the location may be re-adjusted and there is less likely to be a life-threatening complication than if the location were misidentified with a scalpel blade. An open cricothyrotomy, by contrast, relies on identification of the cricothyroid membrane and airway by visual inspection after a vertical incision is made with a scalpel. In the event of hemorrhage, visualization can become impossible. Additionally, in obese patients and those with otherwise poor anatomic landmarks, identifying the midline can be a challenge.

Although there are a variety of commercially available percutaneous cricothyrotomy kits, this technique can be done easily with supplies commonly found in the emergency department. There are many procedures that rely on Seldinger technique. A central venous catheter kit could be utilized, for example. It should be noted that other versions of this technique have been described. Some feel that identification of the airway using a needle without the subsequent use of Seldinger technique is the best strategy, combining elements of open cricothyrotomy and needle identification of the airway.