



Minitracheostomy

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Retained tracheobronchial secretions complicate the recovery of hospitalized medical and surgical patients and may lead to significant pulmonary complications such as atelectasis, pneumonia, and respiratory failure. Traditional methods of dealing with difficulty clearing secretions include proper hydration, provision of humidified oxygen, encouraging early mobilization and coughing, use of incentive spirometry, chest physical therapy, antibiotics if appropriate, and, rarely, blind nasotracheal suctioning. These measures may fail and occasionally lead to the need for intubation and ventilation. Minitracheostomy was reported by Matthews and Hopkinson in 1984 as a novel, minimally invasive method to facilitate endotracheal suctioning and clear secretions [1]. The technique involves placement of a small 4 mm (internal diameter) plastic tracheostomy cannula through the cricothyroid membrane into the distal trachea. The trachea can be stimulated by a catheter to produce a cough to clear secretions. Due to the small size of the cannula and preservation of glottic function, secretions can be coughed up via the normal route into the pharynx. Speech and swallowing are unaffected. If needed, endotracheal suctioning may be performed if a stimulated cough does not clear secretions. The cannula is capped when not in use. Other reported uses of minitracheostomy include airway access in acute airway obstruction and jet ventilation.

Indications

The indications for minitracheostomy include prophylactic and therapeutic. Prophylactic uses are mostly postsurgical after major thoracic or upper abdominal operations, which are judged to be particularly high-risk. Risk factors for pulmonary complications include advanced age, emergency status, poor functional status, preoperative smoking, chronic obstructive pulmonary disease—especially bronchitis, and altered mental status. In these cases, minitracheostomy is done at the conclusion of the operation before transfer to the recovery area. Minitracheostomy may also be done in intensive care unit (ICU) patients who are ready to be extubated from a ventilatory point of view but still have a weak secretion clearance. In these cases, it is usually better to treat the problem at a very early stage rather than waiting for respiratory failure to develop. The therapeutic uses of minitracheostomy include the treatment of sputum retention in patients with pneumonia, chronic obstructive pulmonary disease (COPD) exacerbations, major atelectasis (usually postoperative), depressed mental status, thoracic trauma (especially chest wall), and neuromuscular conditions causing respiratory muscle weakness. Again, a balance needs to be achieved in terms of when to consider inserting a minitracheostomy. Clearly the majority of patients with pneumonia do not require one and waiting until impending respiratory arrest is too little, too late. In general, minitracheostomy should be considered in patients who show signs of significant sputum retention. These include a persistently elevated respiratory rate, breathlessness at rest, mild lethargy, inability to clear with bedside chest physiotherapy, persistent rhonchi, major atelectasis, inability to sleep due to

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constant productive cough, and rising $p\text{CO}_2$. Therapeutic bedside bronchoscopy is another reasonable treatment modality in these patients and is often performed once to clear secretions and see if one clearance will get the patient over the hump. It is generally not practical to do bronchoscopy more than once a day or at night, so if a long-term need is seen or anticipated, minitracheostomy is a better choice.

Contraindications

The contraindications to minitracheostomy include anatomic, hematologic, physiologic reasons, and training-related issues. Rare patients have anatomic concerns that preclude safe placement of the device. These include inability to distinguish anatomic landmarks in the neck (morbid obesity, neck mass, previous neck surgery that obscures landmarks, etc) and a calcified cricithyroid membrane precluding cannulation of the airway. Patients with a significant coagulopathy should be avoided, as bleeding can cause not only local wound problems such as a

hematoma, but also can cause bleeding into the airway, which can easily become life-threatening. Patients who have impending respiratory failure and are close to intubation should usually just be intubated. Waiting until the last minute to insert a minitracheostomy will usually not reverse the course of the severely compromised patient. Minitracheostomy, although a relatively minor bedside procedure, is a surgical procedure that requires careful judgment and technique. It should not be done by inadequately trained physicians. The procedure is best done with two people; one to actually perform the procedure and one to monitor the patient, assist the surgeon, and restrain the patient if needed.

Devices

There are several commercially available kits for minitracheostomy. Our unit has experience with the one made by Portex, the Mini-Trach II (Portex, Keene, NH). This kit contains the minitrach cannula, an introducer (obturator), a guarded scalpel, a suction

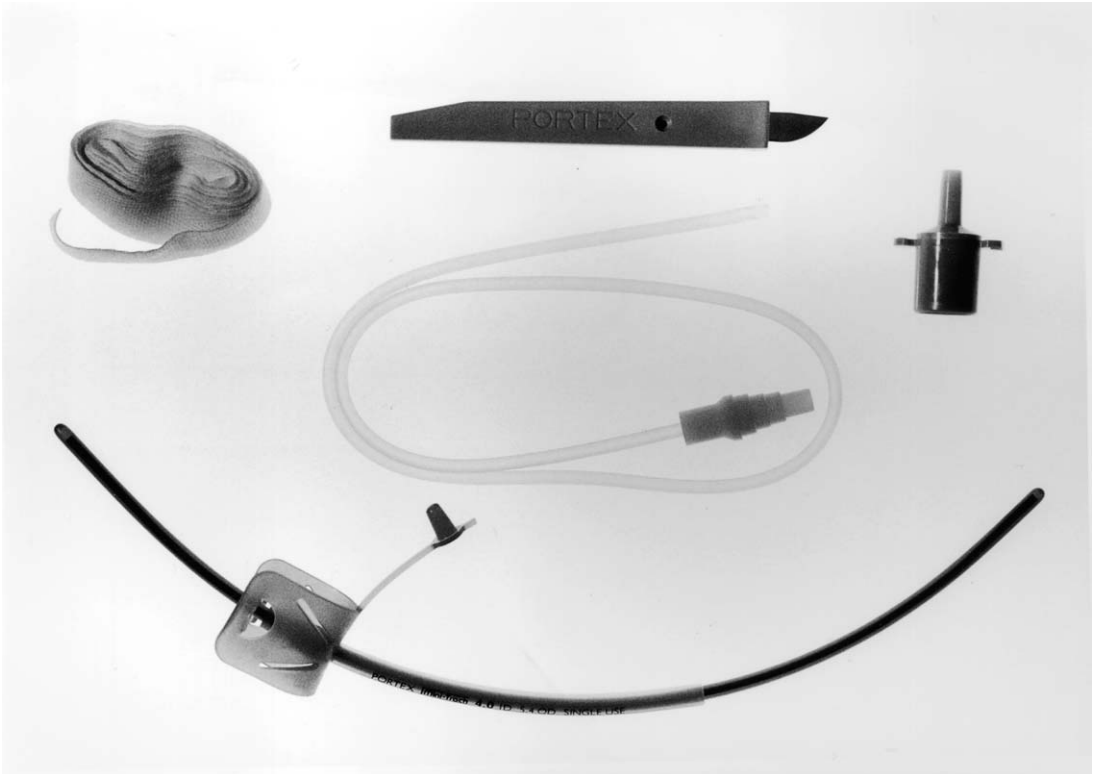


Fig. 1. Contents of Portex Mini-Trach II kit (Portex, Keene, NH). Included are the cannula with the insertion obturator, a special scalpel, a suction catheter, a connection adaptor and cotton trach tape.

cannula, a ventilator adapter, and tracheostomy cotton tape for securing the cannula (Fig. 1).

Technique

The patient should have oxygen provided and have oxygen saturation monitoring during the procedure. The patient should be supine with a roll under the shoulders to extent the neck (Fig. 2). The assistant should help hold the head so the patient doesn't move during the procedure. The neck is palpated and the cricothyroid membrane is identified.

I find it helpful to mark this by outlining the thyroid and cricoid cartilages on the skin with an indelible marker. The skin is prepared with an antiseptic. A small amount of local anesthetic (1% lidocaine with epinephrine) is injected in the cricothyroid area with a small 25-gauge needle. It is important to not use an excessive amount, as it will obscure the landmarks. I find it helpful to puncture the membrane with this small needle to establish the depth of the airway and anesthetize the upper airway. The guarded scalpel is used with its cutting edge facing the feet (toward the cricoid) and a vertical 7-mm stab incision is made through the cricothyroid membrane into the airway.

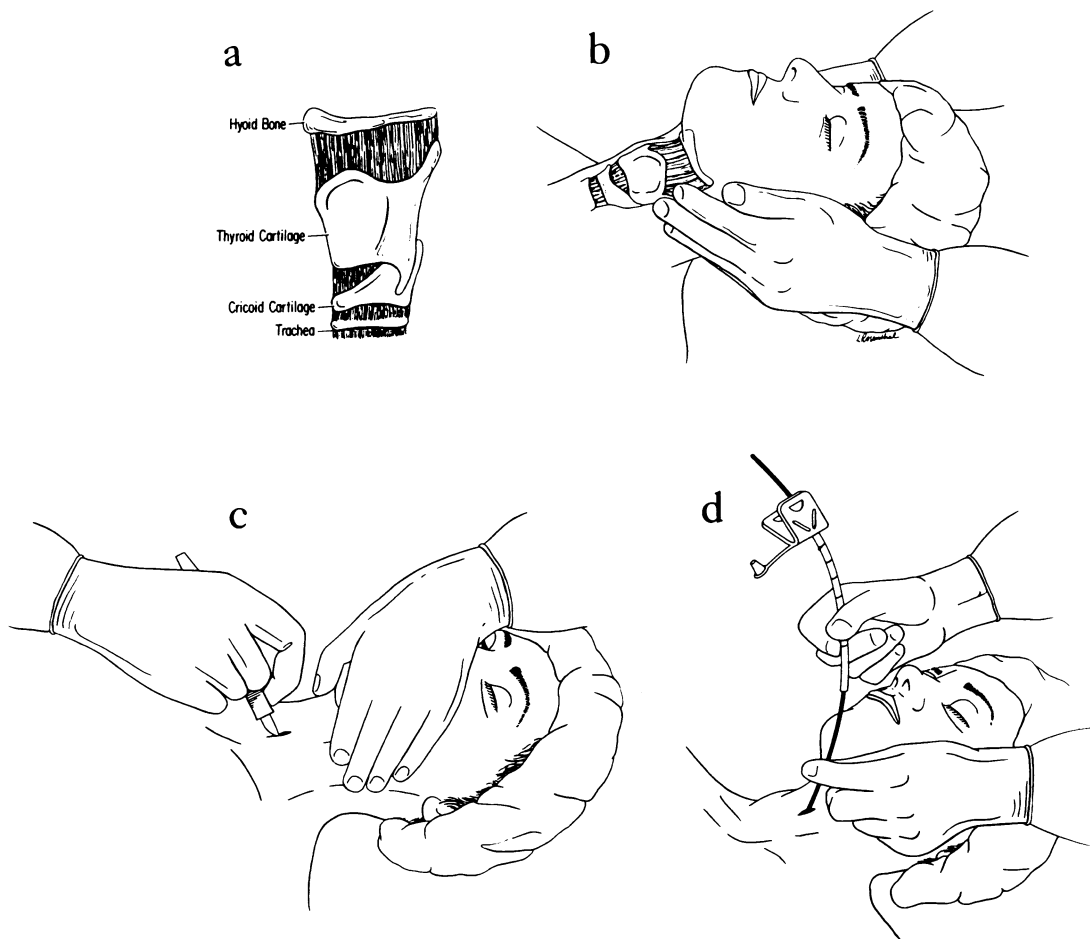


Fig. 2. Minitracheostomy insertion technique. (a) Anatomy of the upper airway. (b) The patient is supine with the neck fully extended and an assistant stabilizing the head. The cricothyroid membrane is identified. (c) After injection of local anesthetic, a vertical incision is made in the cricothyroid membrane while the left hand firmly holds the skin taut over the larynx. The sharp edge of the knife is directed inferiorly. (d) The introducer is passed into the trachea with minimal resistance. The cannula is guided over it into the trachea. The introducer is then removed and the cannula secured. Intratracheal placement is confirmed by air passage thru the cannula, aspiration of secretions, and a satisfactory chest radiograph. (From Wain JS, Wilson DJ, Mathisen DJ. Clinical experience with minitracheostomy. *Ann Thorac Surg* 1990;49:881–6; with permission.)

During this maneuver the surgeons left hand should be pressing the skin tight over each side of the larynx to immobilize it and reduce bleeding. If the skin is allowed to slide off this area, the skin incision site may not line up with the membrane incision site. The introducer is then passed through the stab incision into the trachea. It should pass easily with little resistance into the airway. If resistance is encountered, it should not be forced. If needed, it is sometimes helpful to find and dilate the tract with a small curved mosquito hemostat. The minitracheostomy cannula is then passed over the introducer, through the incision, and into the trachea. The flange is then held against the skin as the introducer is withdrawn. The cotton trach tape is then used to secure the minitracheostomy. The patient can then be safely suctioned with the provided suction catheter. A chest radiograph should be obtained to confirm proper placement. An open technique can also be used in difficult patients, with a slightly larger vertical midline incision to directly expose the cricothyroid membrane. The technique is otherwise the same. The procedure can be done at the end of an operation with endotracheal intubation with the aid of a bronchoscope. The endotracheal tube is drawn back to the proximal larynx with the aid of the bronchoscope and the cricothyroid membrane directly visualized from the inside. It is best if a videobronchoscope is used so the surgeon can glance at the screen while the insertion is performed. Once the minitracheostomy is inserted, the endotracheal tube can be advanced back into the trachea until the patient is ready to be extubated. The minitracheostomy cannula can also be inserted by a Seldinger technique analogous to that used for percutaneous dilatational tracheostomy. In that case, an 18-gauge needle is used to cannulate the airway and a flexible J guide wire is inserted through it into the trachea. The skin entrance site is then enlarged to 5 mm with the scalpel. A 12F dilator is then used over the guide wire to enlarge the tract and the tracheostomy cannula is then advanced over the dilator into the trachea. The minitracheostomy cannula can be also placed in the subcricoid position in the normal position for a tracheostomy [2]. In this case the Seldinger technique should be used to avoid troublesome bleeding from the thyroid isthmus.

Results

In general, many centers have found minitracheostomy to be a useful adjunct in the care of patients with sputum retention (or those thought to

be at high risk for that problem). The success rate of placing the cannula has been from 96% to 100% [2–6]. Patients have been cared for in the ICU, hospital ward, and at home successfully with a minitracheostomy. The average duration of use seems to be about 1 week. Cannulas have been in place for as long as several months. Cannulas have rarely been re-replaced in patients who were decannulated once [3]. Removal is a clinical decision made when the patient no longer requires suctioning and has regained an adequate cough. Patients rarely report a subtle voice change with the cannula which usually diminishes when it is removed. Swallowing has been normal in patients with a cannula in place. Only one report mentions long-term follow-up (1–4 years); there were no late complications seen [2]. Two small randomized studies have been reported studying minitracheostomy. Randell and colleagues reported on 29 patients undergoing thorotomy [5]. Fourteen were randomly assigned to minitracheostomy. There was more atelectasis on chest radiographs in the control patients on the first ($P < .05$) and seventh postoperative days ($P < .01$). Bronchoscopy was needed in 6 control patients and none of the minitracheostomy patients ($P < .05$). The authors concluded that minitracheostomy was a useful postoperative adjunct. Issa and colleagues reported on 30 patients undergoing lung resections [4]. Fifteen were randomly assigned to minitracheostomy. Pulmonary complications of collapse or consolidation were seen in 9 control patients and only 2 minitracheostomy patients ($P < .03$). The mean duration of the cannula was 4 days. Complications were recorded in 8 patients, and all resolved after removal of the cannula (pain in 4, voice change in 4, subcutaneous emphysema in 1, and stridor in 1).

Wain and colleagues reported 60 minitracheostomies in 56 patients for secretion management [3]. Overall, it was found to be an effective method of secretion removal. Two patients had bleeding requiring endotracheal intubation. Five patients had a local hematoma, 2 had subcutaneous emphysema and 1 had hoarseness. All complications resolved after cannula removal. The mean duration of the cannula was 8 days. All tracts closed within 2 days. Mastboom and colleagues reported on 74 minitracheostomies [6]. Sixty-one patients had excessive secretions and 13 patients had a cannula placed after major surgery in a prophylactic fashion. It was judged to be an effective aid for secretion removal. Three patients on anticoagulants had local bleeding but none required operative intervention. No other complications were seen. Van Heurn and colleagues reported on 50 patients who had a minitracheostomy

placed in the normal subcricoid tracheal position by a Seldinger technique [2]. The procedure was initially successful in 48 patients, with 2 patients having a paratracheal placement. This was corrected on the second attempt in both cases. One patient had minor bleeding and 2 had subcutaneous air. The mean duration of the cannula was 11 days. The procedure was judged to be beneficial in all but 2 patients who had very thick secretions and needed a larger tracheostomy. Late follow-up (1 to 4 years) showed no problems.

Removal

When the cannula is no longer needed (minimal secretions and a good cough) it is simply removed at the bedside. An occlusive dressing is placed over the tract. The patient should be advised to hold the dressing while coughing so as to not dislodge it. The tract will seal within 3 days and persistent tracts are not seen, as may be the case with regular tracheostomy.

Complication management

Bleeding is the most serious complication and should be promptly addressed [3,7,8]. Pressure should be applied first to see if it will stop quickly. If not, the wound should be explored so that suture ligation of the offending vessel can be performed. The usual culprit is either a high thyroid isthmus or accessory lobe or a midline anterior jugular vein. The cannula should not usually be removed, as it tamponades the bleeding to an extent and minimizes blood draining into the airway. The airway should be thoroughly evacuated of blood after the bleeding is controlled.

Subcutaneous emphysema can occur around the cannula after coughing. There is not much to be done about it other than assure the patient that it will spontaneously resolve. It is best prevented by making

as small a hole in the airway as possible so air will not leak around the cannula.

Summary

Minitracheostomy is a safe bedside procedure that is a useful adjunct to facilitate secretion clearance in patients with sputum retention. It can also be used in a prophylactic fashion after operations in high-risk patients. Insertion requires a trained physician and an assistant. Complications are rare and are usually avoidable.

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