PERCUTANEOUS TRACHEOSTOMY

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Tracheostomy is a common surgical procedure performed on critically ill intensive care patients. Reports have documented considerable associated morbidity, with complication rates varying from 6 to 66%.[1-6] The reports on mortality associated with tracheostomy range from 0 to 5%.[4,5] Minimally invasive procedures are rapidly transforming many areas of surgical practice. Percutaneous tracheostomy, a minimally invasive alternative to conventional tracheostomy, was first described by Toye and Weinstein in 1969.[7]

Two new methods suitable for elective percutaneous tracheostomy at the bedside have been introduced based on the Seldinger technique. The Ciaglia method, developed by Ciaglia et al in 1985, uses graded dilators and is currently the most popular method. Another technique, described by Griggs et al in 1990, is a one-stage dilation technique using a modified Howard-Kelly forceps as the tracheal dilator.[9]

Percutaneous tracheostomy can be performed by an anaesthetist at the bedside in a controlled setting (ICU) with the assistance of nursing personnel without the need to transfer the critically ill patient to the operating theatre.

INDICATIONS FOR TRACHEOSTOMY[10]

- Facilitate weaning from positive pressure ventilation and sedation
- Bypass an obstruction of the upper respiratory tract.
- Prevent aspiration from the pharynx or gastrointestinal tract.
- Facilitate removal of secretion by aspiration.
- Facilitate long-term airway management

Conditions in which surgical tracheostomy may be safer than percutaneous tracheostomy:

- Emergency tracheostomy tube placement
- Difficult to palpate the anatomical landmarks:
  - very obese patients
  - short or bull neck
  - enlarged thyroid
  - nonpalpable cricoid cartilage
  - gross deviation of trachea
- Infection at or near the intended site for tracheostomy.
- In paediatric age group (controversial).[11] Children have a more compliant trachea than adults leading to a tendency to collapse when pressure is exerted with dilators.
- Previous neck surgery may distort the anatomy.
- In unstable cervical spine fracture.
- Required PEEP > 15 cm H_2O, as oxygenation may be compromised during the procedure.
- Malignancy at the site of tracheostomy.
- Uncontrolled coagulopathy, considered as a relative contraindication

Advantages of percutaneous tracheostomy over surgical tracheostomy:

- It is a relatively simple technique suitable for trained staff in the critical care setting.
- It does not require an operating theatre and the procedure is usually performed under local anaesthetic, sedation and neuromuscular blockade as appropriate.
- Forms a stoma between tracheal rings, resulting in reduced blood loss as there is usually no disruption of blood vessels. Moreover, the tracheostomy tube is fitted snugly in the stoma thereby minimising any tendency to bleeding after the procedure.
- Infection rates for percutaneous tracheostomy range from 0 to 3.3%, whereas those for open tracheostomy have been reported to be as high as 36%.[12,13]
- Stenosis rates for percutaneous tracheostomy range from 0 to 9%.[13,14] The reported incidence of late complications resulting from open tracheostomy such as tracheal stenosis, tracheomalacia, fistula and scarring varies widely.
- Small and neat stoma of dilatational tracheostomy generally results in a more cosmetic scar.

DESCRIPTION OF TECHNIQUES[10,15]

The primary requirement for performing percutaneous tracheostomy is the presence of a trained anaesthetist for managing the airway of the patient. They should be equipped with drugs and instruments for rapid sequence orotracheal intubation with a cuffed tracheal tube.

The patient should be adequately anaesthetised to avoid movements and should be monitored using standard techniques. The neck is extended by placing a sandbag under the shoulders and the area around the intended tracheostomy site is cleaned with antiseptic solution. The area is surrounded by autoclaved drapes.

The thyroid cartilage, cricoid cartilage and first three tracheal rings are identified by palpation. The desired space for tracheostomy is identified, which may be between 1st and 2nd or 2nd and 3rd ring. The cuff of the existing tracheal tube is deflated and the tube is withdrawn under direct laryngoscopy until visualisation of its cuff in larynx. The tracheal tube must be carefully stabilised at this time to prevent dislodgement and the cuff reinflated. Withdrawal is necessary to allow unimpeded passage of guide wire and dilators into the trachea. The use of a fibreoptic bronchoscope[16,17] reduces the risk of complications associated with percutaneous tracheostomy. It may be positioned

in the endotracheal tube to observe or check that the point of entry of the needle is through the centre of the anterior tracheal wall. Care must be taken not to damage the bronchoscope with the needle. Fibreoptic bronchoscopy also allows observation of the passage of dilators or entry of modified Howard-Kelly forceps, reducing the risk of damage to the posterior tracheal wall during the procedure and confirming the correct placement of the tracheostomy tube.

The patient should be preoxygenated by ventilation with 100% oxygen for at least 5 minutes before starting the procedure. The orotracheal tube should be kept in situ until ventilation can be transferred to the tracheostomy tube, which should be confirmed by auscultation of lungs and ideally by capnography. A laryngeal mask airway (LMA) may be used in place of orotracheal intubation[18,19] prior to tracheostomy in certain ICU patients eg those requiring relatively low inflation pressures to maintain adequate gas exchange, without the risk of aspiration of gastric contents.

Infiltration of the soft tissues of the intended site for tracheostomy with local anaesthetic (e.g lignocaine 1% with 1 in 200,000 adrenaline) is recommended to reduce bleeding.

A horizontal incision is made at the anticipated point of entry with a scalpel blade. Blunt dissection with forceps is carried out which allows palpation of the cricoid and the upper tracheal rings. A needle and cannula assembly is now carefully introduced in the midline, either between the first and second or between the second and third tracheal rings (figure 1). The needle is then slowly advanced with continuous aspiration until the position of the needle tip in the trachea is confirmed by aspiration of air.

A J-tipped flexible guidewire is threaded through the cannula into the trachea (figure 2) and the position checked using a fibreoptic bronchscope (if available). Next, a small, firm introducing dilator is slid over the wire, through the soft tissues into the trachea. The dilator is then removed, ensuring that the wire stays in place.

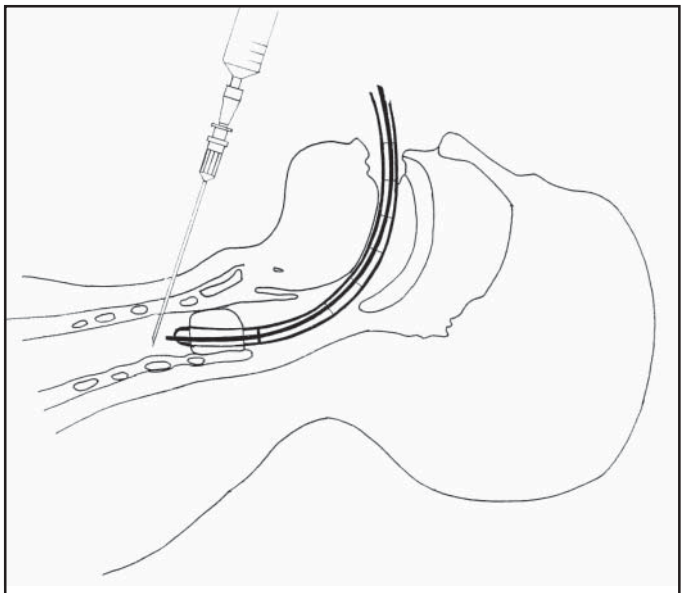

Figure 1:

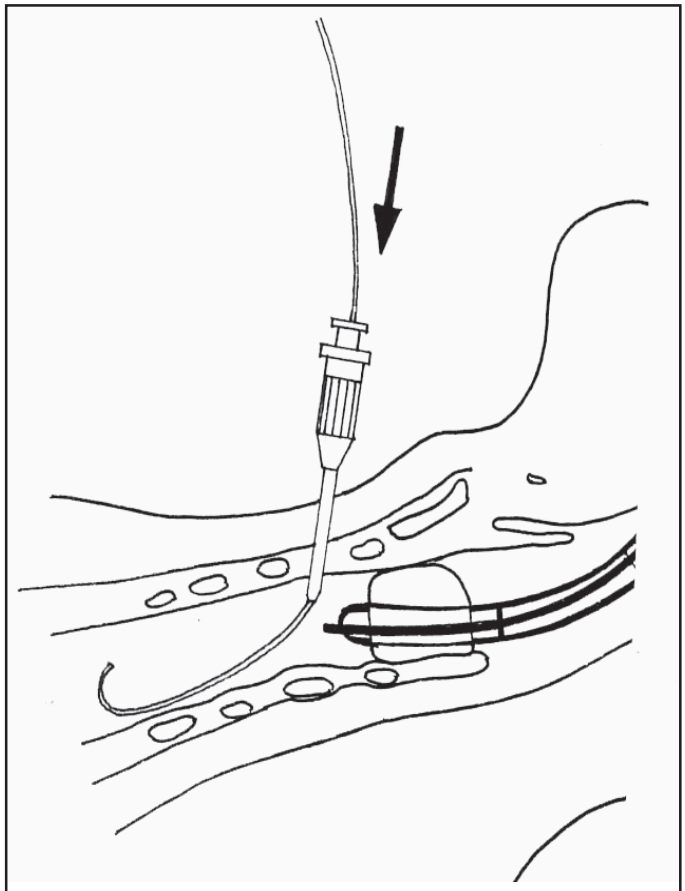

Figure 2:

In the dilatation or Ciaglia technique[8], the stoma is then dilated, using a series of curved tapered dilators (figure 3), starting with the smallest dilator. The dilator is slid over the 'guiding catheter' until the blunt end of the dilator aligns with the 'dilator-positioning' mark on the catheter. During dilatation, the tip of each dilator is lubricated with sterile aqueous jelly and pushed in and out several times with firm pressure. A twisting action or moving the dilator to and fro in the trachea may aid the dilation. The trachea is dilated gradually, up to two sizes above the dilator which fits the tracheostomy tube. Now, the tracheostomy tube is slid over the snugly-fitted and lubricated dilator (figure 4). The tracheostomy tube is also lubricated and both are then introduced into the trachea. Finally, the dilator, guide-wire and 'guiding catheter' are removed, leaving the tracheostomy tube in place. In the 'Blue Rhino' dilation technique (Cook, UK) the serial dilators are replaced by a single graduated dilator. The technique is otherwise similar.

In Grigg's technique[9], after the wire is in place, the dilator is removed and free movement of the wire is checked. The dilating (modified Howard-Kelly) forceps are advanced with the tip at the same angle of approach to the trachea as the wire to fashion the stoma. The handle of the forceps is lifted to the vertical position and is opened to tear the trachea between the rings. The blades of the forceps should lie in the trachea and parallel to it. The forceps are now withdrawn in the open position, ensuring that the stoma is large enough to admit the tracheostomy tube.

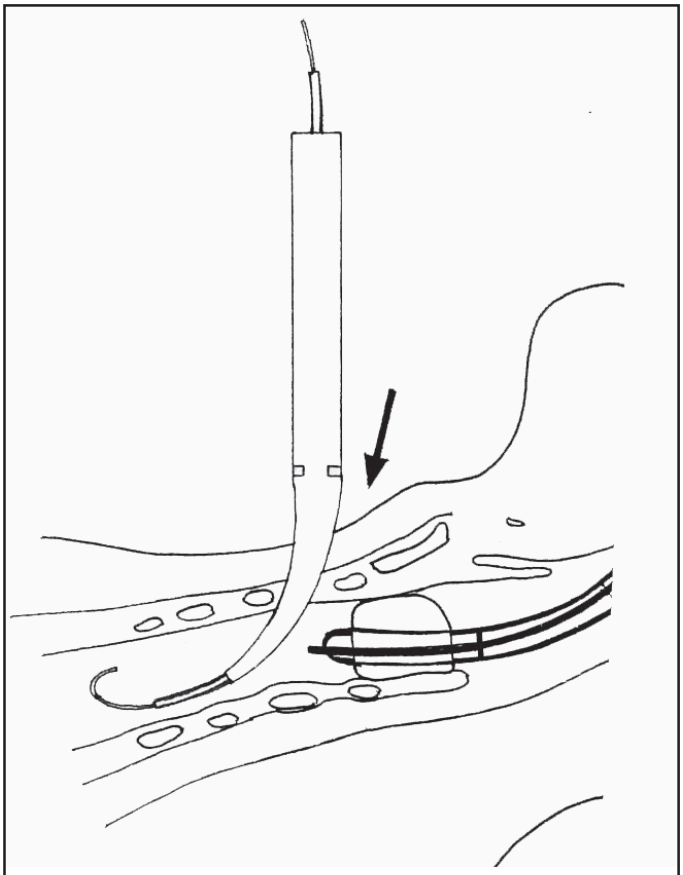

Figure 3:

The tracheostomy tube is slid with its obturator in place down over the wire into the trachea. The guidewire and obturator are then removed, leaving the tracheostomy tube in place.

The cuff of the tube is inflated, the ventilator breathing circuit is connected and the tube secured by tapes around the neck. Satisfactory ventilation is verified by auscultation of chest. The tube is then aspirated to remove blood and secretions. Presence of surgical emphysema at the site is also watched for, and chest X-ray is performed to check for tube position and pneumothorax. If a fibreoptic bronchoscope is inserted via the tracheostomy tube into the trachea, a satisfactory position can be confirmed.

COMPLICATIONS

Although complications are similar to surgical tracheostomy, the incidence is low. There is some evidence to suggest a lower incidence of complications with percutaneous, rather than formal surgical tracheostomy. However, it appears difficult from these studies to distinguish the effect of the experience of the operator from the chosen technique employed upon the complication rate. One study cites the overall mortality rate with percutaneous tracheostomy to be 0.3% as compared to 3.2% for surgical tracheostomy.[20] The incidence of tracheal stenosis was 3.3% (surgical tracheostomy 6.6%) and an overall complication rate was around 15% (surgical tracheostomy 42%).

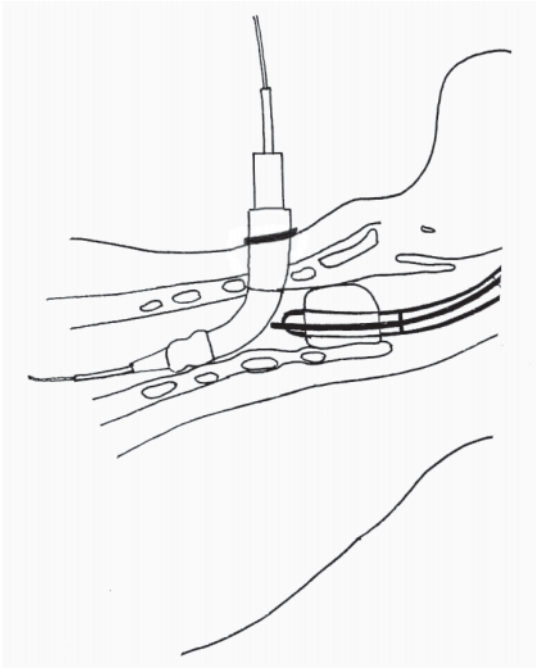

Figure 4:

COMPLICATIONS OF INSERTION

Early

- During the procedure, the patient may develop hypoxia due to failure of ventilation. Furthermore, ventilation of the patient may also be difficult if the cuff of the endotracheal tube is inadvertently punctured. If any difficulties are encountered on insertion of the tracheostomy tube, the existing endotracheal tube should be advanced beyond the incision in the trachea and ventilation recommenced until the patient is stable enough to resume the procedure.

- The patient may develop pneumothorax, pneumomediastinum or creation of a false passage and subcutaneous emphysema due to the placement of the tracheostomy tube in the paratracheal space.

- Damage or injury to the posterior tracheal wall may lead to tracheo-oesophageal fistula.

- Major bleeding is unusual. Minor bleeding can usually be controlled by pressure or occasionally a suture. Haemorrhage into the airway is potentially dangerous as it may result in a blood clot obstructing the airway.

- Needle puncture on the lateral wall of trachea may subsequently lead to stenosis.[21]

- Dislodgement of the tracheostomy tube soon after the procedure may be hazardous as the entry to the trachea is small and deep, hence replacement of the tube may be impossible. The percutaneous tracheostomy tube should not be pushed blindly back in but replaced after proper dilation of the track following orotracheal reintubation.

- Secondary haemorrhage may occur either from infection or erosion of vessels.

Late

The incidence of clinically significant subglottic stenosis is low in percutaneous tracheostomy. The reasons behind the development of subglottic stenosis include laryngeal oedema, damage to the tracheal mucosa, high pressure exerted by the endotracheal cuff and prolonged translaryngeal intubation.[22,23] However in some series, the incidence of subglottic stenosis in percutaneous tracheostomy is lower than that in the open surgical tracheostomy group.

Conclusion

Percutaneous tracheostomy is a useful procedure for airway management in ICU. The chief advantage of the technique is that, it can be performed at the bedside, at the convenience of ICU staff and without disrupting treatment or monitoring of critically ill patients. Studies have shown significant cost saving in Western countries.[15] The main limitations of percutaneous tracheostomy in our country are the high cost and scarcity in the availability of the kit. Were it possible to sterilize and re-use components of the kit this expense might be reduced.

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