Abstract

ICU patients, mainly those who need prolonged ventilatory support, may require tracheostomy, which once was done in the operating room, nowadays is performed in the ICU, as percutaneous dilatational tracheostomy (PDT).

Forty two patients 18-72 yrs of age (mean 44 yrs), with varying indications for tracheostomy, had undergone PDT in the ICU under the standard protocol for this procedure. The mean time for completion of the procedure was 10 min.

Advantages and complications are reviewed.

The difficulties encountered were mainly the anatomical landmarks (10%), difficulties in dilatation (5%) and peristomal oozing (1%).

It is concluded that percutaneous dilatational tracheostomy is an easy, cost effective, practical when done at bedside in the ICU, and spares transferring the patient to the operating theater.

Introduction

Tracheostomy is frequently required in the treatment of critically ill patients to prevent the complications associated with prolonged translaryngeal intubation and to assist in the process of weaning off
mechanical ventilation. The procedure has been performed traditionally by an open surgical technique in the operating room but with many disadvantages, including the risks of transporting critically ill patients, the need for costly operating room time and the use of space and personnel.

Percutaneous tracheostomy was first reported by Shelden & colleagues in 1955, subsequently, several alternative techniques have been described. The technique by Cigilia & co-workers has gained popularity because it can be performed rapidly and safely at the bedside.

The new percutaneous forceps dilatational tracheostomy is a minimally invasive procedure which offers an easier, more rapid method of insertion of a tracheostomy tube than the conventional open surgical techniques or even the relatively old Cigilia method of percutaneous tracheostomy.

This new procedure uses the Seldinger technique to guide the specially designed guide-wire dilatation forceps into the trachea, where it is used to dilate the trachea, the guide-wire is then finally used to position the tracheostomy tube.

**Material & Method**

All adult patients in the medical or surgical ICU who required an elective tracheostomy were considered for percutaneous dilatational tracheostomy (PDT). Other cases who needed tracheostomy in the ICU were excluded due to relative contraindications (enlarged thyroid gland, previous surgery at the tracheostomy site, or bleeding diathesis), or due to absolute contraindications like (emergency airway management, children, preexisting infection or malignancy at the tracheostomy site and uncertainty in identifying the anatomical landmarks.

Forty two patients (Table 1, 2) with a mean age of 44 years were considered.
Table 1

<table>
<thead>
<tr>
<th>Age (yr)</th>
<th>18-30</th>
<th>30-40</th>
<th>40-50</th>
<th>50-60</th>
<th>60-70</th>
<th>70-80</th>
<th>Total</th>
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<tbody>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>2</td>
<td>18</td>
<td>2</td>
<td>5</td>
<td>2</td>
<td>31</td>
</tr>
<tr>
<td>female</td>
<td>--</td>
<td>1</td>
<td>8</td>
<td>2</td>
<td>--</td>
<td>--</td>
<td>11</td>
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</tbody>
</table>

Table 2

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>No of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple trauma</td>
<td>10</td>
</tr>
<tr>
<td>Motor neuron disease</td>
<td>8</td>
</tr>
<tr>
<td>Cerebral stroke</td>
<td>10</td>
</tr>
<tr>
<td>Brain damage</td>
<td>7</td>
</tr>
<tr>
<td>Thoracotomy</td>
<td>3</td>
</tr>
<tr>
<td>Major abdominal surgery</td>
<td>4</td>
</tr>
</tbody>
</table>

Tracheostomy was done following 15 days of endotracheal intubation where extubation was not expected within few days, or the patient was difficult to wean from artificial ventilation.

Duration of PDT ranged between 8-20 min, with an average of 10 min (Table 3).

Table 3

<table>
<thead>
<tr>
<th>Time in mins</th>
<th>8-12 mins</th>
<th>12-16 mins</th>
<th>16-20 mins</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of cases</td>
<td>30</td>
<td>8</td>
<td>4</td>
</tr>
</tbody>
</table>

The PDT was performed with continuous monitoring of electrocardiography, arterial blood pressure, end-tidal carbon dioxide and peripheral oxygen saturation.

A respiratory therapist constantly supervised the tracheal tube and ventilation attachments at the head of the bed.

Patients received 100% oxygen and peep (if any) was reduced to 5 cm H₂O before the procedure.

Patients were maintained on full sedation and opioid infusion with
muscle relaxants when required, to ensure they are comfortable and pain free during the procedure.

We used a special PDT kit containing a scalpel, 14G intravenous cannula, 10 ml syringe, guide-wire with introducer, dilator, reusable guide-wire dilating forceps and tracheostomy tube with special obturator with lumen (Fig. 1).

The procedure itself was performed according to the standard protocol shown as by (Fig. 2-13):

- The neck of the patients was extended over a pillow and the anterior part prepared with sterile solution and draped (Fig. 2).

- The orotracheal tube was withdrawn under visual control so that the tip remained below the level of the vocal cords, to avoid the risk of damaging the tube during the procedure.
A fibreoptic bronchoscope was used to control tracheal penetration by the Seldinger technique.

Location and markings of the anatomical landmarks (thyroid cartilage, cricoid cartilage, suprasternal notch) was done with sterile marker (Fig. 3).

A local anesthetic (lignocaine with adrenaline) was injected, mid distance between the cricoid cartilage and suprasternal notch above the second tracheal ring. A crease line incision 1.5-2 cm was made at the chosen insertion site, through which the trachea was cannulated with a 14G cannula between the first and second or second and third rings. Intra-tracheal placement was confirmed by fibreoptic bronchoscope and by aspiration of air in a saline filled syringe. (Fig. 4, 5).

A J guide-wire with introducer was passed into the tracheal lumen through the catheter, and the introducer then removed (Fig. 6).

A small dilator was passed over the wire to penetrate the tracheal wall and at the same time dilating both the tissues and the tracheal wall (Fig. 7).
The clamped dilating forceps was advanced over the guide-wire until it reached the tracheal wall and then used to dilate the pretracheal tissues by opening it (Fig. 8, 9).

The clamped forceps were rethreaded and advanced through the tracheal wall and the forceps handles were raised into the vertical position so that the forceps jaws further penetrated the tracheal wall and lied longitudinally in the trachea, then the forceps were opened and pulled out in the open position, dilating the trachea in one step (Fig. 10, 11, 12).

After removal of the forceps, the guide-wire was threaded through the obturator of the tracheostomy tube and both were advanced into the trachea and then the obturator and guide-wire were removed (Fig. 13).

Tracheal suction was done through the tracheostomy, cuff inflated, patient reconnected to the ventilator tracheostomy tube secured to the patients neck, the oroendotracheal tube is then removed and suction to the oropharyngeal area was done.

Successful intra-tracheal placement of the tube was confirmed by auscultation, end-tidal CO$_2$ measurement and visualization of the carina by fibreoptic bronchoscope.

A chest X-ray was taken to exclude pneumothorax, surgical emphysema. Complications and difficulties were recorded (Table 4).
Table 4
Difficulties & complications encountered during PDT

<table>
<thead>
<tr>
<th>Issue</th>
<th>No of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identifying anatomical landmarks</td>
<td>4</td>
</tr>
<tr>
<td>Difficult dilatation</td>
<td>3</td>
</tr>
<tr>
<td>Peristomal oozing</td>
<td>1</td>
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</tbody>
</table>

No major bleeding, pneumothorax, surgical emphysema, false passages or infection was encountered.

Discussion

First performed 3600 BC, tracheostomy is now an integral part of airway management and despite its relative simplicity, traditional open surgical tracheostomy is not without complications. The problem associated with moving a vulnerable patient from an intensive care to the operating theater and the delays in organizing and performing an open procedure, have led to other methods of approach.

In 1955, a percutaneous tracheostomy was introduced which involved a blind cannulation of the trachea with a bladed instrument that held the tracheostomy tube. This and other techniques, however, have failed to achieve a wide acceptance because of their inherent risk of false passages and tracheal damage.

For critically ill patients, bedside tracheostomy performed by the percutaneous dilatational approach (PDT) is easier, rapid, less expensive than traditional surgical tracheostomy and since its introduction in our ICU, and as confirmed by other reports, has proven to be quicker, associated with lower complication rate and decreased risk of infection, when compared to open tracheostomy.

Early tracheostomy for critically ill patients shortens both the duration of ventilation, the length of hospital stay and is advantageous over prolonged tracheal intubation.

To lessen the likelihood of false passages, modifications of the percutaneous technique, has been introduced, most of which involve a guide-wire insertion into the trachea.
In the present study, all patients were screened for bleeding diathesis before the procedure and care was taken during the procedure so as not to injure the anterior jugular veins, thus decreasing incidences of bleeding or peristomal oozing. The main difficulty encountered in our approach was identifying the anatomical landmarks and so it is highly recommended to avoid performing this procedure in cases of very short necks and severe obesity.

Meticulousness and keeping the head of patient straight up by the assistant during the whole procedure, together with the use of fiberoptic bronchoscope, resulted in no incidences of pneumothorax, surgical emphysema or false passages, similar to reports by other authorities. It is preferable to have two senior anesthetists or one senior anesthetist a senior respiratory therapist, to help in maintaining the airway, while one anesthetist is performing the procedure.

After performing tracheal dilatation, an air leak is expected. This is compensated for by increasing the tidal volume.

All our cases have been done on elective basis, as this procedure should not be used for emergency surgical management, where cricothyrotomy is the standard procedure of choice.

Since most patients in our ICU and other units are on ionotropic support and are fragile to be moved to the operating room, this bedside procedure has helped a lot in keeping patient safe and hemodynamically stable.

Our patients were followed up for weeks observing the tracheostomy site during and after removing it. No cases of infection or hypoxia were observed. The post tracheostomy scar was cosmetically better looking than the usual open surgical tracheostomy scar.

**Conclusion**

Percutaneous forceps dilatation tracheostomy (PDT) performed at bedside in the ICU, is a minimally invasive cost effective and quick procedure with minimal patient disturbance. It avoids the risks associated
with moving the patient to operating room and maintains patient’s hemodynamic stability.

References