SHORT COMMUNICATION

An improvised tracheostomy tube for weaning in less privileged countries

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SUMMARY

Tracheostomy tubes are widely used in critical care settings, in emergency airway management, in anticipated prolonged mechanical ventilation, to provide protection from aspiration, to provide access to lower respiratory tract for management of excessive secretions and as a major treatment for chronic respiratory failure thus improving its prognosis. Several modifications have been done in tracheostomy tubes to facilitate weaning patients after prolonged mechanical ventilation by allowing patients to breathe spontaneously through their upper airways with tracheostomy tube in situ during periods of weaning and to restore speech.

Though several modified tracheostomy tubes have been manufactured; but these are usually costly and not readily available everywhere, thus restricting their free use in critical care settings in many countries of the world. We describe a modification in commonly available standard tracheostomy tube for purposes of weaning from prolonged ventilation.

Key words: Modified tracheostomy tube; Weaning; Prolonged ventilation; Fenestrated tracheostomy tube; Phonation

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INTRODUCTION

Traditionally, tracheostomy was used as an emergency measure for upper airway obstruction or to provide a patent airway. With time, the use of tracheostomy tube has increased further for managing a multitude of problems related to respiratory insufficiencies. Now it has been extended to positive pressure ventilation, management of chronic respiratory failure, failure of airway protective reflexes, management of excessive secretions and protection against aspiration. Several modifications have been made and are commercially available to allow weaning from mechanical ventilation, phonation and swallowing of food safely with tracheostomy tube in situ.[1,2] We describe an effective improvisation done in commonly available standard tracheostomy tubes to achieve the same purpose. The modified tracheostomy tube can be easily made in critical care settings and is a cost effective alternative. This is an effective device for weaning from mechanical ventilation of tracheostomy tube dependent patients but have its own limitations.

METHODOLGY

Every tube has to be prepared afresh for a particular patient. The steps for designing this equipment are as follows:

1. Standard tracheostomy tube is provided and inspected with respect to integrity of the tube and cuff.
2. Sterile surgical blade is used for making an oval hole (10 mm x 5mm) at 2 cm above the upper margin of tracheostomy cuff on the convex curvature of tracheostomy tube (Fig 1).

Figure 1: Modified tracheostomy tube with punched out holes

3. Another oval hole is made about 1 cm (10 mm x 5mm) above the upper margin of previous hole on same curvature.
4. After preparation of fenestrated tracheostomy tube (as mentioned above), the tube is repacked if not immediate required and kept aseptically.
5. The plunger of a 2 or 3 ml disposable sterile syringe is removed (Fig 2).
6. Sterile gauge piece is wrapped over the plunger and micro tape applied circumferentially (Fig 2).
7. This plunger assembly is kept aseptically with the tube and can be used to occlude the proximal end of the fenestrated tracheostomy tube, during vocalization by the patient (Fig 2).
8. Thorough lubrication of the tube and the tracheostomy stoma will be required to avoid injury during insertion of the modified tube.

We have successfully weaned thirty two adult patients over one year using this modified tracheostomy tube, though further studies with larger sample size may be warranted in adults and pediatric groups to evaluate its efficacy for weaning purposes.

DISCUSSION

Various strategies have been suggested for weaning off the patients with tracheostomy, but there is no common consensus. A systematic multi-disciplinary approach is essential for successful weaning.[1] A logistic assessment is needed before considering the weaning process. This includes assessment of patients' gag or swallowing reflexes and dependency on suctioning. The absolute prerequisites are the presence of spontaneous cough, ability to swallow secretions and patent upper airway.

The methods of tracheostomy weaning include gradual increase in periods of cuff deflation with decrease in size and capping of tracheostomy tubes,[1] use of fenestrated tracheostomy tubes,[1,2] and speaking valves.[3] One of the most crucial factors for tracheostomy weaning is the restoration of speech in a tracheostomy dependent patient. Phonation in these patients may act as psychosocial kick, allowing them to communicate and help in reinstating smell and taste.[1]

Simplest method for phonation is the cuff deflation with capping of the tracheostomy tube. Cuff deflation allows air to pass around the tracheostomy tube and then through the vocal cords thus facilitating speech. This technique is in wide use in critical settings but has certain limitation. With the tracheostomy tubes in situ, the air flows in the channel between the trachea and the outer wall of the tube and around the cuff to the vocal cord apparatus. This creates significant resistance to the air flow and thus needs more effort for phonation.[4] On the contrary, the fenestrated tubes markedly reduces the resistance by permitting the air to flow though the lumen of the tube as well as between the tube and the trachea.[4] There are many models of the fenestrated tracheostomy tubes available in the market (Portex® Blue Line Ultra® Fenestrated Cuffed Tracheostomy Tube, Blom® Tracheostomy Tube System etc.).These tubes are similar in construction to standard tracheostomy tubes, but with an opening in the posterior portion of the tube above the cuff. It is designed to allow patient to breathe through normal nasal/oral route, with cuff deflated during weaning and allows phonation. The tube is capped with cuff completely deflated allowing patient to breathe through the fenestrations and around the tube.

Even these tubes have some limitations. Many a times the fenestrations in the tube are not positioned properly, thus significantly increasing the resistance through the upper airway.[2] Moreover, the fenestrations may become obstructed by the mucus plugs or granuloma resulting in severe airway compromise.[5]

We improvised existing tracheostomy tube by creating an oval hole (10 mm x 5mm wide), 20 mm above the cuff on the convex curvature of the tube. We chose these dimensions, as the point of the hole is approximately aligned with the distal opening of the standard tracheostomy tube (size 7.0-8.5 mm) and the total area of the hole remains more than transverse area of the tubes used. This dimension reduces the resistance to airflow during vocalization thus reducing the work of breathing. We made another hole about 10 mm above the upper margin of the previous hole on the same curvature and of similar dimensions, to act as reserve should the previous hole is blocked due to mucus plugs or granulations. The fenestration is made by cutting out a measured area of tube above the cuff, in oval form, using sterile surgical blade. The modified tube is then repacked under all aseptic precautions before using it.

The modified fenestrated tube has several advantages for weaning purposes. It helped our patients to vocalize and breathe through native upper airway with cuff deflated intermittently. Weaning was more rapid as patients were able to communicate with effective rehabilitation of the speech, taste and smell sensations. Though, we have certain limitations that need to be evaluated further. The sharp edges of the fenestrations can cause injury to the overlying mucosa while insertion of the tube and thus the insertion needs to be done cautiously. In contrast to the commercially available tubes there was no one way valve to be mounted over the proximal end of the tube. The proximal end of the tube is to be blocked by a custom made plug out of plunger of a 2 or 3 ml syringe (Fig 2).This may increase the effort of the patient for vocalization. Revertion back to ventilation if required with modified tracheostomy tube in situ may also prove difficult. Commercially available tubes have an additional tube which can be inserted inside the fenestrated tube thereby occluding the fenestrations and thus allowing ventilation by mechanical ventilators when required without any air leak. Careful selection of the patients is required and a new standard tracheostomy tube of appropriate size be available to replace the modified tube.

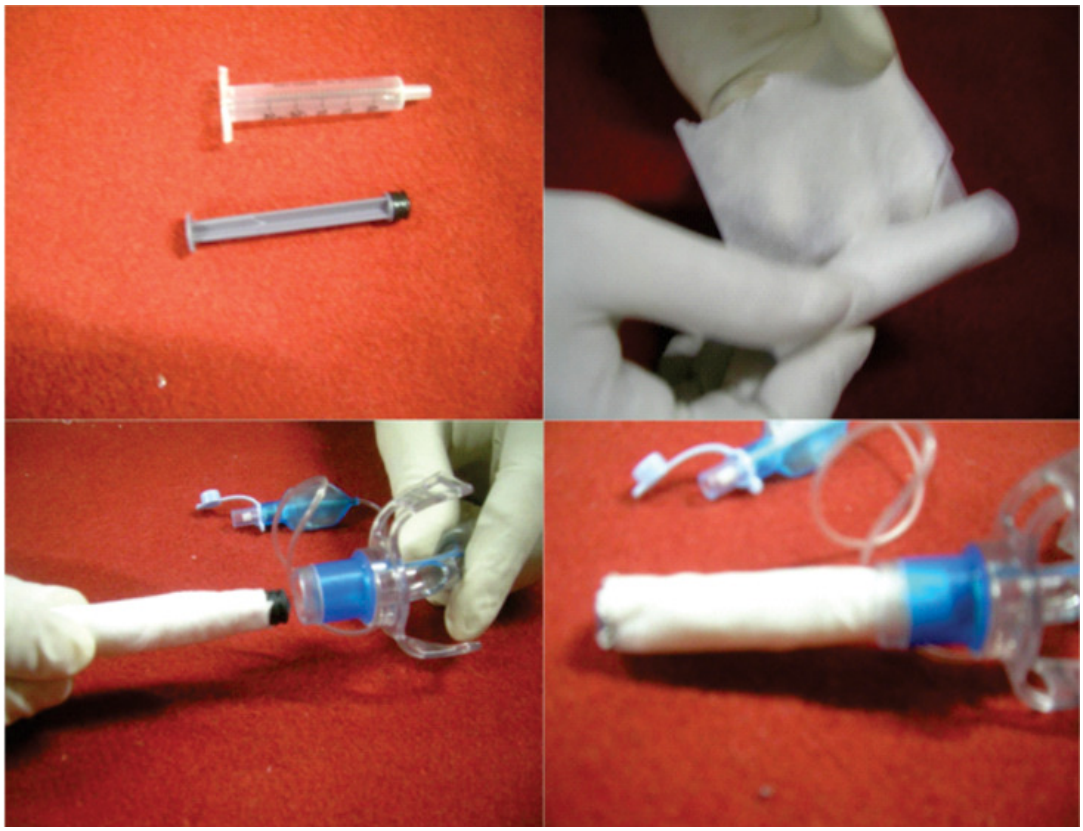

Figure 2: Proximal end plug manufactured out of 3ml syringe plunger and a piece of rubber glove

CONCLUSION

In conclusion, the modified fenestrated tracheostomy tubes are a cost effective and easily available alternative for weaning. They can be readily used in trauma intensive care (ICU), high dependency units (HDU), emergency wards where the patients are kept on ventilators and are in need to be weaned. This modified tracheostomy tube can be easily made from the standard tracheostomy tube even by the paramedics and ancillary emergency staff, as most of the time the commercial fenestrated tubes are not available in less privileged countries of the world, specially the third world countries. This modified tracheostomy tube can result in better outcome with few drawbacks that were reasonably managed or tolerated. We have successfully weaned thirty two adult patients over one year using this modified tracheostomy tube, though further studies with larger sample size may be warranted in adults and pediatric groups to evaluate its efficacy for weaning purposes.

Conflicts of Interest: The authors declare no financial or personal relationship(s) which may have inappropriately influenced the material in this paper.

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