Technique training: endoscopic percutaneous tracheostomy

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Summary

Percutaneous tracheostomy is being used increasingly in the intensive care unit and endoscopic control of this procedure affords an improved level of safety. Training in such new minimal access techniques can be a significant risk factor in patient outcome. Surgical simulation provides training which minimizes this risk. We present a method of training in percutaneous endoscopic tracheostomy using a simulation model based on animal tissue. Our experience with this model is reported. (Br. J. Anaesth. 1998; 81: 401–403).

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Various methods of percutaneous tracheostomy have been described. Some authors have recommended that some techniques should be “relegated to the wastepile” because of unacceptable levels of operative complications. Longer term complications such as subglottic stenosis have also been reported. Improvement in safety has been demonstrated by carrying out the procedure under bronchoscopic control.

Acquisition of new skills, such as percutaneous endoscopic tracheostomy, requires both supervised training and the opportunity for sufficient practice. It is ethically unacceptable for surgical skills training to be a serious risk factor in patient outcome. Surgical simulations offer a means of achieving these aims without placing patients at risk. In this way a minimum skill level for trainees can be attained before the first live procedure is ever performed.

We present an animal tissue model that allows four to six endoscopically controlled percutaneous tracheostomies to be performed under continuous guidance by a trainer. This facilitates a basic grounding before the procedure is carried out on live patients.

Materials and methods

We studied the laryngobronchial tree of commonly slaughtered agricultural animals and found the pig to be the most suitable. The anatomy of the pig larynx and trachea is remarkably similar to the human. The diameter of the trachea is the same, allowing the standard percutaneous tracheostomy kit and tracheostomy tubes to be used.

The pig thorax is positioned on its back with the head extended, as would be done for a human patient undergoing the same procedure. The animal’s trachea is intubated with an oral tracheal tube, the cuff inflated and placed against the glottis creating a seal (fig. 1). A ventilator may be attached to further simulate the real situation. A fibreoptic bronchoscope is passed down the tracheal tube to see the trachea, and a television camera and monitor attached to it. This allows both the trainee performing the procedure to see the results of their manipulations and the trainer to monitor and advise as they proceed (fig. 2). By working from the sternal notch upwards towards the larynx, 4–6 tracheostomies may be performed on each animal tissue preparation.

Both of the two popular percutaneous tracheostomy techniques, the Ciaglia dilational technique and the Portex forceps technique, may be practised on the model. In this way trainees gain a feeling for the technique they prefer. The skill training achieved using the model is rated well by trainees (table 1).
USE OF THE MODEL
First, the fibreoptic bronchoscope is inserted into the tracheal tube and focused correctly so that a good picture is obtained on the monitor screen. The picture obtained is orientated correctly using both the marks on the tracheal tube and the curve of the anterior tracheal wall. The bronchoscope is passed down the trachea to the carina, and the right and left bronchi examined to exclude mucus plugs or other obstructions to ventilation. If these are discovered they may be cleared by suction. The bronchoscope is drawn back to lie just inside the tracheal tube to avoid damage. The sternal notch is palpated and the index finger moved superiorly to lie over the trachea. Pressure is exerted down onto the trachea, and compression of the correct part of the trachea confirmed endoscopically. To maximize the number of insertions practised on each model, the first puncture is initiated at the most inferior available portion of trachea. Subsequent tracheostomies are performed moving cranially in sequence. A 2-cm incision is made in the overlying area of satisfactory compression. The seeker needle is inserted and pressed against the anterior face of the trachea. If this compression is found not to be at a 12 o’clock position, the needle may be “walked” over the trachea until the correct insertion point is determined. In the human situation this allows the level of insertion to be checked; the tracheal rings can be counted until the space between the second and third rings is found. The seeker needle may then be pushed through the tracheal wall into the lumen, and its position confirmed endoscopically.

Insertion of the guidewire follows, and confirmation that it is passing down into the trachea, rather than up into the larynx, is again obtained endoscopically. The initial dilator is slid over the guidewire and the tip manipulated gently until it is seen within the trachea on the monitor: full insertion may then proceed without risk of kinking the guidewire and creation of a false passage.

If a Ciaglia dilation technique is to be used, each bougie insertion is monitored carefully to ensure that there is no damage to the posterior tracheal wall, and that each bougie lies within the tracheal lumen (fig. 3). Using the Portex technique, the same endoscopic control is used to ensure that the forceps are well clear of the posterior tracheal wall. When a sufficiently large fistula has been created in the trachea, the tracheostomy tube may be inserted. Again, endoscopic control ensures that both the tracheostomy tube itself and the cuff of the tube are inserted within the lumen of the trachea. Before the cuff of the tracheostomy tube is inflated, the pig model (or human patient) should remain ventilated adequately via the oral tracheal tube. The final procedure is to pass the bronchoscope through the tracheostomy tube to confirm that it is within the lumen of the trachea, and above the carina. Only then is the tracheostomy tube inflated, the ventilator attached to the tracheostomy tube and the tube sutured into position.

Discussion
Endoscopic control during percutaneous tracheostomy makes the procedure easier and safer to perform. The exact technique we use on our patients and in training on our model differs slightly from the standard protocol. As subglottic stenosis has been reported with tracheal puncture immediately below the cricoid, we have practised insertion between the second and third tracheal rings. When using the non-endoscopic technique it is much easier to place the tracheostomy tube in the subcricoid area, as this is the most superficial.

Using endoscopic control, the level most appropriate for tracheostomy tube insertion can be located without difficulty. We believe that it is not appropriate that such a procedure should be performed for the first time on a patient without prior practice using a simulation. The reckless use of the non-endoscopic
procedure without proper training inevitably leads to complications and possible unnecessary fatalities.

We have presented a model which simulates the human trachea well and allows monitoring of skill acquisition. Practical training using models is a well proven method of teaching new techniques safely and is popular with trainees. Mistakes made using the model have no consequences in terms of patient care: those on live patients may be disastrous.

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References


