ABSTRACT

We describe a case of posterior tracheal wall tear managed conservatively with a successful outcome. The presentation of a sudden increase in cuff volume and subcutaneous emphysema presents a challenging management problem requiring careful bronchoscopic and computed tomography delineation and isolation of the injury using a double lumen tube. This case also highlights the vulnerability of the trachea to injury from airway intervention and considers the possible mechanisms of tracheal injuries during the commonly performed intensive care procedure of percutaneous tracheostomy. (Critical Care and Resuscitation 2000; 2: 191-194)

Key words: Tracheal laceration, posterior tracheal wall injury, percutaneous tracheostomy, mediastinal emphysema, endobronchial tubes, bronchoscopy

Iatrogenic tracheal injuries were widely published as case reports in the later part of the last century. The common site of injury is the posterior tracheal wall and is usually associated with endotracheal intubation, although surgical and percutaneous dilational tracheostomies now contribute to some of these reports. Loss of integrity of airway in a mechanically ventilated patient is a serious threat to the patient’s life and a difficult management problem. While some favour an early surgical repair, this case highlights the role of conservative management.

CASE REPORT

A 69 year old lady was admitted for thoracoabdominal oesophagogastrectomy, for a carcinoma of the stomach. Preoperative imaging of her chest and abdomen did not show any evidence of metastasis. The operation was performed through a left thoracoabdominal approach, using a 35 FR left-sided double lumen tube, under combined general and thoracic epidural anaesthesia, consisting of N2O, O2, narcotic, sevoflurane and epidural aliquots of 0.5% bupivacaine. The lower 5 cm of the oesophagus and the upper 80 - 90% of the stomach were removed and a pyloroplasty and an end-to-end oesophago-gastric anastomosis were performed. The surgery lasted for 3.5 hours with a total blood loss estimated at 600 mL.

The patient was admitted to the intensive care unit anaesthetised and ventilated through the double lumen tube. Upon arrival, the double lumen tube was changed without difficulty to an 8 mm cuffed orotracheal tube with a cuff pressure of 28 cm H2O. The postoperative chest X-ray showed some degree of left lower lobe collapse but no mediastinal emphysema. The next day, she was weaned from the ventilator and extubated. However, on the 2nd postoperative day her pulmonary function deteriorated due to a further collapse of the left lower lobe, requiring reintubation and mechanical ventilation. Fibreoptic bronchoscopy was performed at this stage which revealed a mucous plug blocking the left main bronchus. This was removed resulting in...
increased left lung expansion and an improvement in pulmonary gas exchange.

On the evening of the 3rd postoperative day, she suddenly developed extensive bilateral subcutaneous and mediastinal emphysema. The operative chest drains were patent. The cuff of the endotracheal tube required higher volumes and a pressure in excess of 50 cm H₂O failed to produce an adequate tracheal seal. She was resedated, curarised and maintained on pressure controlled ventilation overnight without any worsening of her subcutaneous or mediastinal emphysema.

On the 4th postoperative day, a fibreoptic bronchoscope was passed through the endotracheal tube. The latter was withdrawn up to the level of the vocal cords to visualize the proximal sub-glottic trachea, revealing a longitudinal tear in the posterior wall of the trachea that did not extend to the carina. It was decided to replace the endotracheal tube with a 35 FR left-sided double lumen tube, the tracheal cuff of which was gently inflated to facilitate ventilation of both lungs. As the tracheal cuff could be inserted closer to carina with the double lumen tube when compared with the normal endotracheal tube, this allowed the trachea to be sealed with minimal cuff pressure. It also effectively isolated the torn portion of the sub-glottic posterior tracheal wall above the tracheal cuff of the double lumen tube. Pulmonary ventilation improved, resulting in a significant reduction of the surgical and mediastinal emphysema.

At this stage the opinion of a thoracic surgeon was obtained who advised that the tracheal tear should be managed conservatively. Over the next 24 hr her lung function improved. She had an elective surgical tracheostomy performed on 6th postoperative day and an 8 mm adjustable length tracheostomy tube was inserted with the cuff positioned beyond the tracheal tear. Following this, she made a rapid recovery, allowing the cuff to be deflated and the patient to breathe spontaneously.

On the 11th postoperative day a gastrografin swallow was performed which demonstrated free flow of contrast and the absence of a tracheo-oesophageal fistula. The trachea was then decannulated, she began oral nutrition and was transferred to a general ward on the 12th postoperative day.

A contrast chest computed tomography (CT) scan performed on the 13th postoperative day revealed a longitudinal tear, of approximately 4 cm, in the posterior trachea (figures 1-3). She was discharged home on 20th postoperative day. A telephone inquiry 6 months after the hospital discharge did not reveal any obvious airflow obstruction or abnormalities in her speech.

**DISCUSSION**

In this patient, the posterior tracheal tear may have occurred at any time during her tracheal manipulation and may have had a delayed presentation which in one study was reported up to 124 hr following initial injury. Nevertheless, the cause was not entirely clear as the anaesthetist did not experience any difficulty in the placement of the initial endobronchial tube and the surgery was uneventful. No difficulty was experienced...
when she was reintubated on the 1st postoperative day and the patient did not exhibit any signs of a tracheal tear during the first 48 hr of her intensive care admission. The fibreoptic bronchoscopy performed on the 2nd postoperative day to clear the mucous plug was an unlikely cause for the tracheal tear, as it was performed through an existing endotracheal tube without difficulty and by an experienced operator. Nevertheless, several possibilities exist. For example:

1. A small tear may have been produced in the posterior trachea, during the initial double lumen endobronchial intubation, becoming clinically obvious on the third postoperative day. Airway rupture from the use of double lumen tubes is a known complication with one review quoting a tracheal injury incidence of 36% with the use of polyvinyl chloride double lumen tubes size 35 FR.

2. The endotracheal tube cuff and pressure may have increased during surgery due to N2O use, which is usually encountered in patients undergoing prolonged surgery. However, the resulting mucosal lesions produced by this effect usually cause minimal or no major postoperative respiratory complications. Moreover, the cuff of the original double lumen tube and the site of the tear were at different levels in this patient. In fact, the re-introduction of the double lumen tube successfully isolated the tracheal tear.

3. Posterior tracheal wall diverticulae have been described and may have been present in this patient. These are potential sites of weakness in the trachea. During episodes of coughing and straining, the endotracheal tube can exert very high pressures over the tracheal mucosa causing pressure necrosis and a tracheal diverticular rupture may have occurred in this patient.

4. Pre-existing erosion of the posterior wall of the trachea due to a local metastasis, may have been present. However, this was unlikely, as there was no clinical or radiological evidence of this prior to surgery.

In the intensive care patient any airway intervention (e.g. suction catheters, introducers, endotracheal tubes, bronchoscopes, etc) may be associated with tracheal injury. Endotracheal intubation using double lumen tubes may cause tracheobronchial injuries due to carinal hooks, stylets, over-inflated cuffs and tube tips. In the majority of cases, the left main bronchus is the site of injury. Percutaneous tracheostomy is a recent intensive care procedure that is also associated with tracheal injury. One study reported a 12.5% incidence of posterior tracheal wall lacerations secondary to percutaneous tracheostomy. During percutaneous tracheostomy performed using the Ciaglia technique, the guidewire and guiding catheter offer the posterior tracheal wall little protection from the dilators, which are passed in and out of the trachea repeatedly. This is compounded by the lack of adequate support to the anterior tracheal wall, which can be vulnerable to injury due to the pressure exerted by the operator during the passage of dilators. In an unreported case from our institution, a large posterior tracheal wall tear was produced during a percutaneous tracheostomy performed using the Ciaglia technique. A prolonged surgical repair was unsuccessful, and healing of the tear occurred by ventilating the patient for several days through a double lumen tube. Fibreoptic bronchoscopy during the percutaneous tracheostomy procedure provides direct visualization of the passage of each dilator and may reduce the incidence of tracheal injuries, although it prolongs the procedure and is labour intensive. The guidewire and forceps dilation percutaneous tracheostomy technique reported by Griggs et al, has an added advantage in this respect as it does not involve repeated passage of dilators. Bringing the tip of the dilator forceps in the longitudinal axis of the trachea before attempting the dilation helps to prevent the accidental splitting of the posterior wall of the trachea by the tip of the dilator forceps. The skin incision and the pre-tracheal tissue dilation should be adequate for the passage of the tube before tracheal dilation and insertion is attempted. Once dilation is done, threading of the tube into the trachea should follow immediately.

The immediate management of a posterior tracheal wall laceration is to stabilize the airway. This usually requires endobronchial intubation and may require selective lung ventilation. Pressure controlled ventilation with deep sedation and paralysis helps to limit the surgical and mediastinal emphysema. Additional chest tubes may be required if there is a pneumothorax or an extensive pneumomediastinum. Fibreoptic bronchoscopy and thoracic CT scan are performed to define the extent of the injury. If the diameter of the inflated endotracheal tube cuff in the CT scan is more than 2.8 cm, a tracheal tear should be suspected as mean tracheal diameters in female and male tracheas are 2.0 cm and 2.4 cm, respectively.

If the perforation is deep, a gastrografin swallow and oesophagoscopy may be indicated to locate the site and extent of oesophageal involvement. Antibiotics may be required to prevent mediastinitis. Conservative treatment has been reported to be successful in the management of posterior tracheal wall injuries, although an early surgical repair may be beneficial when injury to the tracheal cartilages is present. Lower tracheal injuries are generally repaired through a right
In summary, posterior tracheal wall injuries are preventable if airway interventions are performed carefully. A detailed preoperative clinical and radiological assessment of the airway prior to endobronchial intubation can help to reduce the incidence of airway damage in operating room. Fibreoptic bronchoscopy should be performed prior to intubation to review the anatomy of the airway in a patient where endobronchial intubation is expected to be difficult. The safety standards and continuous education in the field of airway management (particularly with the procedure of percutaneous tracheostomy) should also be reviewed further, to prevent tracheal injuries.

Received 19 June 2000
Accepted 23 June 2000

REFERENCES