Silicone Y-stent insertion under extracorporeal membrane oxygenation (ECMO) in a patient with tracheal tear

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SUMMARY

Tracheal tear after endotracheal intubation is extremely rare. The role of silicone Y-stent in the management of tracheal injury has been documented in the previous studies. However, none of the studies have mentioned the deployment of silicone Y-stent via rigid bronchoscope with the patient solely supported by extracorporeal membrane oxygenation (ECMO) without general anaesthesia delivered via the side port of the rigid bronchoscope. We report a patient who had a tracheal tear due to endotracheal tube migration following a routine video-assisted thoracoscopic surgery sympathectomy, which was successfully managed with silicone Y-stent insertion. Procedure was done while she was undergoing ECMO; hence, no ventilator connection to the side port of the rigid scope was required. This was our first experience in performing Y-stent insertion fully under ECMO, and the patient had a successful recovery.

BACKGROUND

Tracheal tear is a life-threatening complication of endotracheal tube (ETT) insertion. With a reported incidence of approximately 0.005%, tracheal rupture following endotracheal intubation is extremely uncommon .[1] Tracheal injury's complications such as pneumothorax, subcutaneous emphysema, haemoptysis and respiratory failure have been documented.[2–4] These complications usually occur intraoperatively or in the immediate postoperative period. They appear commonly intraoperatively or in the immediate postoperative period. We report a case of a patient who had a iatrogenic tracheal tear following migration of double-lumen tube (DLT) during a routine video-assisted thoracoscopic surgery (VATS) sympathectomy. A silicon Y-stent was inserted while she underwent extracorporeal membrane oxygenation (ECMO to rest the lung as a bridge to the destined therapy.

CASE PRESENTATION

A 24-year-old woman with no known comorbidities presented with a chief complaint of bilateral palmar hyperhidrosis since childhood. She had suffered from having sweaty palms and feet since the age of 9 years. She had background of strong family history of hyperhidrosis. There were no symptoms of hyperthyroidism. Apart from sweaty palms and feet, her physical examination was otherwise unremarkable.

Her thyroid function test was normal as were other blood parameters. She was scheduled for a therapeutic VATS sympathectomy. Her preoperative assessment was normal. She subsequently was sent to operating theatre where she was intubated with double-lumen 32Fr ETT in view of the need to do one-lung ventilation (OLV) during surgery. Bronchoscopy confirmed the correct ETT placement.

For right sympathectomy to be performed, her right lung was collapsed following left OLV and right sympathectomy was done without difficulty. The surgery was subsequently continued with left sympathectomy. However, in less than 1 min of right OLV in order to collapse the left lung, she desaturated to 85% oxygenation thus left sympathectomy was abandoned. Both lungs were ventilated, resulting in improved oxygen saturation to up to 99%.

INVESTIGATIONS

An immediate flexible bronchoscopy was done to check the position of the DLT, which revealed migrated bronchial cuff had migrated and obstructed the right bronchus. During this period, left pneumomediastinum developed. The DLT was then repositioned and the left lung was isolated. A chest tube was inserted on the left side. Inspection of the left lung however revealed no injury. After the surgery ended, DLT was changed to a single-lumen tube. A subsequent bronchoscopy later revealed a tracheal injury at the posterior wall of the trachea, measuring 1 cm above carina and 2 cm in length (figure 1A). This explained the pneumomediastinum. Oesophageal tear as a cause of pneumomediastinum was ruled out by a normal oesophagogastroduodenoscopy done on table.

DIFFERENTIAL DIAGNOSIS

Pneumothorax following sympathectomy is a common complication of the surgery; however, in this particular case, the occurrence of left pneumomediastinum is likely due to tracheal tear which was caused by the injury during ETT migration. Furthermore, pneumomediastinum occurred before left sympathectomy was performed.

TREATMENT

In view of the deep tracheal laceration, the patient underwent veno-venous ECMO to allow self-healing while 'resting' the lung. However, a repeat bronchoscopy after 5 days on ECMO showed

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persistent tracheal tear measured 4 cm in length and 1–1.5 cm above carina. Hence, a decision to insert a silicon Y-stent was made to expedite healing of the tracheal tear. Rigid bronchoscopy with Y-stent insertion was done on the same day. The Y-stent was deployed successfully with intended limb 2 cm in the right main bronchus (RMB) and 1 cm in the left main bronchus (figure 1B).

The patient was able to be weaned off ECMO 1 day after Y-stent insertion. Repeat chest radiograph confirmed resolution of the pneumomediastinum. Subsequently, her haemodynamic status significantly improved, and she was able to be extubated on day 2 of the Y-stent insertion. Postoperative echocardiography revealed good ejection fraction with no pericardial effusion. She was then discharged well 4 days post extubation.

OUTCOME AND FOLLOW-UP

A surveillance bronchoscopy 1 month post procedure confirmed that the Y-stent was in situ. Contrasted-enhanced CT (CECT) of the thorax later on confirmed resolved pneumomediastinum.

The patient successfully had her Y-stent removed 2 months post procedure, and a surveillance bronchoscopy 1 month post Y-stent removal showed well-healed tracheal tear site with presence of granulation tissue (figure 1C). On follow-up, patient had recovered well, and she is now happily married.

DISCUSSION

Tracheal injury in endotracheal intubation is uncommon but carries potential life-threatening consequences. Several factors may be associated with tracheal injury. However, two main reasons that can be postulated in this case were over inflation of ETT cuff and sudden migration of ETT which obstructed the RMB. These two mechanisms typically caused longitudinal lacerations of the posterior membranous trachea, which rarely extend into the main bronchi.[4] Hence, its management is crucial and needs to be timely as well as minimally invasive as it could add up to the severity and complexity of the injury. Traditionally, tracheal tear was managed surgically with high perioperative mortality.[4]

Conservative management includes expectant management, and cluster care was tried with good outcome however with longer hospital stay.[5] In a literature review conducted by Chen *et al*, women over 50 years of age who required intubation with DLTs and/or excessive pressure of the tube cuff were included among high-risk population.[6]

Few literature reviews are looking at options between conservative and surgical approach . In our case, as the tracheal tear was located below the first third of the trachea and did not extend beyond the main carina, it was an appropriate and reasonable approach to treat the patient's injury via Y-stent insertion. In view of its potential risks and complications, surgical approach was not advisable. This was also supported by algorithm in management of tracheal tear proposed Yopp *et al*.[7]

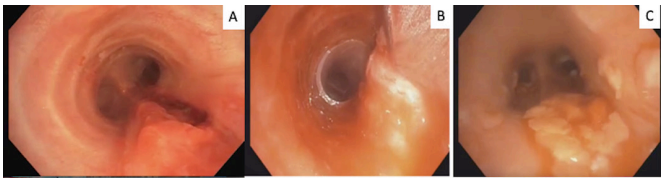

Figure 1 Tracheal tear (A) visualised at posterolateral wall of the distal trachea. Y-stent placement (B) at the main carini. presence of granulation tissue (C) at distal trachea 1 month post Y-stent removal.

When deciding between conservative management, stenting and surgery, Tazi-Mezalek *et al* proposed that conservative management should be considered in non-ventilated patients with iatrogenic tracheal injury and when it is located in the upper trachea of ventilated patients where ETT or tracheostomy cannula bypasses the injury. Airway stenting should be considered in ventilated patients with tracheal injury located in the lower trachea, and surgery should be reserved for tracheoesophageal fistula and when conservative and endoscopic management failed.[8 9]

The length of the tracheal tear was noted to have increased from the first bronchoscopic evaluation (2 cm) compared with the second bronchoscopic evaluation (4 cm). The differences in size of the tracheal tear in these two bronchoscopic evaluation were likely due to worsening injury as a result of failed self-healing process that was expected in this patient in the first place. Absence of specific intervention addressing to this injury was also contributing to the worsening of the tracheal tear. Conservative management was opted for this case initially in view of the small size of tracheal tear (2 cm). As discussed by previous literatures, conservative management was one of the best option for small tracheal tear of less than 2 cm.[8] Infection is also another possible cause of the worsening of tracheal tear; however, there was no fever or other evidence of infection in this case. Hence, Y-stent insertion was attempted to assist and expedite the healing of the tracheal tear, in view of failed conservative management which was proven to be successful in her.

In this case, ECMO was opted to allow self-healing of the tracheal tear, in view of the deep tracheal laceration, while allowing adequate gas exchange to sustain patient's life, without the need of ETT. Putting patient under prolonged ETT might worsen the tracheal tear and delay the healing process. Traumatic tracheal injuries are potentially life-threatening conditions which require early measures to guarantee an adequate ventilation and avoid severe consequences. ECMO is a paramount to the pulmonologist, surgeon and anaesthesiologist, and a valid measure, especially when conventional ventilation might impose further risks to patient's ongoing tracheal injury. Aprile *et al* performed a literature review looking at the indications for ECMO in traumatic tracheal injuries, and concluded that ECMO is a viable and feasible technique and proven to be useful in selected traumatic tracheal injury cases, allowing an efficient gas exchange where ventilation is not feasible.[10] Zhao *et al* described on the importance of avoiding the positive pressure ventilation to prevent further expansion of tracheal.[11] With endotracheal intubation, certain situations predispose the patient to further complications of the tracheal tear, including the skill of the operator, improper use of a stylet, high-pressure cuff usage and tube manipulation

Learning points

- Y-stent insertion in a patient with tracheal injury is a viable and feasible option in certain patient cohort.
- Y-stent deployment help in the healing process of the injury site due to tracheal tear.
- A minimally invasive therapeutic option can be attempted via Y-stent insertion even with larger tear of up to 4 cm, with sparing of the carina.
- Extracorporeal membrane oxygenation can be performed as a bridging therapy while waiting for subsequent definitive treatment in management of tracheal tear.

with a blocked cuff.[12] Hence, ECMO is a valid option to prevent all these possible complications.

Y-stent insertion is a breakthrough in managing tracheal tear, and it appears to be a safe and feasible option in patient who has tear even up to 4 cm. The use of ECMO as a bridging therapy to rest or bypass the injured site of the lungs favours in the good clinical outcome for this patient.

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