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CASE REPORTS / CASE SERIES

Novel use of a guidewire to facilitate intubation in an obstructing anterior mediastinal mass

Utilisation originale d'un fil-guide pour faciliter l'intubation lors d'une obstruction par une masse médiastinale antérieure

Eldon W. Ward, MBChB · M. Sean McManus, MBBS

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Abstract

Purpose *This report describes the management of a life-threatening tracheal obstruction due to a thymoma in the anterior mediastinum and the use of a guidewire to facilitate intubation.*

Clinical features *Anesthetic management of patients presenting with large anterior mediastinal masses is always challenging. Catastrophic complications can occur after loss of consciousness due to compression of the airway, heart, or great vessels. Intrathoracic airway compression may become complete with a life-threatening inability to ventilate the lungs. We discuss the management of this case presenting to a regional centre prior to transfer to a tertiary care facility and point out current recommendations for pre-induction assessment and airway management in similar cases.*

Conclusion *Confirmed guidewire placement prior to induction enabled intubation in a setting without cardiothoracic backup capabilities.*

Résumé

Objectif *Ce cas décrit la prise en charge d'une obstruction trachéale potentiellement fatale liée à la présence d'un thymome dans le médiastin antérieur et l'utilisation d'un fil-guide pour faciliter l'intubation.*

Caractéristiques cliniques *La gestion de l'anesthésie chez des patients présentant une large masse médiastinale antérieure est un défi constant. Des complications catastrophiques peuvent survenir après la perte de conscience en raison de compression de la voie respiratoire, du cœur ou des grands vaisseaux. La compression de la voie aérienne intrathoracique peut devenir complète et ainsi mettre la vie en danger en raison de l'impossibilité de ventiler les poumons. Nous discutons la gestion du cas d'un patient se présentant dans un centre régional puis transféré dans un établissement de soins tertiaires, et soulignons les recommandations actuelles pour l'évaluation pré-induction et la gestion de la voie aérienne de cas semblables*

Conclusion *Le positionnement confirmé d'un fil-guide avant l'induction a permis l'intubation dans un centre sans capacités de soutien cardiothoracique.*

Case report

Written consent was obtained from the patient to write this report.

A 39-yr-old female was admitted to a regional hospital with cough, shoulder pain, and increasing shortness of breath. She was comfortable only when sitting upright. Five weeks earlier, she had been diagnosed with a thymoma and was waiting to see an oncologist to formulate definitive management.

Computerized tomography (CT) showed a large mass extending from the anterior mediastinum into the middle mediastinum, superiorly towards the left, and partially compressing the left pulmonary artery. There was severe compression of the trachea from the thoracic inlet to the

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E. W. Ward, MBChB (✉) · M. Sean McManus, MBBS
Department of Anesthesia, Intensive Care and Perioperative Medicine, Cairns Hospital, PO Box 902, Cairns, QLD 4870, Australia
e-mail: eldon.ward@health.qld.gov.au

carina that resulted in a tracheal diameter of 3.6 mm. The left main bronchus was compressed, which led to partial collapse of the left lower lobe. Both the right main bronchus and right lung were clear (Figs 1 and 2).

The patient was admitted to the intensive care unit, but her condition continued to deteriorate so arrangements were made for transfer to the nearest tertiary care cardiothoracic unit (a distance of 400 km) for more definitive treatment. Intubation was necessary prior to transport. When the anesthetic team reviewed the patient, she was sitting upright, her breathing was stridorous, but she was well oxygenated. There was no significant medical history and no clinical predictors of difficult laryngoscopy.

The patient's condition presented the anesthetic team with several important limitations. First, she was unable to lie in a supine position. Accordingly, inhalational induction would have been slow, difficult, and likely unsuccessful. Alternatively, intravenous induction (with or without paralysis) might have resulted in the complete inability to ventilate the patient's lungs. Furthermore, due to the extensive length of the obstructing lesion, there was considerable uncertainty that an endotracheal tube (ETT) could be advanced beyond the obstruction. To complicate matters further, if we advanced the 4.2-mm diameter bronchoscope, which we had available, through the already narrowed trachea, it would have resulted in complete obstruction and made standard awake bronchoscopic intubation unfeasible. There was no option for a tracheostomy as access to the trachea at this site would not have been beyond the level of the obstruction. Lastly, the absence of cardiopulmonary bypass (CPB) or extracorporeal membrane oxygenation (ECMO) in our regional hospital limited our potential backup solutions.

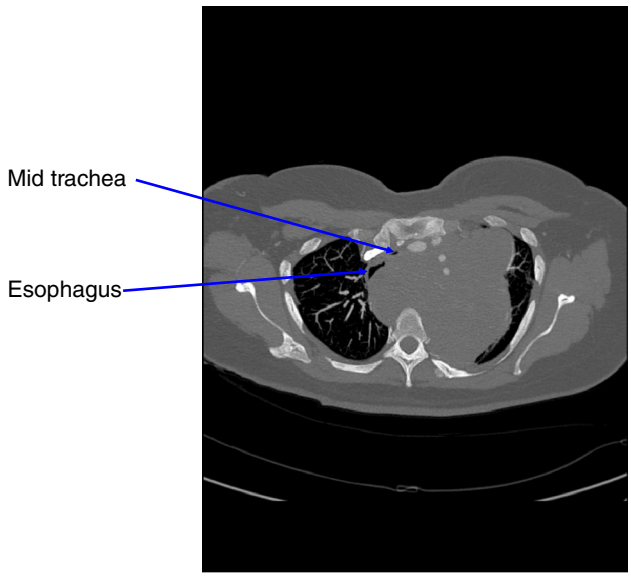

Fig. 1 Chest computed tomography scan at level of the mid trachea. The trachea diameter is 3.6 mm

Our plan involved keeping the patient awake and sitting up for as long as possible during the intubation process. We utilized a Cook® Staged Extubation Set (Cook Inc, Bloomington, IN, USA) which was available. The kit contains a 0.035-in (0.89-mm) diameter wire and an 83-cm 14.0-Fr catheter. It has a 15-mm connector for attaching to a standard anesthetic circuit and an alternative connector for jet oxygenation (Fig. 3).

An otolaryngology consultant was also standing by in the operating room and was equipped for rigid bronchoscopy if required.

Oxygen was administered by nasal prongs while the patient's airway was topicalized with 8 mL of atomized 4% lidocaine. The patient was not sedated. An oropharyngeal intubating airway was inserted and the video bronchoscope was maneuvered into the proximal trachea just above the level of the obstruction. The wire from the kit was passed through the working channel of the bronchoscope and advanced 10 cm past the tip and beyond the tracheal obstruction. The scope was removed and the wire was left *in situ*, which was well tolerated. With the patient still awake and sitting upright, a fluoroscopic image

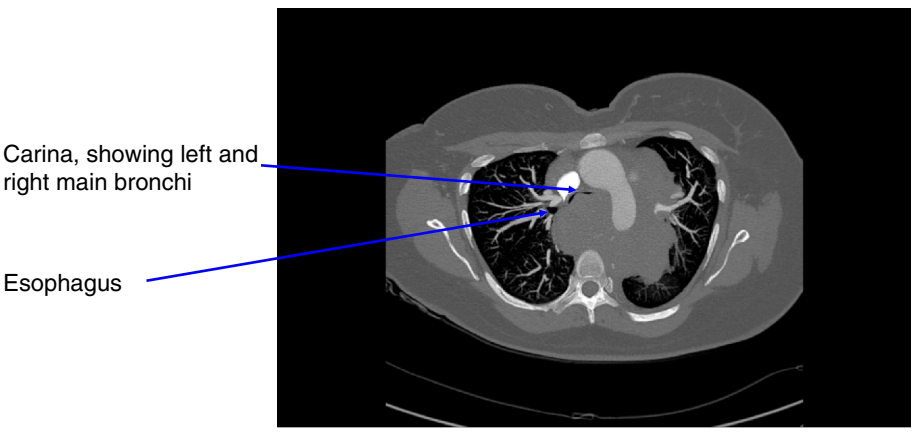

Fig. 2 Chest computed tomography scan at the level of the carina showing tracheal compression extending down to and including the left main bronchus

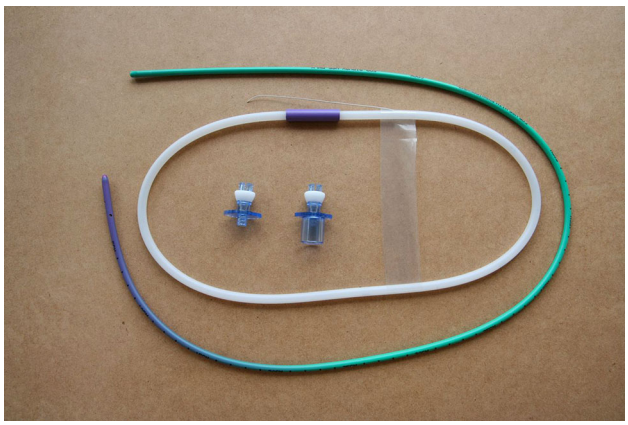

Fig. 3 Cook Staged Extubation Set showing guide wire (in white sheath), catheter and connectors

intensifier was used to confirm the position of the wire in the proximal right main bronchus.

Prior to induction of anesthesia, the Cook Staged Extubation Catheter was loaded onto the wire, and then a size-6 microlaryngoscopy tube was loaded onto the catheter. This tube was chosen as it was considered to be long enough to pass beyond the obstruction, wide enough to pass over the Staged Extubation Catheter, and narrow enough to fit through the obstruction. Anesthesia was induced with fentanyl, propofol, and rocuronium with the patient in a sitting position. The Staged Extubation Catheter was then advanced through the oropharyngeal airway and into the distal trachea, and this was immediately followed by advancing the ETT its entire length. The wire and extubation catheter were then removed, and the anesthetic circuit was attached with the patient in the supine position. The ETT had entered the right main bronchus, but ventilation and oxygenation were satisfactory. The ETT was withdrawn slightly under bronchoscopic guidance but remained in the proximal right main bronchus. The ETT was left in that position to decrease the likelihood of it migrating into the obstructed region of the trachea during transfer of the patient. With the effect of shunting likely decreased due to the compromised flow through the left pulmonary artery, an oxygen saturation of 98% was achieved using volume control ventilation (300-mL tidal volume at 10 breaths·min^{-1}) on 100% oxygen.

The patient was returned to the intensive care unit where her oxygen saturation continued to be satisfactory on 40% oxygen. Transfer occurred later that day.

The ETT remained *in situ* for 22 days while high-dose radiotherapy was administered to decrease the size of the tumour. After the initial few days, pressure support ventilatory assistance was instituted, which allowed a subsequent uneventful tracheal extubation. Adjuvant chemotherapy has since been administered.

Discussion

Anterior mediastinal tumours can cause life-threatening airway and vascular compression, and these effects can be exacerbated by general anesthesia. In extreme cases, the patient may not be able to tolerate lying supine. In our case, these obstacles were overcome by placement of a guidewire (with radiological confirmation) prior to induction of anesthesia with the patient awake and in an upright position.

The anterior mediastinum is spatially defined anteriorly by the sternum, posteriorly by the heart and great vessels, superiorly by the thoracic inlet, and inferiorly by the diaphragm.[1] The common causes of anterior mediastinal tumours in adults are lymphoma, thymoma, germ cell tumour, granuloma, bronchogenic carcinoma, and thyroid tumours.[2]

The literature contains numerous cases of patients with mediastinal masses who experience severe or even fatal intraoperative airway compromise with the onset of general anesthesia.[1] With the induction of anesthesia, dynamic and structural changes can rapidly lead to compression of the airway. Mechanically, there is a reduction in inspiratory muscle tone, cephalad displacement of the diaphragm, and loss of elastic recoil of the chest wall. With loss of spontaneous respiration, the transpleural pressure gradient is decreased, resulting in loss of radial traction on intrathoracic airways. These effects are all exaggerated by neuromuscular blockade and can result in life-threatening airway compression and collapse. Positive pressure ventilation cannot be relied on to overcome the obstruction in this situation. In our view, the use of a muscle relaxant, although non-conventional, allowed us to position our extubation catheter and ETT more expeditiously, knowing that we had already successfully positioned a wire beyond the obstruction.

Before attempting to manage the airway in a patient with an anterior mediastinal mass, focused assessment should be performed to elicit signs and symptoms associated with compression of the airway, heart, or great vessels. Ominous signs for tracheal compression are positional dyspnea and/or stridor. Positional blood pressure changes, plethora of the head and neck, and jugular venous distension suggest compression of the superior vena cava – these patients are at risk of cardiovascular collapse after induction.

Investigations may include a chest radiograph followed by a CT scan of the chest to define the position and size of the mass. An echocardiogram may be indicated to evaluate compression of the heart or major vascular structures and to look for pericardial effusion.[1]

In a recent series of 105 anesthetic cases, it was found that patients at high risk of perioperative complications can

be identified by the presence of cardiorespiratory signs and symptoms, tracheal compression > 50% on CT scan, or pericardial effusion.[3] Other features associated with high risk include superior vena cava syndrome or tracheal compression with associated bronchial compression.[1]

Virtually all reported cases of severe complications have occurred after abolition of spontaneous ventilation.[1] Maintaining spontaneous ventilation until the patient's airway is definitively secured or the procedure is completed is a safe strategy if it is achievable.[2] Nevertheless, it was unlikely that our patient would have achieved adequate spontaneous ventilation if anesthetized or in a supine position. Awake bronchoscopic intubation may be desirable if there is an area of non-compressed trachea distal to the obstruction, especially if the patient cannot lie flat. The difficulty in our case was that the bronchoscope would completely occlude the trachea at the level of the obstruction. Thus, we compromised and accepted some additional risk by keeping the patient upright and spontaneously breathing until there was definitive access to the distal trachea (with a wire), enabling us to secure the airway rapidly after induction using a modified Seldinger technique. Having the wire *in situ* prior to induction provided a rigid guide for the Staged Extubation Catheter, thus maximizing the chances of this relatively soft tube advancing past the obstruction without kinking. Having the patient upright during this maneuver prevented her trachea from being compressed further and facilitated passage of the catheter and ETT past the obstruction.

Intraoperative airway compression usually responds to either repositioning the patient or rigid bronchoscopy and ventilation distal to the obstruction.[2] Rigid bronchoscopy would have provided only a temporary solution in our case.

Patients who are at extreme risk of failed airway management may require preoperative establishment of CPB or ECMO. There have been case reports where this capability has been on standby[4,5] and cases where the patient was on CPB prior to induction of anesthesia.[6] Some suggest that the usefulness of having CPB on standby is unrealistic, as it requires too much time to establish oxygenation in the event of catastrophic airway collapse. This option was not available, but in an ideal setting, it would have been a realistic and safe option to consider.

This case highlights the challenges of dealing with severe intrathoracic airway obstruction, particularly in a centre that did not have all management options (i.e., CPB) available. We utilized an innovative technique to secure the airway using the contents of a Cook Staged Extubation Set, a bronchoscope, an image intensifier, and a microlaryngoscopy tube.

Competing interests There are no disclosures or competing interests for either author.

References

1. *Blank RS*, *de Souza DG*. Anesthetic management of patients with an anterior mediastinal mass: Continuing Professional Development. Can J Anesth 2011; 58: 853-67.
2. *Slinger P*, *Karsli C*. Management of the patient with a large anterior mediastinal mass: recurring myths. Curr Opin Anaesthesiol 2007; 20: 1-3.
3. *Bechard P*, *Letourneau L*, *Lacasse Y*, *Cote D*, *Bussieres JS*. Perioperative cardiorespiratory complications in adults with mediastinal mass: incidence and risk factors. Anesthesiology 2004; 100: 826-34.
4. *Seong Tan PC*, *Esa N*. Anesthesia for massive retrosternal goiter with severe intrathoracic tracheal narrowing: the challenges imposed—A case report. Korean J Anesthesiol 2012; 62: 474-8.
5. *Tempe DK*, *Arya R*, *Dubey S*, *et al*. Mediastinal mass resection: femorofemoral cardiopulmonary bypass before induction of anesthesia in the management of airway obstruction. J Cardiothorac Vasc Anesth 2001; 15: 233-6.
6. *Wang G*, *Lin S*, *Yang L*, *Wang Z*, *Sun Z*. Surgical management of tracheal compression caused by mediastinal goiter: is extracorporeal circulation requisite? J Thorac Dis 2009; 1: 48-50.