Update in
Anaesthesia

Anaesthetic Management of a Patient with Suspected Tracheal Amyloidosis

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PATHOPHYSIOLOGY

Amyloidoses is a protein misfolding disease - the failure of proteins to adopt functional conformational states. It is caused by the conversion of soluble and functional peptides or proteins into organized fibrillar aggregates with a cross-beta super-secondary structure known as "amyloid".[1] This process might involve the intracellular protein quality control system, extracellular chaperones and matrix components, proteases, and other cofactors.[2] There are up to 30 different types of amyloidosis, each due to a specific protein misfolding.[3] Amyloidosis can be localized or systemic. Systemic amyloidoses affect more than one body organ or system whereas localised amyloidosis affects only one body organ or tissue type. The lung presentation of amyloidosis can be classified into tracheobronchial, nodular and alveolar septal amyloidosis.[4] Tracheobronchial amyloidosis (TBA) is a rare condition with only a few hundred cases reported in the world.[5,6] Male to female ratio suffering the disease is around 2:1, with middle-aged males being the most diagnosed group.[7] The mean age at presentation is 50 - 60 years.[8]

CLINICAL FINDINGS

Patients with TBA may present with respiratory symptoms including cough with sputum, hemoptysis, hoarseness of voice, progressive dyspnea, stridor and dysphagia.[8]

It presents with non- specific signs such as reduced air entry, bilateral basal crackles or wheeze.

DIAGNOSIS

TBA is diagnosed with bronchoscopy and transbronchial biopsy. Bronchoscopy may detect uneven inner luminal wall, mucosal hyperaemia and edema, localized or diffuse luminal stenosis, easy bleeding mucosa and nodules within tracheobronchial lumen etc.[8]

The definite diagnosis is made by Congo red staining of the biopsy specimen. Histological finding of "apple-green" birefringence with Congo red staining on polarized microscopy confirms the diagnosis.

RADIOLOGICAL FINDINGS

Computed Tomography (CT) may show mucosal thickening +/- calcification involving segments of the trachea + bronchi and narrowing of the affected airway. The posterior membrane of trachea is classically involved.[9]

Chest X-ray may show nodular and irregular narrowing of the tracheal lumen. Lung collapses may be seen secondary to obstruction caused by amyloid deposition. However, up to 25% of cases can have normal findings in plain films.[9]

CASE REPORT

A 90-year-old lady was admitted for right mastectomy + sentinel lymph node biopsy +/- axillary dissection. She had a body weight of 75kg and a height of 173cm (i.e., BMI of 27.5) Preoperative anaesthetic assessment was unremarkable with no obvious difficult airway. The patient was edentulous. Patient had two general anaesthesia done with no history of difficult airway. Blood tests showed normal results.

During intubation, despite videolaryngoscope showing VL grade1, resistance was felt when a 7.0mm tracheal tube (TT) was inserted. It could not pass beyond 18cm at lip. The TT was immediately withdrawn and switched to gum elastic bougie. Bougie insertion through the vocal cord was successful with some resistance. We attempted to intubate with a 6.5mm TT but were only able to insert at 20cm at lip. Auscultation of the chest reviewed reduced air entry over the left chest. A 4cm blood clot was evacuated from the TT and air entry over the left chest improved afterwards. Bronchoscopy assessment showed blood pooling at floor and left main bronchus and irregular tracheal rings. Operation was abandoned and the patient was sent to Intensive care unit (ICU).

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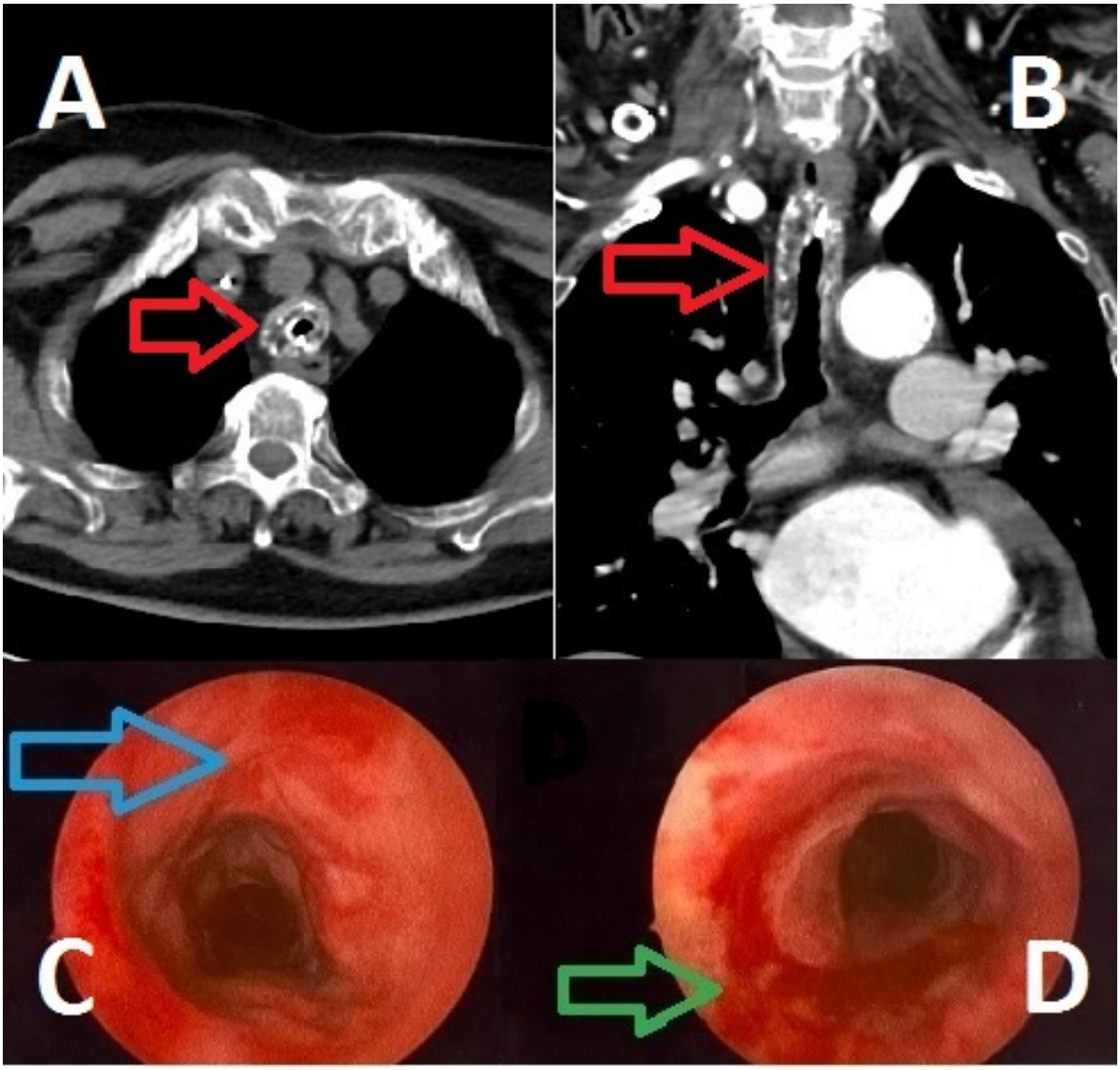

Figure 1: CT and endoscopic images

CT neck + thorax with contrast were done and the report was written: "Mucosal thickening and circumferential calcifications mainly involving the intrathoracic trachea. Query related to tracheal amyloidosis." (Figure A, B)

Looking at the CT retrospectively, the distance between patient's lip and the vocal cord is around 14cm. As the length from the tip of TT to proximal cuff end of tube is around 6cm, the ETT should be inserted to at least 20cm at lip to pass beyond the vocal cords and allow ventilation.

Ear, Nose and Throat Surgery (ENT) colleagues were consulted, and they decided for direct laryngoscopy/ microlaryngoscopy + trial of extubation in the same session as breast surgery. We maintained the anaesthesia with Target controlled infusion propofol and remifentanil and monitored the depth of anaesthesia with BIS. Intraoperative assessment found ~25% circumferential narrowing ~5cm below true cord. It also revealed irregular tracheal luminal wall, mucosal hyperaemia and edema, and blood pooling on mucosal surface (Figure C, D). ENT team, decided for a trial of extubation and not for biopsy in view of bleeding risk. Prior to extubation, BIS level was larger than 90; the patient was spontaneously breathing with spontaneous eye opening; the respiration was regular with adequate tidal volume. Extubation was successful. The patient was sent back to ICU.

Unfortunately, the patient developed desaturation shortly after extubation. She was re-intubated with a 6.5mm TT fixed at 22cm at lip with aid of videolaryngoscope and gum elastic bougie. The patient developed right sided pneumothorax afterwards and a chest drain was inserted.

With reduction of oxygen requirement and re-expansion of lung in CXR, the patient was sent for another trial of extubation. Trial of extubation was unsuccessful due to poor respiratory effort and persistent drowsiness despite injection of Naloxone and Flumazenil. After a multidisciplinary discussion, we decided for one more trial of extubation and proceed to tracheostomy if failed in view of repeated

failure of extubation and ventilator related complications. Before extubation, the patient was alert and obeyed command; Bispectral index (BIS) was >90; respiration was regular with adequate tidal volume. She was successfully extubated. SpO_2 maintained at 99% on room air. Arterial blood gas after extubation reviewed normal results with no acidosis. Patient was discharged from hospital after 3 weeks.

DISCUSSION

Options of management for suspected cases of TBA

The non-specific clinical manifestations and investigation results of TBA raise diagnostic challenges in elective operation settings. A discussion with surgeons, patient and family members should be conducted to consider possible options of management when there is clinical suspicion of undiagnosed TBA. A preoperative formal bronchoscopy assessment and/ or a preoperative CT neck and thorax with contrast can be offered. This may delay the surgery with potential harm to the patient. Alternatively, one may proceed to operation with anticipated difficult intubation, while a formal bronchoscopy assessment and CT scan can be arranged after operation. Pros and cons of each option should be clearly explained to patient.

Airway management when TBA is suspected

A fiberoptic bronchoscopy assessment can be done before intubation. Bronchoscopy assessment of the airway before intubation gives important information on the airway e.g., the extent of luminal stenosis, presence of an active bleeding site, nodule(s), or mass within tracheobronchial lumen etc. Subsequent steps of management will depend on the bronchoscopy findings. If intubation is considered possible, awake fiberoptic intubation can be performed. An appropriate tracheal tube size can be chosen based on bronchoscopy findings which facilitates a smoother intubation. If the luminal stenosis is so severe that intubation is not possible, or an active bleeding site/ obstructing mass is found during assessment; anaesthetists should abort intubation. Other possible methods for airway management include the use of facemask or supraglottic airway for ventilation. The choice of method would depend on both surgical and anaesthetic factors. A discussion with surgeons and patient is required for further plan of management.

Airway management for unexpected / undiagnosed TBA

The possible diagnosis of TBA can be missed despite high levels of suspicion. Unanticipated difficult airways may occur due to the poor predictive value of airway tests or failure of adequate assessment.[5] Difficult Airway Society (DAS) guideline provides a reference for anaesthetists of plans to be implemented when unanticipated difficult intubation is encountered.[6] Unfortunately, the case mentioned above demonstrates that the guideline is not exhaustive when it comes to the unusual presentations of TBA during intubation. There are several points to be considered when there is difficulty in advancing tracheal tube during intubation.

Firstly, the length of the tracheal tube within trachea. Clinical findings under laryngoscopy provide important information. If the proximal end of tube cuff is seen below the vocal cord, the trachea tube is considered adequately deep within the trachea to maintain airway. It is not advisable to advance the tube further even if resistance is felt. This can prevent traumatic injury from forceful insertion of tracheal tube.

Alternatively, patient's height could be used as a reference to give an indication of the distance from the tip of the tube to the level of teeth. The relationship between a person's height and appropriate tracheal tube length has been studied in adult subject and formulae have been derived which predict appropriate lengths for tracheal tubes[10]:

Distance from teeth to mid-point of trachea = Height(cm)/10+2

It is important to note that this calculation only acts as a reference. The calculated value may not be accurate if the patient is edentulous. Average length of adult trachea can also be used as a reference. The mean tracheal length was found to be 107.8 ± 13.2mm in males and 101.4 ± 12.8mm in female in a recent study.[11]

Alternative airway management other than intubation should be considered if there is likelihood of bleeding when tracheal tube is to be further advanced. Supraglottic airway or bag-mask ventilation are possible alternatives if not contraindicated. Patient, surgical and anaesthetic factors should be carefully considered. A thorough discussion with surgeons is crucial for decision-making.

Post-operative management - trial of extubation

A spontaneous breathing trial (SBT) should only be performed when there is improvement of the underlying pathology, satisfactory PaO_2, adequate cough reflex and minimal requirement for PEEP.[7] Assessment of airway should be done before extubation. A bronchoscopy assessment with ENT colleagues is advised. The expertise and experience of ENT colleagues on the bronchoscopy assessment can reassure that the patient's airway is fit for extubation. The presence of ENT surgeons also allows for emergency tracheostomy while necessary. Depth of anaesthesia should be monitored with BIS, which should be larger than 90 before extubation. The patient should be alert and obey commands. The reversal of neuromuscular blockade (if any) should be monitored with Train-of-four using a peripheral nerve stimulator. A 100% ratio of the fourth twitch to first twitch should be achieved. The breathing effort should be regular with an adequate tidal volume. If all the conditions mentioned are satisfactory, the patient should be extubated carefully. It is advised to transfer the patient to ICU for close monitoring.

Decision for Tracheostomy

The extubation outcome depends on age, amount of endotracheal secretion, respiratory effort; level of consciousness etc.[7] Extubation failure is defined as the need for reintubation or emergency support with non-invasive positive airway pressure within 48 to 72 hours after planned extubation.[12] Prolonged intubation increases the duration of invasive ventilation which increases incidence of ventilator related pneumonia and other complications e.g., pneumothorax. Although there is no protocol for the decision of performing tracheostomy, patients fail to satisfy the SBT criteria after 2 weeks of invasive mechanical ventilation or patients who are not expected to satisfy the criteria within 2 weeks are considered candidates for tracheostomy.[7]

CONCLUSION

Tracheobronchial amyloidosis (TBA) is a rare condition. Its non-specific clinical manifestations and investigation results raise diagnostic challenges in elective operation settings. TBA should be considered in patients who present with cough with sputum, hemoptysis, hoarseness of voice, progressive dyspnea, stridor and dysphagia. Options of management include formal pre-operative bronchoscopy and/ or CT assessment or proceed to surgery with anticipated difficult intubation. A clear communication between patient, family members, colleagues from different specialties and all operating theatre members is crucial for a successful outcome. The unusual presentations of TBA may pose challenges to anaesthetists during intubation. Subsequent plan of management will depend on the situation encountered.

List of Abbreviations

- **TBA**: Tracheobronchial amyloidosis
- **ENT:** Ear, Nose and Throat
- **CT:** Computed Tomography
- **AL:** Amyloidosis
- **TT:** Tracheal tube
- **ICU:** Intensive care unit
- **FOB:** Fiberoptic bronchoscopy intubation
- **SBT:** Spontaneous breathing trial
- **PaO_2**: Partial pressure of oxygen
- **PEEP**: Positive end expiratory pressure

Table 1: List of abbreviations

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2. Costigan SN, Sprigge JS. Dural puncture: the patients' perspective. A patient survey of cases at a DGH maternity unit 1983–1993. Acta Anaesthesiol Scand 1996; 40: 710–14.
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