

Successful management of tracheal blood clot obstruction using a meconium aspirator: a case report

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Background: True airway emergencies due to a tracheal obstruction are rare. When they do occur, emergent action must be taken to avoid life-threatening hypoxia, impairment in ventilation, and hemodynamic collapse. Reported techniques include advanced bronchoscopic methods and passage of a rigid suction catheter or Magill forceps into the trachea. These methods have limitations in speed and ease of set-up and in efficacy for distal objects and objects with softer consistency. We present a case of an obstructing endotracheal blood clot causing complete airway obstruction that was managed rapidly and successfully with a meconium aspirator attached to an in situ endotracheal tube (ETT) and wall suction. A meconium aspirator is a plastic adaptor that allows for suctioning of the trachea when attached to an ETT and continuous negative pressure. Adaptation of this technique has been shown to be successful in an adult with food impaction but has not been described in the management of obstructing blood clots.

Case Description: A 53-year-old male with history of intravenous drug use and chronic hepatitis C was admitted with fever and altered mental status. He was discovered to have sepsis due to MSSA endocarditis with resulting septic pulmonary emboli. He was endotracheally intubated due to encephalopathy and respiratory failure. During the early morning of hospital day 10, he developed massive hemoptysis leading to acute worsening of his oxygenation and ventilation. Complete tracheal obstruction due to a blood clot was identified. A unique management technique was utilized, in which a meconium aspirator was connected to the standard 15 mm adaptor on the existing ETT and then directly to wall suction. Suction was applied via the meconium aspirator's side suction control port and the clot was extracted. Device assembly and clot removal took less than one minute. The patient's clinical status improved within two minutes, which allowed him to undergo bronchial artery embolization. More distal clot was removed via bronchoscopic cryotherapy. He was ultimately discharged to a rehabilitation facility.

Conclusions: Immediate intervention in cases of complete airway obstruction is critical. The meconium aspirator suction technique is easy to assemble and quick to deploy making it ideal in such scenarios.

Keywords: Meconium aspirator; vacuum extraction; tracheal obstruction; pulmonary hemorrhage; case report

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Introduction

Tracheal obstruction resulting from blood clots, mucus or food impaction, or foreign bodies can lead to life-threatening hypoxia, impairment in ventilation, and hemodynamic collapse. While relatively rare, this can be catastrophic if not immediately recognized and reversed. The prevalence of blood clots causing tracheal obstruction is unknown, but it has been described in cases of bronchiectasis, mitral stenosis, tuberculosis and other cavitary lesions, pulmonary infarction or embolization, carcinoma, intrathoracic trauma, and instrumentation of the trachea, among others (1). Hemoptysis precedes the majority of endobronchial blood clots. However, up to 30% may occur without evidence of hemoptysis (1). In a single center, retrospective study of patients undergoing cryotherapy for central airway obstruction, blood clots accounted for 20 of 262 obstruction (7.6%). The subset of patients with complete or near-complete tracheal obstruction was not described, but was likely much lower (2).

Management of tracheal obstruction due to blood clots depends on the location of the clot within the endotracheal tube (ETT) or tracheobronchial tree. If the clot is located entirely in the ETT and standard suctioning is not successful, the patient can simply be extubated and re-intubated. If the clot is distal to the tube, removal is more complex. The most discussed management techniques in

adults include use of advanced bronchoscopic methods, such as suctioning, forceps or basket retrieval, or cryotherapy. Passage of an oral suction catheter or Magill forceps into the trachea have also been described. In cases of true airway emergencies, however, advanced bronchoscopic methods can be time consuming and difficult to deploy. If a clot located beyond the ETT cannot be removed with suction catheters passed down the ETT, flexible bronchoscopy with lavage and suction is often the next attempted intervention (1). However, the small working channel of the bronchoscope often cannot supply enough suction power to remove a large, obstructing clot. All bronchoscopic methods may also be limited by lack of immediately availability, lack of a skilled operator, and the time required for setup. Forceps, cryotherapy and other specialized bronchoscopic equipment may not be readily available in the intensive care unit, and the techniques often require several passes over the course of several minutes or longer for clot removal. Likewise, local treatment topical thrombolytics may require serial dosing over 5–10 minutes to be effective (3).

The meconium aspirator is frequently utilized to remove meconium from the tracheobronchial tree of neonates on delivery wards and in the emergency department (4). Prekker *et al.* also reported the use of a meconium aspirator as a rapid way to convert an in-situ ETT into a large bore suction catheter for removal of an obstructing tracheal food bolus (5). This technique has also been shown to be superior to simple Yankauer suction instruments at removing liquids of various viscosity during emergent endotracheal intubation (6). In this case report, we present the novel use of a meconium aspirator in an adult intensive care unit to successfully manage life-threatening tracheal obstruction due to a blood clot. We present this article in accordance with the CARE reporting checklist (available at <https://amj.amegroups.com/article/view/10.21037/amj-23-66/rc>).

Highlight box

Key findings

- A meconium aspirator was successfully utilized to convert an *in situ* endotracheal tube (ETT) into a large bore suction catheter to relieve a complete tracheal obstruction from a blood clot.

What is known and what is new?

- Meconium aspirators are commonly used in neonatal resuscitation to remove thick meconium from the airways. One case report describes the use of meconium aspirator to remove an obstructing food bolus from the airway.
- Use of a meconium aspirator has not been previously reported in the medical intensive care unit, nor has it been reported to successfully remove a blood clot causing complete tracheal obstruction.

What is the implication, and should change now?

- A meconium aspirator can be easily used to convert an existing ETT to a large bore suction catheter to relieve acute, life-threatening airway obstructions. This may be quicker, safer, and more effective than traditional techniques.

Case presentation

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patients for publication of this case report and accompanying images. A copy of the written consent is available for review by the editorial office of this journal.

A non-domiciled 53-year-old White male with active intravenous drug use and chronic hepatitis C presented to the emergency department with fever, altered mental



Figure 1 Bronchoscopy view of clot located just distal to tip of the endotracheal tube causing intermittent ball-valving effect.

status, and abdominal pain. He was initially diagnosed with undifferentiated sepsis, resuscitated with intravenous fluids, and treated with intravenous vancomycin and piperacillin-tazobactam. On the day of admission, computed tomography (CT) imaging of the abdomen revealed a perforated duodenal ulcer. He underwent emergent exploratory laparotomy with Graham patch repair. He was extubated post-operatively and admitted to the intensive care unit. Blood cultures drawn on admission began growing methicillin sensitive *Staphylococcus aureus* (MSSA) and *Escherichia coli*. Subsequent cultures continued to grow MSSA. On hospital day (HD) 4, transthoracic echocardiography revealed extensive tricuspid valve endocarditis and chest CT demonstrated diffuse septic pulmonary emboli. Over the ensuing 5 days, the patient had progressive respiratory failure requiring escalation from simple nasal cannula to high flow nasal cannula. He required endotracheal intubation on HD 9. Shortly after intubation, he was noted to have secretions streaked with blood. This continued overnight until he acutely developed large-volume hemoptysis early in the morning on HD 10. Within one hour of large-volume hemoptysis, he developed abrupt airflow obstruction and refractory hypoxemia. At that time, tidal volumes dropped to 20–30 mL and pressure-volume curves on the ventilator suggested complete airflow obstruction. An obstructing blood clot was suspected. Nursing and respiratory therapy staff were asked to obtain a flexible bronchoscope, a meconium aspirator and additional items from the unit's airway supplies.

Over the next two minutes, numerous interventions

were taken. The patient was immediately disconnected from the ventilator and deep endotracheal suctioning was attempted. The suction catheter was met with firm resistance near the distal end of the ETT. The patient was then deeply sedated and paralyzed. Manual ventilation with an Ambu bag (Ambu Inc., Columbia, MD, USA) was attempted. High airway pressures were noted with manual ventilation and oxygen saturations dropped to the mid-70's. A flexible bronchoscope (Ambu Inc., Columbia, MD, USA) was rapidly passed into the ETT. Firm resistance was met near the distal end of the ETT and the camera view was completely obstructed with blood.

At this point, we presumed that the ETT was completely occluded by a blood clot and that we may be able to remove it by removing the existing ETT. Over the subsequent two minutes several more actions were taken. The patient was extubated and then immediately re-intubated with a new ETT using video laryngoscopy and a bougie. No clot was removed during this process, and the patient's clinical condition remained unchanged. At this time, we suspected primary tracheal obstruction due to the blood clot as it was not removed during extubation. Bronchoscopy through the new ETT then revealed a large clot intermittently occluding the end of the ETT in a "ball valve" manner (*Figure 1*). As expected, bronchoscopic suctioning again failed to dislodge the clot.

At that time, a meconium aspirator (Neotech, Valencia, CA, USA) was brought to the bedside. It was attached to the *in situ* ETT and connected to wall suction (*Figure 2A*) within seconds. Suction was engaged by occluding the meconium aspirator suction control port. A large portion of clot was sucked into the suction tubing and additional clot was seen in the ETT. The visualized clot was removed with the ETT en bloc by extubating the patient (*Figure 2B*). Following immediate re-intubation with a new ETT, manual ventilation was easily performed, and the patient stabilized from a hemodynamic and respiratory perspective. Repeat bronchoscopy demonstrated removal of the tracheal clot with remaining, non-occlusive clot in the right mainstem bronchus. The patient then underwent successful right-sided bronchial artery embolization. The remaining clot burden was removed with cryotherapy later the same day. He did not have any subsequent episodes of hemoptysis and no complications from the use of the meconium aspirator were identified.

The patient ultimately required tracheostomy placement after failed extubation attempt for recurrent respiratory failure due to difficulty managing secretions. He was

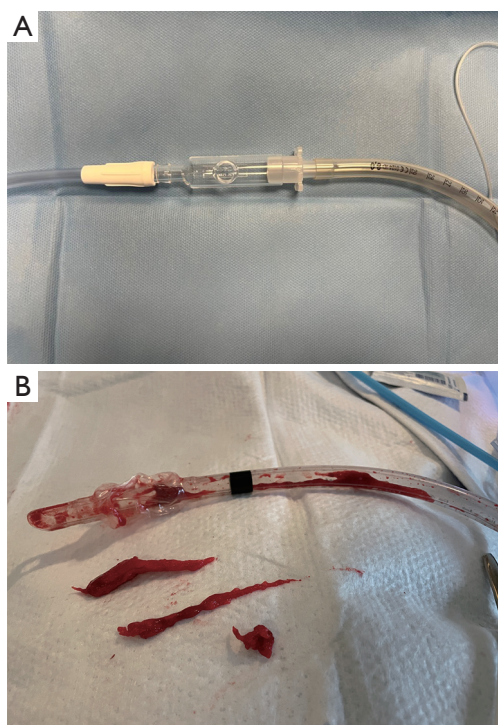


Figure 2 Adaptation of endotracheal tube and meconium aspirator for use as large bore suction. (A) Endotracheal tube connected to a meconium aspirator and wall suction. The circular port of the meconium aspirator can be occluded with the operator's hand to engage suction. (B) Clots removed using the meconium aspirator and in situ endotracheal tube.

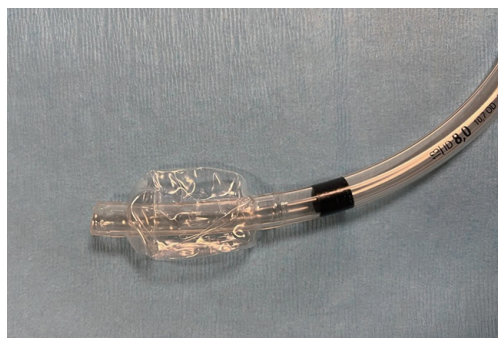


Figure 3 Modified endotracheal tube cut between Murphy eye and cuff. The removal of the Murphy eye allows for better engagement of the foreign body with the suction mechanism.

discharged in stable condition to a long-term acute care hospital for rehabilitation and medical optimization prior to planned valve replacement surgery. Unfortunately, after discharge from the rehabilitation facility, he continued

to struggle with substance use and ultimately died approximately 6 months later from unknown causes.

Discussion

Vacuum extraction with a meconium aspirator attached to the *in situ* ETT was effective in reversing life-threatening airway obstruction from a blood clot in this patient. To our knowledge, the use of a meconium aspirator for reversal of lower airway obstruction caused by a blood clot has not been described in the adult critical care literature.

Meconium aspirators are commonly used in neonatal resuscitation to remove thick meconium from the lower airways (4). The technique has also been promoted to clear airway obstructions in adult patients (5,7). The original technique requires the ETT to be cut between the cuff and the Murphy eye, allowing for a direct seal to the foreign body (7) (Figure 3). We connected the meconium aspirator to the *in situ* ETT without modification, accelerating assembly. This was successful because either the blood clot or tracheal wall occluded the Murphy eye allowing the wall suction to bring the clot into the ETT. If we had been unable to remove the clot, we would have attempted again with a modified ETT.

It is important for critical care physicians to rapidly intervene in the event of lower airway obstruction. Bodenham reported a technique like ours in which a Y-adaptor was attached to an *in situ* ETT to remove an obstructing blood clot (8). While this may be an alternative to our technique, most readily available Y-adaptors do not fit snugly within standard 15 mm ETT connectors. Dongelmans *et al.* also reported a technique utilizing “whole tube suction” where an ETT was advanced over a flexible bronchoscope and utilized to directly engage the blood clot (9). The tube was then connected directly to wall suction while the tube was gradually withdrawn, extracting the clot from the airway. While this was successful in their case (9), the meconium aspirator offers more secure attachments between the ETT and suction tubing. Traditional wall suction tubing does not fit over the 15 mm ETT adaptor. The meconium aspirator also includes the option to control timing and strength of the suction by fully covering, partially covering or uncovering the side port. Other methods to relieve lower airway obstruction include bronchoscopy with suction, instrumentation or cryotherapy, or passage of Magill forceps or an oral suction catheter into the airway (1,7). However, in life-threatening scenarios, advanced bronchoscopic methods can be too

time consuming as equipment may not be readily available and may require multiple attempts. Magill forceps may be utilized in scenarios in which a foreign body is visualized just below the vocal cords, but the technique has limited utility with more distal objects or objects with soft consistency (7). Similarly, the curvature of oral suction devices may not reach a more distal tracheal foreign body. For these reasons, we believe the use of a meconium aspirator and large bore ETT is the best method for relieving complete tracheal or ETT obstruction by amenable objects.

This technique, however, should be reserved for true airway emergencies. High-pressure suction applied to the ETT may cause damage to the tracheal wall, atelectasis or airway collapse, negative-pressure pulmonary edema, and new or worsened pulmonary hemorrhage (4). The meconium aspirator has a side hole that allows users to intermittently engage suction, which may limit suction-related complications. In the event of an airway emergency, these risks are secondary.

Conclusions

We present a technique using a meconium aspirator attached to wall suction and an *in situ* ETT for removal of a blood clot causing tracheal obstruction. Assembly of the device is rapid, and the necessary equipment can easily be stocked on airway carts. The same technique can be attempted for other causes of tracheal occlusion such as aspirated foreign bodies and food impactions.

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Footnote

Reporting Checklist: The authors have completed the CARE reporting checklist. Available at <https://amj.amegroups.com/article/view/10.21037/amj-23-66/rc>

Peer Review File: Available at <https://amj.amegroups.com/article/view/10.21037/amj-23-66/prf>

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Registry]. The other author has no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patients for publication of this case report and accompanying images. A copy of the written consent is available for review by the editorial office of this journal.

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