Complete airway obstruction by foreign body: another anesthetic challenge. A brief review

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Abstract

In this brief review we present the challenging management of complete airway obstruction by foreign body, from the anesthesiologist’s point of view. A case report is followed by a description of the clinical picture of airway obstruction and its management including the use of some nonconventional management alternatives. The review is concluded by proposing an airway obstruction management algorithm.

Note: this brief review will not include any discussion on the complete airway obstruction resulting from a failed intubation – ventilation scenario caused by difficult airway.

Keywords: airway obstruction, foreign body, management algorithm

Introduction

Foreign body aspiration (FBA) is a life-threatening emergency that requires prompt removal of the foreign body (FB), which occasionally may remain undetected due to atypical history or misleading clinical and radiological findings. Up to 2000 deaths from foreign body aspiration (4% of the total amount of FB aspiration) are reported annually in the USA [1-3]. Most cases of FB aspirations in adults occur due to failure of airway protection caused by neurological disorders, or decreased level of consciousness such as it occurs with deep sedation or general anesthesia without airway protection by an endotracheal or a tracheostomy tube [2, 4]. About 20% of the aspirated FB will lodge in the larynx or trachea, 30% in the left bronchus and 50% in the right bronchus [1-3].

A study by Baharloo et al. [4] showed that in contrast to the adult group, the majority of the FBs in children were lodged in the proximal airways, possibly because of the smaller bronchial tree diameter in this age group. Twenty six percent of the FBs in children were localized in the more distal and lobar bronchi. Unlike the common belief that in children FBs are lodged preferentially in the right bronchial tree because of its more vertical disposition [5], it was shown that this was the case only in the adults, while in children FBs may be found in either side [4].

The incidence of foreign body aspiration during deep sedation or anesthesia is unknown.

Report of an imaginary case

A 40- y.-old healthy male was admitted to an in-hospital dental clinic for extraction of a molar tooth and reposition of a dislodged, two unit porcelain fused to metal bridge. Besides local anesthesia, the patient also requested sedation which was provided with 3 mg of midazolam and 100 μg of fentanyl administered intravenously. The patient’s vital signs were monitored with ECG, pulse oximetry and non-invasive blood pressure measurement. One minute after the extraction
of the molar tooth, during the reposition of the bridge, it suddenly fell into the patient’s mouth. A few seconds later, the patient became agitated and cyanotic. He was unable to speak and was holding his neck with both hands. The pulse oximeter showed an oxy-hemoglobin saturation of 70%, the heart rate was 150 bpm and the blood pressure 180/95 mmHg. About a minute later the patient lost consciousness. With the suspicion of tooth inhalation the managing team started performing abdominal thrusts to help dislodging the FB. This proved to be unsuccessful. The patient’s trachea was easily intubated but ventilation was impossible and the patient went into an asystolic cardiac arrest. During the intubation, no FB could be seen in the larynx or elsewhere. Cardiopulmonary resuscitation (CPR) was started and simultaneously rigid bronchoscopy was performed revealing that the bridge was impacted at the level of carina making ventilation of both lungs impossible. The otolaryngologist (ENT surgeon) was unable to dislodge the FB by either trying to extract it or pushing it into a main bronchus. Trials to push a pediatric ventilating tube exchanger or a 4 mm long microlaryngeal tube or a standard 3 mm cuffed endotracheal tube (ETT) beyond the FB were also unsuccessful.

As a life-saving measure, within minutes, the cardiac surgical team who was present at the scene connected the patient to an Extracorporeal Oxygenator (ECMO) machine. The venous and the arterial cannulae were inserted into the femoral vein and femoral artery, respectively.

Subsequently, the FB was extracted with a larger rigid bronchoscope. The patient was discharged from the hospital seven days later with residual neurologic impairment.

Several questions could be asked regarding the management of this case:

1. Was an anesthesiologist present in the OR during the administration of sedation? If not, was the team certified to provide sedation and cardiopulmonary resuscitation?
2. Was there a dedicated person for monitoring besides the dentist who performed the dental extraction?
3. Were the sedative drugs administered in a titration fashion rather than a single bolus?
4. What was the depth of sedation? Is deep sedation, even in the presence of an anesthesiologist acceptable, without securing the airway with an endotracheal tube, in upper airway procedures including dental surgery?

However, in this review we will discuss only the issue of complete airway obstruction.

**Reasons for airway obstruction during anesthesia**

The following conditions may lead to the development of partial or complete airway obstruction during anesthesia:

- Airway collapse during induction of anesthesia culminating in failed intubation & ventilation as well as airway collapse during anesthesia without endotracheal intubation or after extubation at the end of anesthesia.
- Anesthesia of a patient with an anterior mediastinal mass leading to central airway obstruction and inability to ventilate the patient despite successful intubation.
- Foreign body aspiration.

**Clinical presentation of airway obstruction**

The clinical picture of the acute FB aspiration depends on the degree of obstruction and the location of obstruction (Table 1). Complete obstruction at the larynx is more frequent than complete airway obstruction below the glottis.

It should be remarked that a partial obstruction can convert to a complete obstruction by dislodgement of the FB caused by body position change.

**Management guidelines**

1. Apply European Resuscitation Council (ERC) or American Heart Association/Advanced Cardiac Life Support AHA/ACLS foreign body removal guidelines including Heimlich maneuver [6, 7].
2. If this fails, follow the steps as described by Stewart et al. [8] or other maneuvers/procedures as

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<th>Table 1. Symptoms and signs of FB airway obstruction*</th>
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<tr>
<td><strong>Incomplete obstruction</strong></td>
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<tr>
<td>Able to speak, breathe and cough</td>
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* depending on the degree of obstruction and location of the FB
Complete airway obstruction by foreign body

described below. With complete airway obstruction and failed Heimlich maneuver:

- try to avoid mask ventilation before performing laryngoscopy, if possible;
- with laryngeal FB, try to extract it with Magill forceps and if this fails proceed with surgical airway;
- with tracheal or carinal FB, push the FB into a bronchus and then perform bronchoscopy;
- if ventilation through an ETT is impossible perform down/up maneuver with the ETT to pass through a soft FB or push a solid FB into a bronchus and if successful, perform bronchoscopy;
- if ventilation is still impossible, try to pass a long, 4 mm microlaryngeal tube or a standard 3 mm cuffed ETT or a pediatric ventilating tube exchanger or a gum-elastic bougie beyond the FB into one of the bronchi and ventilate the lung;
- if ventilation is still impossible, with bilateral hyperinflation, suspect a bilateral pneumothorax and perform bilateral needle thoracostomy (ball-valve effect) [9].

Some important issues should be remembered in regard to the management of FB airway obstruction [7]. First, management approaches are based on anecdotal reports and are not evidence based. Secondly, sticky materials are removed with difficulty by Heimlich maneuver and even by bronchoscopy. Thirdly, abdominal thrusts to dislodge the FB are contraindicated in pregnancy and children less than 1 year of age. Furthermore, blind finger sweeps should be avoided.

**Failure to relieve a complete airway obstruction**

In this rare situation, tracheostomy may save the patient’s life if the FB is located at the glottis or supraglottic and if all the other management maneuvers have failed. If the FB is situated in the trachea or at the carina and cannot be removed or moved in either direction, resulting in complete lower airway obstruction, live-saving ECMO should be quickly instituted.

Extracorporeal Oxygenator (ECMO) has been extensively used in pediatric cardiac surgery and other life threatening conditions as a last resort, life-saving treatment [10-12].

ECMO or full cardiopulmonary bypass has been also used for preventive or emergency management of complete “central airway” obstruction with acute airway collapse, in pediatric and adult patients with anterior mediastinal masses of various origins [13-16] (Fig. 1).

![Fig. 1.](image_url)

Fig. 1. a. Chest radiography of a 51 year old female patient, admitted to the emergency department due to severe dyspnea and stridor. The picture demonstrates a large posterior mediastinal mass; b. Computed tomography of this patient after intubation successfully performed only with a 5 mm ID endotracheal tube. The picture demonstrates a large posterior-middle mediastinal mass with mediastinal deviation, compressed trachea intubated by a small endotracheal tube and deviated esophagus with nasogastric tube; c. Computed tomography of the patient with the mediastinal mass, nearly occluded trachea beneath the endotracheal tube; d. Computed tomography of the patient with the mediastinal mass with right upper lobe passive atelectasis.)
ECMO has also been rarely used for management of airway collapse due to FB aspiration [17-21].

As shown in these articles, if instituted early enough, ECMO may save the patients’ lives and moreover may diminish the risk of residual brain damage.

Algorithm for management of FB airway obstruction (Fig. 2)

Considering the complexity of some of the cases and the need for rapid intervention, we believe that an airway management algorithm must guide the clinician under such critical circumstances. Airway management algorithms may help clinicians in solving specific clinical scenarios and enable an organized approach with multiple back-ups. However they should be simple and should use a stepwise decision making.

Conclusions

Complete airway obstruction due to foreign body aspiration is a challenging, life-threatening condition necessitating prompt intervention. If conventional therapeutic means fail, nonconventional interventions should be considered such as placing the patient on extracorporeal membrane oxygenator.

Conflict of interest

Nothing to declare

References

Obstrucția completă a căii aeriene prin corp străin: o provocare anestezică.

Rezumat

În acest scurt referat sunt prezentate din punctul de vedere al anestezistului dificultățile tratamentului în obstrucția căii aeriene prin corp străin. Prezentarea unui caz este urmată de descrierea tabloului clinic al obstrucției căii aeriene și a tratamentului acesteia, incluzând utilizarea unor alternative terapeutice neconvenționale. Referatul se încheie cu un algoritm al tratamentului obstrucției căii aeriene. Notă: acest scurt referat nu include discutarea obstrucției complete a căii aeriene în cadrul scenariului intubație – ventilație imposibilă produsă de o cale aeriană dificilă.

Cuvinte cheie: obstrucția căii aeriene, corp străin, algoritm de tratament