

Airway Obstruction by a Mucous Plug in a Ventilated Child A Case Review

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Received: 30 Apr 2021

Accepted: 19 May 2021

Published: 25 May 2021

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Citation:

Che Omar SB et.al. Airway Obstruction by a Mucous Plug in a Ventilated Child A Case Review. J Clin Med Img 2021; V5(9): 1-4.

1. Abstract

Mucus plugs can partially or completely obstruct one or more airways and cause serious consequences, including atelectasis. Invasive ventilation increases the risk for mucus plug formation, since mucociliary clearance is impaired in the presence of the endotracheal tube and because relatively dry gases cause mucosa to produce more mucus. Moreover, ineffective coughing resulting from depressed levels of consciousness, sedation, and paralysis, together with weakness before extubation, is another reason why invasively ventilated patient is at increased risk for airway obstruction due to mucus plug.

2. Introduction

In a ventilated patient, occlusion of airway is life-threatening event [1,2]. Since air movement is disrupted, rapid desaturation will prevail. It is important to detect the obstruction and remove it. If there is an obstruction, ventilation is only possible using high inspiratory pressures, which may cause a variety of complications. Although mechanical ventilation is lifesaving in critical patients in the Intensive Care Unit (ICU), it can sometimes lead to profoundly serious life-threatening complications [2]. In this review, will present a case on difficulty occurred in ventilation management due to mucosal plug in the bronchus. Thus, it is aimed to draw attention to the importance of bronchoscopy especially in intubated patients during treatment in ICU.

3. Case Report

A one year two months old boy presented with alleged fall. Post trauma, child was less responsive brought to nearest clinic and subsequently transferred to HUSM. While transferring child had

multiple episodes fitting, aborted with intravenous Diazepam. On arrival to ED HUSM, the child's GCS was E1V1M3, successfully intubated at 3rd attempt. Chest Xray done post intubation showed the endotracheal tube in situ and the lung fields are clear.

On systemic review, there were not any significant extracranial injuries. CT brain showed right acute subdural Hematoma with mass effect and significant midline shift. Hence, the child underwent a decompressive craniectomy, evacuation of blood clot and Intracranial pressure monitor device insertion. The procedure was uneventful. Post operatively, child required Hyperosmolar therapy followed with Thiopental coma for refractory raised ICP. Child was successfully completed Cerebral resuscitation and planned for weaning with trial of CPAP.

However, on the same day evening child had desaturation episodes with hypersecretion. Clinically, child was tachypneic with desaturation down to 94%, on lung auscultation generalized rhonchi and ABG showed mixed respiratory and metabolic acidosis and high anion gap. Repeated chest x-ray showed there were left upper and middle lobe collapse (Figure 1).

Child was managed with positioning done as left side up, sedated, bronchodilators given, and ventilation adjusted to high with Fio2 60%, and able to slowly wean. Patient also complicated with hyponatremia and was ongoing fluid correction as per Pediatrics endocrine team management. As child improving clinically, required low ventilator setting ventilation. Repeated chest x-ray showed improvement of the left lung. However, Child were subjected for tracheostomy in view of poor conscious recovery. After the procedure, child's ventilation improved and again planned for weaning from the ventilation (Figure 2).

On day four post tracheostomy, child developed another episode of desaturation. Clinically Vitals not supported with saturation down

to 94%. Right chest reduced movement and reduced air entry over right lung. Repeated chest x-ray showed right lung collapse (Figure 3).

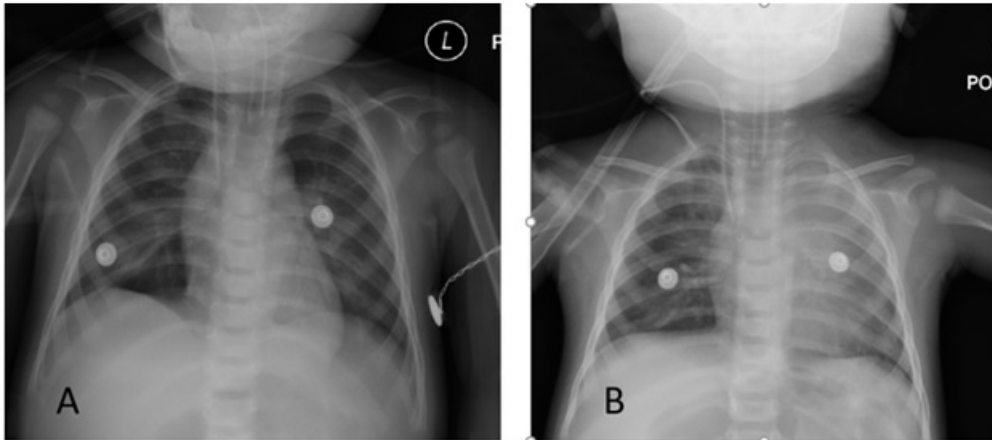


Figure 1(Chest x-ray AP view): A: Initial scan bilateral lung field are clear and symmetrical. B: Collapse of Left upper and middle lobe.



Figure 2(Chest x-ray AP view): Chest x-ray done after tracheostomy.

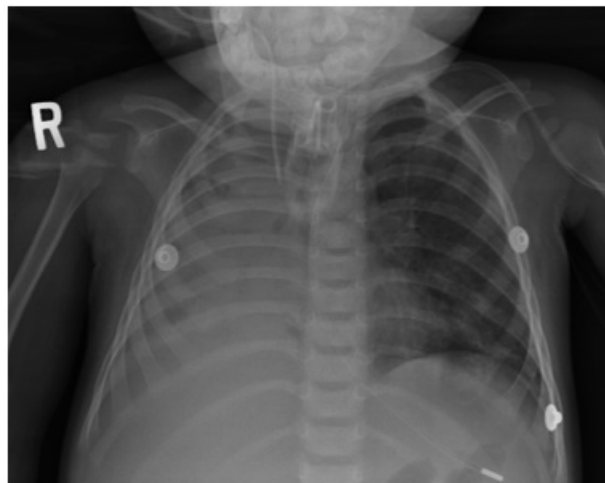


Figure 3(Chest x-ray AP view): Repeated chest Xray on 2nd event.

Suspected one lung ventilation. Hence, Bedside Flex scope done by ORL team noted crusting with mucus plug over right main bronchus with unhealthy mucosa. Left bronchus patent. However, unable to remove the plug via bedside suctioning. Hence planned for direct laryngoscopy and bronchoscopy in operation theater. On the other hand, child developed Isolated Thrombocytopenia with platelet down to 22. Platelet transfusion done. Platelet numbers are improved. Hematologist were consulted and blood investigations sent as per their suggestion. indeed, planned for procedure under platelet cover. Prior to procedure, patient's condition deteriorated further with bleeding from tracheostomy tube and desaturation. Child was desaturated down to 65% subsequently asystole. Cardiopulmonary resuscitation commenced but unable to revive the child.

4. Discussion

Mucus is a soft (deformable) substance made up of 97% of water and 3% of solid compounds (mucin, non-mucin proteins, salts, lipids, and cellular residues). It has the properties of an elastic solid and a viscous liquid. However, the composition of mucus can be altered by pathologic processes that cause stagnation of flow and blockage within the tracheobronchial tree. Mucin hypersecretion or irregularity of surface fluid volume can increase the solids concentration by up to 15% [4]. If mucus hypersecretion is not associated with increased mucus clearance, it leads to the accumulation of mucus in the airway [5]. This is known as mucus plug and this leads to obstruction of many airway lumens, local atelectasis, linear and branched opacity appearance on direct chest X-rays, luminal filling in proximal airways or tree bud opacities in peripheral airways on computed tomography [4]. Moreover, mucus hypersecretion increases morbidity and mortality by increasing susceptibility to respiratory infections as well as airway obstruction [5]. Mucus plugs are a serious problem in patients with intubation and patients with impaired lung mechanism due to stroke, immobilization, or surgery.

Fiberoptic bronchoscopy is known to be used in diagnostic and therapeutic in ICU. The common indications for fiberoptic bronchoscopy in patients were focal or diffuse infiltration with unknown cause in 35 (34.3%) cases, pneumonia in 34 (33.3%) immunosuppressed cases, pneumonia developed in hospital in 24 (23.5%) cases, aspiration requirement in 19 (18.6%) cases and atelectasis in 18 (17.1%) cases. It was reported that the frequent findings of fiberoptic bronchoscopy were infection in 58 (56.9%) cases, alveolar hemorrhage in 11 (10.9%) cases, plug suggesting fungal infection in 10 (9.8%) cases and mucus plug in eight (7.8%) cases [6]. In different study including 4098 patients, in 5.8% of the flexible fiberscope bronchoscopies performed for therapeutic purposes, airway patency was corrected due to respiratory failure and

atelectasis from mucous plaques was treated [7]. In another study involving 208 flexible bronchoscopies in the ICU, it was found that the most common therapeutic indication was the resolution of atelectasis and its most common cause was mucus plugs [8].

Particularly in long hospital stay patients, regular tracheal aspiration as well as flexible bronchoscopy is important in preventing mucus plug formation. The presented case was treated in ICU as intubated and connected to the mechanical ventilator and died in 18th days of treatment. The bronchoscopy revealed mucus plugs that were localized in the right main bronchus and left bronchus is patent [9]. According to patient records, there were a previous incident of left upper lobe and middle lobe collapse. This raises the suspicion of the possibility of the migration of the mucus plug from left lung to right. If it is so, it could be the first rare case of mucus migration from left lung to right. There is no related literature or care review on mucous migration from one bronchus to contralateral bronchus. However, there is a case review of foreign body dislodge and entered the contralateral bronchus during the extraction process using bronchoscopy [10]. During the procedure patients position slightly tilted up during at the location of foreign body might cause the translocation due to gravity. Related to the patient, he was placed left side up on initial event left lung collapse and subsequently developed right lung collapse. Although bronchoscopy showed that the mucus plug closes the right main bronchial entrances, oxygen saturations were in normal limits. It was thought that the presence of oxygen saturations in normal limits could be due to the gaps in the edge of the mucus during inspiration and expiration movements, thus providing air passage.

Bronchoscopy application for patients treated in ICU is not commonly used in our country. Therefore, bronchoscopy was not performed routinely in the presented case. It was observed that the case was intubated because he had reduced consciousness, after his surgery he was admitted to the ICU. His general condition was improved. However, with optimal treatment he was unconscious, and GCS was low until his death due to traumatic brain injury. It is useful to evaluate the indication of bronchoscopy case to case basis and with better general condition and hope for recovery.

In conclusion, as always prevention is better than cure. So, initial management to prevent the mucus plugs involve proper hydration, humidification, bronchodilation, and use of mucolytic agents via nebulization [11]. If there is difficulty in ventilating patient and clinically suggestive of airway obstruction, flexible bronchoscopy may be required. If performed, flexible bronchoscopy may also provide diagnostic information and for therapeutic management. Although most plugs are extractable to suction techniques, tenacious mucus plugs can be difficult to aspirate, requiring advanced bronchoscopy measures.

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