Severe Sand Aspiration: A Case Report with Complete Recovery

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A 5-year-old boy, previously healthy, was admitted to Ratchaburi Hospital after being buried in a sand pile. He presented with dyspnea and tachypnea. Chest radiograph showed opaque particles in both main and segmental bronchi (sand bronchogram). The first attempt of bronchoscopy was unsatisfactory as a considerable amount of sand particles had migrated further into the distal bronchi. A second bronchoscopy was performed with 0.9% saline lavage. Most of the sand particles were successfully removed. Intravenous steroids and antibiotics were administered for treatment. The patient was discharged uneventfully by the end of the first week of hospitalization

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Foreign body aspiration (FBA) can be life-threatening and is regarded as a significant cause of fatal home accidents in children younger than 6 years[1].Most frequently aspirated objects are food, which involved in 75% of the cases; other organic material in 7%; non-organic material, such as metals and plastics in 13%, rock in 1% and toys or parts of toys in 1%[2]. There have been few documented cases of sand aspiration. The authors describe a rare case of life threatening condition following sand aspiration that became lodged in both main and segmental bronchi, which required emergency airway management and bronchoscopic removal of sand particles.

Case Report

A five year-old boy who was previously healthy (HN-544504-45), was seen at the emergency room one hour after being accidentally buried in a sand pile at a construction site. He was alert but dyspneic and tachypneic. There was sand in the mouth and nostrils. He also coughed up sputum containing sand particles of various sizes. There was no apparent superficial injury. Respiratory rate was 30 per minute, pulse rate of 130 beats/minute and blood pressure of 63/27 mm Hg. He developed severe respiratory distress and cyanosis. Endotracheal tube was inserted in the emergency room and he was admitted to the pediatric ICU for mechanical ventilation. Chest radiograph (Fig. 1) showed non-homogeneous opacity in the main and segmental bronchi (sand bronchogram), and in the stomach. Arterial blood gases analysis, reflecting combined severe acute respiratory acidosis, mild metabolic acidosis, marked alveolar hypoventilation and mild hypoxemia, revealed pH of 6.901, $PaCO_2$ of 150.5 mm Hg, PaO_2 of 84.7 mm Hg, oxygen saturation of 85.4% and HCO_3^- of 30.3 m mole/L (FiO_2=1).

Rigid bronchoscopy was performed revealing sand particles filling both main bronchi and beyond. The bronchial mucosa was markedly erythematous and diffusedly inflamed. Sand particles were removed using foreign body forceps and suctioning. However, a lot more unrecoverable fine sand particles were left. The patient was intubated and mechanically ventilated in the ICU. During 3 hours of close observation in the ICU, there was no satisfactory improvement. The authors proceeded to do a second bronchoscopy. It was carried out under

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Fig. 1 Sand Bronchogram (white arrow) and sand in the stomach (black arrow)

general anesthesia. The bronchi were repeatedly lavaged using 200 ml of 0.9% saline solution to facilitate suctioning. The larger pebbles were removed by foreign body forceps. Ventilation to both lungs was improved considerably. After removal of the bronchoscope, the anesthetist maintained the airway with an endotracheal tube. He was observed in the pediatric ICU for 6 hours.

It took 7 hours from the time of sand aspiration until completion of the second bronchoscopy. Chest radiograph (Fig. 2) showed much improvement. Arterial blood gases values were pH of 7.421, $PaCO_2$ of 33.3 mm Hg, PaO_2 of 391.8 mm Hg, O2 saturation of 100.0%, HCO_3^- of 21.7 m mole/L ($FiO_2 = 1$). Broad-spectrum antibiotics (Cefotaxime and Netilmicin sulfate) were given preoperatively and continued to the 7th day of hospitalization. Intravenous steroid was given for the first 2 postoperative days to prevent subglottic and bronchial edema. His breath sound was normal on the 7th day of hospitalization. He was discharged at the end of the first week without any complication. He has remained well without any symptom at the last follow up 15-month visit. CXR showed normal lung expansion with mild peribronchial thickening (Fig. 3).

Discussion

Sand aspiration is a rare condition but a serious life-threatening condition that requires special attention of parents and medical teams. Initial management of the patient who has aspirated sand particles should aim at establishment of adequate ventilation and oxygenation. The patient with sand in his mouth and pharynx should be regarded as having airway obstruction. Attempts should be made to dislodge it by back blow or abdominal thrusts and removal of sand particles by direct laryngoscope, then proceed to endotracheal intubation and ventilation with 100% of O_2 and bronchoscopy and BAL for the removal of sand particles if indicated.

Only 6% to 17% of aspirated foreign bodies are radio-opaque, appropriate radiological studies localize the site of the foreign body in the majority of cases[3] but sand particles are radio-opaque material which CXR demonstrated sand bronchogram within

Fig. 2 CXR after bronchoscopy and bronchoalveolar lavage

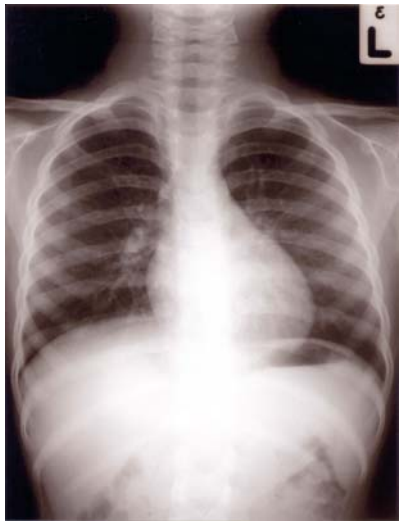

Fig. 3 CXR at the follow up 15-month visit showed normal lung expansion with peribronchial thickening

both main bronchi, segmental bronchi and in lower lobes of both lungs.

The rigid ventilating bronchoscopy is the treatment of choice for sand aspiration that causes respiratory compromise. It is safe, facilitates control of the airway, provides good visualization and allows manipulation with a wide variety of forceps and suction instruments. However, removal of fine sand particles is very difficult. In this case, both main and segmental bronchi were bronchoalveolar lavaged with 0.9% saline solution after forceps extraction of large particles.

There are few published reports detailing the presentation and management of such patients. The first description of sand aspiration in 1962 in the medical literature in which Imburg J[4] described a drowning victim who was difficult to ventilate during cardiopulmonary resuscitation and whose mouth and pharynx were obstructed by sand. With these drowning and near drowning events, it has been reported that there is a 60% frequency of some mud, sand, or aquatic vegetation aspiration.

Mellen JD[5] reported four cases of sand and gravel aspiration after accidental burial in sand. In the three, the patients required emergency airway management followed by bronchoscopy for removal of aspirated material. Another patient, who was a child, recovered after supplement oxygen and chest physiotherapy. In each case the chest X-ray demonstrated sand bronchogram. In one patient, cardiopulmonary by pass during bronchoscopy was beneficial in facilitating the removal of sand material.

Donnie P and Joseph E[6] reported sand aspiration during drowning in a riverbed. The patient was unresponsive and required endotracheal intubation, endotracheal suction yielded large amounts of sand and gravel. After repeated suctioning (six times) and removal of the foreign material, peak airway pressures decreased. Bronchoscopy was performed with BAL with 0.9 % saline. The cytopathologic review of BAL fluid demonstrated heterogonous inorganic, and plant material.

Sand aspiration is probably underdiagnosed and should be suspected in patients being treated for accidental burial or near drowning. Initial clues to significant aspiration include increased peak airway pressures and radiodense linear opacities or "sand bronchogram" on chest radiography. This term was defined by Bonilla-Santiago, et al who reported two cases with sand aspiration. Both patients had sand filling the bronchial tree demonstrating radiodense linear opacities or radiodense materials lining the central tracheobronchial tree[7].

Although a relatively uncommon occurrence, sand aspiration should be excluded because of the spectrum of injuries it may produce. Acute respiratory failure secondary to inadequate ventilation may develop if the oropharynx and upper airway are occluded by sand. Damage to the bronchioles and alveoli can result in significant airway inflammation. Sand particles can be removed from tracheobronchial trees bronchosopically. The complication rate increases as the time to the diagnosis and extraction of the foreign bodies exceeds 24 hours. Prompt endoscopy in patients with suspected bronchial foreign bodies will result in fewer complications and fewer missed foreign bodies[8]. Early and adequate sand extractions from the tracheobroncheal trees must be performed to prevent early and late complications.

Conclusion

Sand aspiration is rare but a serious life-threatening situation. Initial management is adequate ventilation and oxygenation. Treatment of victims ranges from conservative to very aggressive. In general, if the patient is stable and alert, they may be treated conservatively with postural drainage and bronchodilators. While being observed in the intensive care unit; however, more aggressive treatment including bronchoscopy, BAL is warranted if they demonstrate any sign of acidosis or respiratory compromise. In cases of severe airway injury, the cardiopulmonary bypass may be used for patient support.

A 5-year-old boy sustained massive sand aspiration following accidental burial. Treatment consisted of immediate airway management that included endotracheal intubation and rigid ventilation bronchoscopy for removal of sand particles and BAL. The authors suggest bronchioalveolar lavage with 0.9% saline after extraction of the foreign bodies was useful in a small particle foreign body such as sand, nutty substance, bean and organic vegetable matter. Sand particles are removed as much as possible in 24 hr after aspiration to prevent early and late complications. The complications such as recurrent pulmonary infection, hemoptysis, lung abscess, fibrotic scar formation, bronchiectasis must be followed up. Antibiotic therapy is useful for bacterial infection. The use of steroids is controversial but may be beneficial in cases with subglottic and bronchial edema.

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สำลักทราย : รายงานการรักษาผู้ป่วยภาวะวิกฤติจากทรายเข้าทางเดินหายใจ 1 ราย

ชนินทร์ กลิ่นจงกล, สุรชัย เกียรติชัยพิพัฒน์, สมชาย เทพเจริญนิรันดร์

รายงานผู้ป่วยเด็กชายอายุ 5 ปี ได้รับอุบัติเหตุล้มลงในกองทรายและสำลักทรายเข้าทางเดินหายใจส่วนล่าง ผู้ป่วยมาด้วยอาการเหนื่อยหอบ หายใจลำบากได้รับการตรวจเอกซเรย์ปอด พบว่ามีทรายในหลอดลมทั้งด้านขวาและซ้าย (sand bronchogram) ได้ตรวจด้วยกล้องส่องหลอดลม (rigid bronchoscopy) เพื่อการรักษาในครั้งแรก พบทรายในทางเดินหายใจส่วนล่างของหลอดลมทั้งสองข้าง ได้นำทรายออกจากหลอดลมโดยการใช้คีม และการดูดออก (bronchial suction) พบว่าเม็ดทรายเล็กๆจะแทรกลงไปในส่วนลึกของหลอดลม ต้องทำการล้างหลอดลมและปอด (bronchoalveolar lavage) ด้วย NSS จึงประสบความสำเร็จได้และไม่มีภาวะแทรกซ้อน ผู้ป่วยได้รับยาปฏิชีวนะและยาลดบวมสเตียรอยด์ (steroid) ทางเส้นเลือด หลังจากได้รับการรักษาผู้ป่วยหายดีในสัปดาห์แรก
