The Journal of Emergency Medicine, Vol. 45, No. 3, pp. 380–383, 2013

0736-4679/$ - see front matter

ELSEVIER

http://dx.doi.org/10.1016/j.jemermed.2013.03.017

Selected Topics: Critical Care

EXTRACORPOREAL MEMBRANE OXYGENATION CAN PROVIDE CARDIOPULMONARY SUPPORT DURING BRONCHOSCOPIC CLEARANCE OF AIRWAYS AFTER SAND ASPIRATION

Kathryn B. Metcalf, BS,* Andrew J. Michaels, MD, MPH, FACS,* Richard F. Edlich, MD, PHD, FAPS, FACEP,† and William B. Long, MD, FACS‡

*Legacy Emanuel Shock Trauma Center, Portland, Oregon, †Distinguished Professor Emeritus of Plastic Surgery, Biomedical Engineering, and Emergency Medicine, University of Virginia Medical School, Charlottesville, Virginia, and ‡Director of Shock Trauma Center, Legacy Emanuel Hospital, Portland, Oregon

Reprint Address: Richard F. Edlich, MD, PHD, FAPS, FACEP, Department of Emergency Medicine, University of Virginia Medical School, 22500 N.E. 128th Circle, Charlottesville, VA 98606

☐ **Abstract—Background: Sand aspiration occurs in situations of cave-in burial and near-drowning. Sand in the tracheobronchial airways adheres to the mucosa and can cause tracheal and bronchial obstruction, which can be life-threatening even with intensive management. In previous case reports of airway obstruction caused by sand aspiration, fiber optic or rigid bronchoscopy has been effective in removing loose sand, but removal of sand particles lodged in smaller airways has proven challenging and time-consuming. Case Report: In this case report of sand aspiration with acute pulmonary failure, the use of extracorporeal membrane oxygenation for respiratory support allowed more effective removal of sand particles by rigid bronchoscopy and lavage with less patient compromise. Conclusion: Our case of sand aspiration is unique in that the patient presents with complex medical problems (mixed respiratory and metabolic acidosis), hypothermia, hypoxemia, and neoplastic conditions. The fact that she survived the sand aspiration and a long inter-hospital transport time (90 min) with inadequate ventilation and oxygenation without apparent ill effects suggests that the measures we took to resuscitate her and extract the sand from her airways were reasonable and appropriate.** © 2013 Elsevier Inc.

☐ **Keywords—bronchoscopy/bronchus; ECMO; hypoxia; trachea; ventilation; intubation**

INTRODUCTION

Sand aspiration, although uncommon, occurs in situations of cave-in burial and near-drowning (1,2). Sand in the tracheobronchial airways adheres to the mucosa and can cause tracheal and bronchial obstruction, which can be life-threatening even with intensive management (3,4). In previous case reports of airway obstruction caused by sand aspiration, fiber optic or rigid bronchoscopy has been effective in removing loose sand, but removal of sand particles lodged in smaller airways has proven challenging and time-consuming. Furthermore, there is an inflammatory immune-mediated response to the small sand particles, which rapidly become encapsulated within the friable bronchiolar mucosa (1). This can cause the formation of sticky cast material, which is even more difficult to remove. In this case report of sand aspiration with acute pulmonary failure, the use of extracorporeal membrane oxygenation (ECMO) for respiratory support allowed more effective removal of sand particles by rigid bronchoscopy and lavage with less patient compromise. Our case of sand aspiration is unique in that the patient presents with confounding medical problems (mixed respiratory and

RECEIVED: 14 November 2012; FINAL SUBMISSION RECEIVED: 31 January 2013;
ACCEPTED: 15 March 2013

metabolic acidosis), hypothermia, hypoxemia, and a neoplastic condition. The fact that she survived the sand aspiration and a long inter-hospital transport time (90 min) with inadequate ventilation and oxygenation without apparent ill effects suggests that the measures we took to resuscitate her and extract the sand from her airways were reasonable and appropriate.

CASE REPORT

A 52-year-old woman watching the ocean during a winter storm was swept by a rogue wave under a sport utility vehicle. While her husband yelled for help, he held her head above water. Bystanders extricated her from under the car and administered cardiopulmonary resuscitation for 5–10 min. She was apneic and blue. Emergency Medical Technicians (EMTs) provided basic life support and took her to a Level IV trauma hospital in Tillamook, Oregon where the Emergency Department (ED) team provided Advanced Cardiac Life Support measures such as intravenous (i.v.) access, rapid sequence intubation, and insertion of nasogastric and Foley catheters. During the initial treatment, her temperature dropped from 35.5°C to 33.9°C. ED personnel applied warming blankets.

As the weather prevented air evacuation, a ground Advanced Life Support ambulance and crew transported her to our Level I Trauma Center. During the 75-mile transport across the coastal mountains, she became cyanotic, and difficult to ventilate with bag-valve-tube techniques. Endotracheal suctioning failed to improve the situation. The paramedics extubated her because they thought the endotracheal tube was obstructed with sand. Their attempts at reintubation were unsuccessful. She immediately developed respiratory distress. The EMTs supported the patient with bag-valve-mask ventilation and i.v. epinephrine for the rest of the journey.

Upon arrival at the Shock Trauma Center, we took her directly to the trauma operating room to provide immediate intubation or a cricothyrotomy for airway access and effective ventilation. The trauma anesthesiologist immediately intubated her with an orotracheal tube. Her vital signs at the time were: temperature 33.10°C; pulse 105 beats/min; blood pressure 167/102 mm Hg; respiratory rate 24 breaths/min; and oxygen saturation 94% on bag-valve-mask. Glasgow Coma Scale score was 3. The head and neck examination revealed sand in the mouth and pharynx. Auscultation of the lungs revealed crackles bilaterally and decreased breath sounds in the left hemithorax. The examination of her heart, abdomen, and pelvis were all within normal limits. She had bounding peripheral pulses.

The laboratory reported the following values: hematocrit 42%; hemoglobin 14.7 gm/dL; white blood cell count 8400; platelets 376,000; international normalized ratio 1.1. The initial arterial blood gas (ABG) values were: pH 7.01; $PaCO_2$ 94 torr; PaO_2 152 torr; HCO_3 23; base excess (BE) −10.6; and oxygen saturation 99%. Her serum electrolytes were within normal limits and her serum creatinine was 0.9 mg.

The chest radiograph revealed a sand bronchogram and consolidation of the left lung lobe (Figure 1). The computed tomography (CT) scan of the chest confirmed the sand bronchogram. There was a left lower lobe atelectasis with accompanying pleural effusion. The abdominal CT scan showed two lytic lesions in the liver and no potential primary source. With the sand lodged in her lungs and probable aspiration of salt water, the patient had acute pulmonary failure. She was hypothermic, and she had both metabolic and respiratory acidosis, and a urinary tract infection. Fiberoptic bronchoscopy revealed copious amounts of sand in her major airways. A repeat ABG revealed: pHa 6.97; $PaCO_2$ 99 torr; PaO_2 84 torr; HCO_3 22; BE −11; and oxygen saturation 93%. Our attempt to remove the endobronchial sand with a rigid ventilating bronchoscope was unsuccessful due to inability to oxygenate the patient with an adequate O_2 saturation, and high airway resistance.

We placed the patient on ECMO via percutaneous femoral artery/femoral vein cannulation with Bio-Medicus wire wound cannula, Bio-Medicus centrifugal pump, Carmeda coated tubing, and a Medtronic Minimax Oxygenator/heat exchanger (all Medtronic Inc., Minneapolis, MN). We achieved flow rates of 3 L per minute. We performed rigid bronchoscopy while the patient was on ECMO with adequate oxygenation and ventilation. We removed the sand from the tracheobronchial tree with biopsy forceps, as the sand was too sticky to be removed by bronchial lavage. While on ECMO, the patient re-warmed to 37.5°C. We decannulated her after the need for rigid bronchoscopy ended.

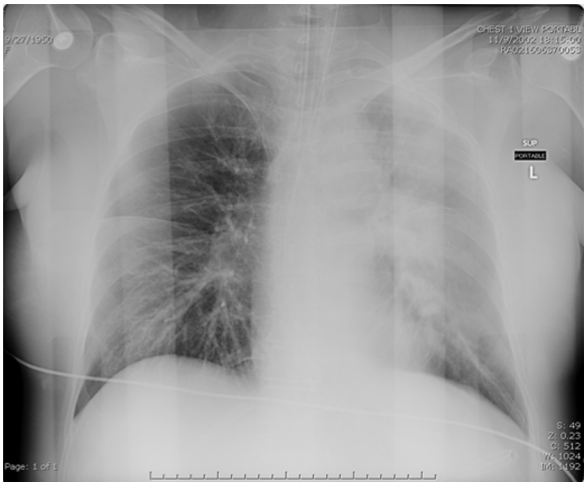

Figure 1. Chest radiograph reveals a sand bronchogram and consolidation of the left lung lobe.