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Selective Intrabronchial Air Insufflation for Acute Lobar Collapse in the Surgical Intensive Care Unit

Max V. Wohlauer, MD, **Ernest E. Moore, MD**, **James B. Haenel, RRT**, **Clay C. Burlew, MD**, and **Carlton C. Barnett Jr, MD**
Denver Health Medical Center and University of Colorado Denver, Denver, Colorado

Abstract

Overview—The horseshoe kidney is more prone to blunt abdominal trauma because of its low position and the presence of the isthmus across the midline. This is a rare case of complete transection of a horseshoe kidney at the isthmus due to blunt abdominal trauma with two sites of active extravasation on initial CT imaging. This extravasation was successfully treated by embolization with coils. Superselective embolization may be used for effective, minimally invasive control of active extravasation due to blunt renal trauma, even in kidneys with congenital malformations such as the horseshoe kidney.

Keywords

trauma; atelectasis; ARDS; acute lung injury; respiratory failure; spinal cord injury

Introduction

A 41-year-old morbidly obese woman, who was an unrestrained passenger in a rollover motor vehicle collision, was transferred to the Rocky Mountain Regional Level One Trauma Center after sustaining a C4-C5 fracture/subluxation. She arrived intubated, on vasopressor support, with a heart rate in the 40's. She was a C-4 tetraplegic and was found to have bilateral vertebral artery injuries. The patient underwent prompt anterior and posterior internal fixation of her spine injury, and a tracheostomy was performed on post-injury day 5 for respiratory failure.

On hospital day 8 she developed a low-grade fever (38.4 C) and became increasingly hypoxemic with a Pa02 to FI02 (P:F) ratio of 57. Chest radiograph demonstrated collapse of the right lower lobe and FIO2 was increased to 100%. Flexible fiberoptic bronchoscopy was performed with slight improvement in ventilation due to suctioning out her tracheobronchial tree. She failed to show meaningful improvement four hours later, however, with a P:F ratio of 61 and persistent right lower lobe collapse (Figure 1).

Attempts to increase PEEP to optimize oxygenation only worsened her condition, resulting in elevated peak airway pressures. Bronchoscopy was repeated with institution of selective intrabronchial air insuffl ation (SII) (Table 1) to resolve atelectasis in the right lower lobe. The associated lung expansion, which correlated with the patient's immediate decrease in oxygen requirements, is demonstrated on this chest radiograph (Figure 2).

Correspondence Max Wohlauer, MD max.wohlauer@ucdenver.edu..

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Discussion

Lobar atelectasis is frequently encountered in the Surgical Intensive Care unit. The spectrum of collapse ranges from subsegmental atelectasis to collapse of an entire lung. Common etiologies include resorption atelectasis due to mucous plugging airway obstruction, passive atelectasis from hypoventilation, compressive atelectasis from abdominal distension, and adhesive atelectasis due to increased surface tension.[1] Conventional management includes chest physiotherapy, bronchodilators, surfactant, DNase, positive end-expiratory pressure, and fiberoptic bronchoscopy. When these treatments fail, SII can become a useful tool for the intensivist.

Attempts to recruit lung volume via increased PEEP levels may lead to hemodynamic instability which is not tolerated in vasopressor-dependent conditions (tetraplegia, septic shock, CHF exacerbation, atrial fibrillation). Selective recruitment of lobar collapse utilizing SII, on the other hand, improves “targeted” lung volume and oxygenation with fewer hemodynamic effects.[2] Additionally, SII is useful in non-intubated patients who are unable to participate in chest physiotherapy due to altered mental status (i.e. traumatic brain injury) chest wall pain (i.e. polytrauma with multiple rib fractures) and the morbidly obese (Table 2).

The primary indication for SII is refractory lobar collapse in the absence of mucous plugging. In a series of 17 critically ill patients, bronchoscopy with SII was 82% effective in treating patients with acute lobar collapse, with optimal treatment in the first 72 hours[3] (Figure 5). In a porcine model, lobar collapse showed a pressure-lung volume relationship similar to that found in acute respiratory distress syndrome.[4] Once collapsed, substantial transpulmonary airway pressure must be generated in order to re-expand the distal airways. Aggressive non-selective recruitment maneuvers i.e. increased positive pressure with PEEP may lead to injurious transpulmonary pressures in the non-collapsed lung. In contrast, collapsed lobes re-expanded without overinflation when SII treatments were delivered, resulting in a safe and effective maneuver for refractory lobar collapse.

References

1. Schindler M. Treatment of atelectasis: Where is the evidence? Critical Care. Aug.2005 9:341–342. [PubMed: 16137380]
2. Hansen LK, Sloth E, Nielsen J, Koefoed-Nielsen J, Lambert P, Lunde S, Larsson A. Selective recruitment maneuvers for lobar atelectasis: effects on lung function and central hemodynamics: an experimental study in pigs. Anesth Analg. 2006; 102:1504–10. [PubMed: 16632834]
3. Haenel JB, Moore FA, Moore EE, Read RA. Efficacy of selective intrabronchial air insufflation in acute lobar collapse. Am J Surg. Nov; 1992 164(5):501–5. [PubMed: 1443377]
4. Koefoed-Nielsen J, Hansen L Kjærsgaard, Larsson A. Does a solitary lobar collapse give pressure–lung volume relationship similar to that found in acute respiratory distress syndrome? A porcine experimental study. Clin. Physiol. Funct. Imaging. 2008; 28:391–97. [PubMed: 18671792]

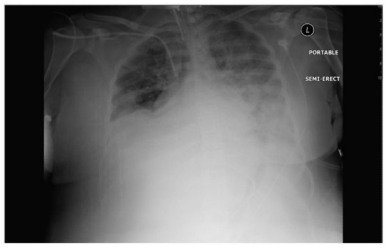

Figure 1.
CXR indicating persistent right lower lobe collapse in our patient.

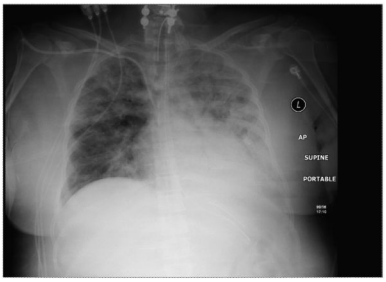

Figure 2.
CXR in our patient demonstrative resolving atelectasis in our patient following SII.

Figure 3.
Bronchoscope outfitted to permit us to complete a selective intralobar insufflation.

Figure 4.
Insufflation after selective intubation by fiberoptic bronchoscopy.

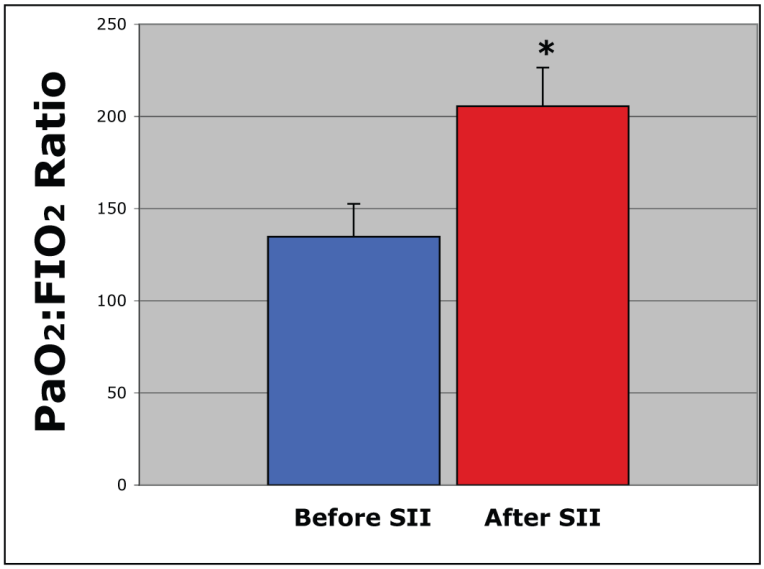

Figure 5.
Selective intrabroncial insufflation improves oxygenation in 16 critically patients (P:F Before SII Treatment vs. p=0.001 After SII Treatment; p=0.001).

Table 1

Selective intrabronchial air insufflation technique.

Selective Intrabronchial Air Insufflation Technique
1. Insert an (15 mm) airway adaptor from a Mallinckrodt 3.0 mm ID uncuffed tracheal tube on to the instillation port of the bronchoscope [Mallinckrodt Inc., St. Louis, MO] (Figures 3,4).
2. Advance bronchoscope into the segment of collapse.
3. Occlude the suction tubing.
4. Attach manual resuscitator (i.e. bag valve mask).
5. Apply 5-10 positive pressure breaths into every segment of collapsed lobe, while monitoring the patient's hemodynamic status.

Table 2

Patients, indications for therapy, their age, and average PaO_2 to FiO_2 ratios before and after selective intrabronchial air insufflation.

Pt	Indication	Age	PaO_2:FIO_2 Before SII	PaO_2:FIO_2 After SII
1	Non-compliant	3	225	285
2	Acute hypoxemia	21	87	180
3	Failed Conventional	56	130	130
4	Failed Conventional.	19	340	425
5	Acute hypoxemia	28	90	240
6	Failed Conventional	62	165	180
7	Failed Conventional	26	123	123
8	Failed Conventional	44	192	188
9	Failed Conventional	69	124	130
10	Acute hypoxemia	86	61	188
11	Acute hypoxemia	44	77	97
12	Acute hypoxemia	21	60	338
13	Failed Conventional	12	160	195
14	Acute hypoxemia	18	74	218
15	Failed Conventional	60	146	172
16	Acute hypoxemia	23	100	200
MEAN		**39**	**135**	**206**