CASE REPORT

Pulmonary air leak syndrome associated with traumatic nasopharyngeal suctioning

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SUMMARY

We describe a healthy 7-month-old female infant who developed spontaneous pneumomediastinum (PM) and subcutaneous emphysema after traumatic nasopharyngeal suctioning (NPS) while hospitalised for respiratory syncytial virus bronchiolitis. To the best of our knowledge, this is the first reported case of pulmonary air leak syndrome associated with traumatic NPS in a healthy infant affected by bronchiolitis. Although NPS is currently the mainstay of treatment in patients admitted with bronchiolitis in the USA, currently there are minimal data regarding the safety and effectiveness of the procedure in patients with bronchiolitis. Physicians should consider the possibility of pulmonary air leak as a complication of NPS and have high suspicion in a decompensating infant after suctioning who is afflicted with bronchiolitis.

BACKGROUND

In the USA, bronchiolitis is responsible for ~20% of acute care hospitalisations in children aged 1 year or less. It primarily results from a lower respiratory tract viral infection,¹ most commonly caused by respiratory syncytial virus (RSV).² Bronchiolitis is characterised by acute inflammation, oedema and necrosis of epithelial cells lining small airways, as well as increased mucus production.³ Bronchiolitis is usually a self-limited disease with relatively good prognosis in which complications are rare.⁴ For healthy children, without risk factors, complications include otitis media, superinfection with pneumonia, meningitis and rarely pulmonary leak syndromes. Pulmonary air leak syndrome is a constellation of disorders that includes pneumothorax (PTX), pneumopericardium (PPC), pulmonary interstitial emphysema (PIE), pneumomediastinum (PM) and subcutaneous emphysema (SCE).⁵ Although spontaneous air leaks are a recognised rare complication of bronchiolitis in children, the incidence remains largely unknown and is limited to case reports.⁶ Nasopharyngeal suctioning (NPS) is a common practice in the treatment of bronchiolitis in infancy as is reflected in the American Academy of Pediatrics bronchiolitis guidelines published in 2014.³ Since infant's are obligate nasal breathers, the practice of NPS is used to clear the airway of secretions to provide temporary relief in an infant's work of breathers and has been shown to decrease length of hospital stay.⁷ NPS involves inserting a catheter into an infant's nose, advancing it into the nasopharynx and then intermittently applying suction to remove secretions.⁸ However, this is an invasive practice lacking

supporting evidence and a standardised approach. Currently, only minimal data are present in the literature in regard to complications associated with traumatic NPS.

CASE PRESENTATION

A 7-month-old female infant with no significant medical history was admitted following 3 days of fever, dry cough and wheezing. There was no family history of asthma. Initially, an albuterol and ipratropium bromide nebulisation trial was attempted with no improvement in symptoms, and the patient was admitted to the inpatient unit for acute respiratory failure secondary to airway obstruction from copious secretions. RSV direct antigen by nasopharyngeal swab was positive and confirmed by viral culture. The patient was hospitalised for 1 day and discharged following clinical improvement. After 3 days of continued fever at home (maximum temperature: 39.8°C) with worsening cough and increased work of breathing, the patient was admitted to the inpatient ward with worsening respiratory status that was not responding to conservative outpatient treatment. A chest X-ray (CXR) performed at that time showed extensive bilateral airspace disease (figure 1). The patient was started on ceftriaxone for presumed superinfection and received frequent deep NPS to clear the airway of secretions.

On hospital day 3, 45 min after traumatic deep NPS (noted by blood in the suction container), the patient suffered an acute clinical deterioration with moderate respiratory distress. She had tachypnoea, intercostal retractions, nasal flaring, grunting, and swelling around the neck and upper chest wall with

Figure 1 Chest X-ray on admission showing bilateral airspace disease.

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Figure 2 Portable chest X-ray showing hyperinflation with pneumomediastinum (black arrow) and a large amount of subcutaneous emphysema involving the soft tissues of the neck (double arrow) and left axilla (white arrow).

crepitus on palpation. Vital signs were blood pressure 95/48 mm Hg, pulse 126 bpm, respiratory rate 50 bpm, blood oxygen saturation level (SpO₂) 97% and temperature 37°C.

INVESTIGATIONS

Complete blood count, basic metabolic panel, lactate and C reactive protein were unremarkable. Venous blood gas showed a pH of 7.33, carbon dioxide of 44 mm Hg and partial pressure of oxygen (pO₂) of 63.7 mm Hg. CXR (figure 2) revealed hyperinflation with PM, SCE involving the soft tissues of the neck and left axilla, and an in the right perihilar region. Decubitus CXR did not reveal PTX (figure 3).

TREATMENT

The patient was started on 100% supplemental oxygen (O₂) via a non-rebreather mask with flow rate of 10 L/min of 100% O₂ and transferred to a paediatric intensive care unit for

Figure 3 Right lateral decubitus chest X-ray showing pneumomediastinum (small arrow) with no pneumothorax. There is a large amount of subcutaneous emphysema (large arrow).

cardiopulmonary monitoring. After 24 hours of monitoring, the patient was sent back to the general paediatric ward, intravenous ceftriaxone was switched to oral amoxicillin and supplemental O₂ was weaned and discontinued on hospital day 3. The patient was discharged home on hospital day 6 and finished her antibiotics course as an outpatient (for a total of 7 days).

DISCUSSION

Bronchiolitis is a common childhood disease with a benign natural course in which complications are rare. An uncommon complication which has been reported is pulmonary air leak syndrome which encompasses SCE, PM, PTX and PPc, a group of disorders characterised by the inappropriate presence of gas in correspondent anatomical structures.⁵ The aetiology of air leaks in bronchiolitis is thought to be secondary to inflammation leading to mucosal oedema, increased secretions and cellular debris, which result in obstruction of the small airways. The small airway obstruction leads to air trapping and an increase in alveolar pressure. The resulting pressure gradient between the alveoli and the neighbouring tissues precipitates alveolar rupture and air leakage. This effect is exacerbated by coughing episodes and possibly by traumatic NPS which may cause bronchial or alveolar tissue injury if excessively advanced or if the pressure used is more than that recommended for infants and children. The air then dissects through tissues and fills potential spaces in the mediastinum, neck and subcutaneous space.⁵

A recent publication reviewed 13 reported paediatric cases of spontaneous air leaks associated with bronchiolitis. Of the reported cases, PTX was the most common complication and PM was the rarest. A majority of the cases were due to RSV infections and were in healthy infants with severe bronchiolitis. There is no report of associations of air leaks with NPS in this publication or in the English literature.⁶ Although there are no previous reports of cases, there are a handful of case reports of premature, critically ill neonates who were intubated and experienced air leaks with endotracheal tube suctioning.⁷⁻⁹ The mechanism of injury in these reports was largely from tissue trauma causing perforations in the trachea or the bronchial tree.^{10 11} This mechanism was further studied in newborn pigs who received deep endotracheal suctioning as compared with those that had an alternative shallow technique. The study showed that there was significantly increased necrosis and inflammation of the tracheobronchial tissue following deep suctioning.¹¹

These cases could potentially share a similar pathophysiology as the case we report, if a large nasopharyngeal suction catheter were used with high negative pressure and advanced too far. Evidence has shown confusion in licensed care providers over catheter sizes, appropriate negative pressures and a range of adverse effects despite receiving training in the NPS technique.¹²

In this case, we used the theory of nitrogen washout in the treatment of the PM and SCE. The said theory suggests that breathing higher concentrations of O₂ compared with room air improves the length of time to resolution of air leak. The theory posits that by decreasing the partial pressure of nitrogen in the alveolus compared with the pleural space, the created pressure gradient allows the nitrogen to move from the pleural space into the alveoli, thus also moving air from the pleural space into the alveoli.¹³ A 2014 study by Shaireen *et al* compared full-term neonates with spontaneous PTX treated with room air O₂ and those treated with more than 60% O₂. The study showed no difference in the time to clinical resolution of PTX between infants treated with room air or higher concentrations of O₂.¹⁴

Pulmonary air leaks are a rare complication of bronchiolitis and may be associated with traumatic deep NPS. More studies and trials need to be done in order to assess safety and potential complications of using deep NPS in treating bronchiolitis. Infants with air leak syndrome need close monitoring and supportive care to avoid life-threatening complications. Paediatric physicians should have a high suspicion of air leak in patients with bronchiolitis who have worsening respiratory distress or have any signs of SCE.

Learning points

- Pulmonary air leak syndromes are a potential complication of deep nasopharyngeal suctioning in healthy infants admitted for bronchiolitis.
- Paediatricians should have a high suspicion for pulmonary air leak in infants with bronchiolitis who have severe respiratory distress or decompensate with conservative management.
- Pulmonary air leak syndromes associated with bronchiolitis can be treated conservatively without oxygen administration but require cardiorespiratory monitoring in an intensive care setting.

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