

Case Report

A newborn baby born via elective c-section for placenta praevia was noted to have a gradual onset of tachypnea, subcostal indrawing, nasal flaring and grunting at 5 minutes of life. Oxygen saturation via pulse oximeter was 85%. Continuous positive airway pressure (CPAP) of 6 cm H₂O was initiated via bag and mask in room air with improvement in symptoms.

Maternal history revealed a healthy 32-year-old G6P1A4 (4xTA) mother with a seroprotective spontaneous pregnancy. There was a single episode of vaginal bleeding and cramping at 27 weeks requiring one dose of betamethasone and Anti-D intramuscularly. Anatomy scan was normal and integrated prenatal screening was declined. There was a maternal history of depression and attempted suicide, but at present the mother was well. Only medications were prenatal vitamins.

Due to on-going respiratory effort and 'CPAP requirement', the infant was admitted to the neonatal intensive care unit (NICU) for initiation of nasal CPAP by a respiratory therapist. On admission, vitals included a heart rate of 149 beats/min, respiratory rate 54 breaths/min, oxygen saturation 100% in room air, blood pressure 76/32 mmHg and temperature 36.1°C. Blood glucose was 4.7 mmol/L, white blood cell count 12.38 (x10⁹/L), hemoglobin 150 g/L, platelets 223 (x10⁹/L) and absolute neutrophils 4.33 (x10⁹/L).

Chest x-ray at one hour of life confirmed the diagnosis of pulmonary air leak, with bilateral pneumothoraces, pneumomediastinum and the classic sail sign (Figure 1). CPAP was discontinued at 90 minutes. The baby remained hemodynamically stable on room air with no evidence of respiratory distress. As there were no septic risk factors, and the baby was delivered via an elective c-section, a partial septic work-up was not completed and antibiotics were not started.

Chest x-ray repeated seven hours later showed minimal resolution of the air leak (Figure 2). The baby continued to remain asymptomatic and no further intervention was indicated. After a further period of observation, the baby was discharged from the NICU to the post-partum floor with no further respiratory symptoms.

Discussion

Pulmonary air leak, referring to either pneumothorax, pneumomediastinum, pulmonary interstitial emphysema (in premature infants) or rarely pneumopericardium, is a common finding in the newborn period. Approximately 1-2% of term and 5-7% of preterm infants have evidence of a spontaneous pneumothorax on chest x-ray although few are clinically significant.¹⁻² Air leak is thought to occur when an over-distended alveoli ruptures.³ Risk factors for neonatal air leak include: prematurity, meconium aspiration syndrome, c-section, pulmonary hypoplasia and mechanical ventilation (particularly with excessive, prolonged or high inspiratory pressures).³

Newborns with pulmonary air leak may or may not have signs of respiratory distress. If oxygen saturation is normal, there is no known additional benefit to providing further supplemental oxygen as a 'washout'.⁴ If the pneumothorax is thought to be contributing to significant respiratory distress or is hemodynamically significant, thoracentesis and chest tube placement may be beneficial. Most spontaneous pneumothoraces resolve without the need for further intervention, including thoracentesis.⁵

Up to 10% of newborns require some form of resuscitation at birth but less than 3% require extensive measures such as positive-pressure ventilation or endotracheal intubation. The underlying cause of on-going respiratory distress in newborn can be due to a variety of causes, including transient tachypnea of the newborn (TTN), respiratory distress syndrome, meconium aspiration syndrome, air leak, neonatal pneumonia or sepsis.³

Infants with spontaneous respirations but who have laboured breathing or persistent cyanosis often receive CPAP via bag and mask ventilation, T-piece resuscitators and/or ventilators with a nasal prong interface. For practical reasons, newborns who require on-going CPAP for respiratory distress are often admitted to the NICU and initiated on nasal CPAP (nCPAP).

All infants admitted to the NICU for on-going respiratory distress requiring ongoing CPAP should be further investigated to ensure correct diagnosis and management. Had we assumed that respiratory distress was due to TTN, and observed for 4-6 hours on CPAP (or longer), the air leak could have continued to worsen causing hemodynamically significant symptoms requiring urgent and invasive interventions (e.g. needle thoracostomy).^{3,5} Clinical follow-up including frequent reassessment may

allow appropriate interventions (e.g. intubation/thoracentesis/chest tube placement) in a safe, sterile and non-urgent matter.

Chest transillumination is commonly used to diagnose neonatal pneumothorax, although the sensitivity and specificity are inferior to chest x-ray.⁶ One small study found the diagnostic accuracy of lung ultrasound similar to chest x-ray,⁶ but widespread use of ultrasound at present is limited.

A commonly held belief is that over-ventilation using CPAP may inadvertently lead to air leak but there is little data to support this notion in healthy term infants. While a recent retrospective single-centre Japanese study reported an increased prevalence of air leak associated with increased use of CPAP,⁷ there is little consensus in the literature. Further, there are no clear guidelines on the timing, frequency or need for repeat imaging in well neonates with a pneumothorax. Judicious use of radiography should be guided by the patient's clinical status and the need for imaging to change management.

Key Points

1. Newborn infants with respiratory distress who require on-going CPAP for respiratory support should have chest radiography completed for appropriate diagnosis and management.
2. Pulmonary air leak is a common finding in newborn infants with respiratory distress.
3. Newborns with pneumothoraces can be managed conservatively if hemodynamically stable.

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Conflict of interest

None of the authors have a conflict of interest to declare.

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Multiple choice questions

1. A term newborn with no septic risk factors is started on CPAP room air due to tachypnea, subcostal indrawing and nasal flaring. Chest x-ray revealed a moderate-sized right pneumothorax. Which of the following statements is true regarding the management of a pneumothorax in this case?
 - a. CPAP should be continued until radiographic resolution of the pneumothorax
 - b. Supplemental oxygen will help quicken pneumothorax resolution
 - c. Chest tube placement is indicated to relieve respiratory distress
 - d. Broad-spectrum antibiotics should be initiated
 - e. **Discontinue CPAP until air unless respiratory distress**

Explanation: Continuing CPAP in the absence of respiratory distress could worsen the air-leak and lead to hemodynamically significant symptoms requiring urgent and invasive interventions (e.g. needle thoracostomy). If oxygen saturation is normal, there is no known additional benefit to providing further supplemental oxygen as a 'washout'. Chest tube placement is only indicated if the pneumothorax is contributing to significant respiratory distress or is hemodynamically significant. Most spontaneous pneumothoraces resolve without the need for further intervention, including thoracentesis, and do not require on-going therapy until radiographic resolution. In the absence of septic risk factors and with reassuring vital signs, broad-spectrum antibiotics are usually not indicated.

2. A late-preterm (35 weeks) infant mechanically ventilated for suspected meconium aspiration syndrome is found to have large bilateral pneumothoraces on chest x-ray. Which of the following is **not** a risk factor for air leak?
 - a. Prematurity
 - b. Meconium aspiration syndrome
 - c. C-section
 - d. **Gestational diabetes**
 - e. Mechanical ventilation

Explanation: Pulmonary air leak is a common finding in newborns. Approximately 1-2% of term and 5-7% of preterm infants have evidence of a spontaneous pneumothorax on chest x-ray. Air leak is thought to

occur when an over-distended alveoli ruptures. Risk factors for neonatal air leak include: prematurity, meconium aspiration syndrome, c-section, pulmonary hypoplasia and mechanical ventilation (particularly with excessive, prolonged or high inspiratory pressures). Gestational diabetes is not a risk factor for pneumothorax.

3. A 2-day old term infant with meconium aspiration syndrome warranting mechanical ventilation develops new-sudden onset severe respiratory distress. What is the diagnostic gold-standard to confirm pneumothorax?
- a. Chest transillumination
 - b. Chest x-ray**
 - c. Ultrasound
 - d. Auscultation and percussion
 - e. Echocardiography

Explanation: Infants with meconium aspiration syndrome often require excessive, prolonged or high inspiratory pressures to maintain adequate ventilation and oxygenation which increases the risk of air leak syndrome. Radiography remains the gold-standard to diagnose air leak syndrome. In an acute clinical scenario accompanied with hemodynamic instability, physical exam is frequently used to diagnose pneumothorax and expedite urgent life-saving intervention (e.g. needle thoracentesis). If available, chest transillumination is also used to diagnose neonatal pneumothorax, although the sensitivity and specificity are inferior to chest x-ray. While the scope and use of ultrasound is expanding, widespread use is limited and the diagnostic accuracy is similar to chest x-ray. While echocardiography can detect a pneumopericardium, a rare finding, it will not pick-up pneumothoraces and pneumomediastinum which are much more common.

Figures

Figure 1: Chest x-ray at one hour of life.

Figure 2: Repeat chest x-ray at 8 hours of life.