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Case Report

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Management of massive air leak with persistent pneumothorax and pneumoperitoneum in a 1.2kg preterm neonate: A case report

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KEYWORDS

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Tube thoracocentesis,
Premature,
Massive air leak,
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ABSTRACT

Background: Pneumothorax is a life-threatening condition with potential iatrogenic causes which can extend to pneumomediastinum and pneumoperitoneum. Risk factors of spontaneous pneumothorax include prematurity, low birth weight, low APGAR scores, and cesarean-section delivery.

Case Presentation: A 1255 grams preterm boy (Twin-2) was born at 28+3 weeks of gestation by emergency lower segment cesarean section. He showed signs of respiratory distress after uncomplicated endotracheal tube insertion which was required due to apneic episodes during continuous positive airway pressure ventilation. Recurring tube thoracocentesis and high-frequency oscillatory ventilation (HFOV) treated persistent right-sided pneumothorax and nonsurgical pneumoperitoneum, with improvement on day 10, gradual removal of five chest drains by day 19, and extubation on day 24. Transillumination and chest radiography were the main diagnostic investigations. Laryngotracheobronchoscopy on day 16 identified erythema and possible old injury at the carina. He was also treated for hypotension, suspected sepsis, and pulmonary hypertension and was discharged home on day 66.

Conclusion: Identifying pneumothorax promptly is essential to reduce morbidity and mortality. Management is patient-specific and includes needle and tube thoracocentesis and often, mechanical ventilation. Our case demonstrates the challenges of managing a massive air leak in a premature newborn, who with adequate tube thoracocentesis and HFOV, successfully recovered from presumed iatrogenic persistent pneumothorax and pneumoperitoneum.

INTRODUCTION

Spontaneous pneumothorax has an incidence of 1-2% in term neonates and 6% in premature infants presenting with respiratory distress. [1] Pneumothorax can also be a complication of ventilation (3%), continuous positive airway pressure (CPAP) (9%), and endotracheal tube (ETT) insertion due to potential hypopharyngeal injury. [2] Subsequent hypoxia and hypercarbia lead to high morbidity and mortality (30%). [2] A massive air leak may manifest as pneumomediastinum and pneumoperitoneum. Pneumoperitoneum in a preterm neonate usually arises due to gastrointestinal perforation, mostly secondary to necrotizing enterocolitis. [3] Non-surgical pneumoperitoneum could occur due to a pulmonary air leak and may not require drains or laparotomy. [3] We herein report a case of a male preterm baby with a presumed iatrogenic airway injury.

CASE REPORT

A baby boy (twin) was born at 28+3 weeks of gestation, to a 33-year-old mother. Due to cord prolapse, an emergency lower segment cesarean section was undertaken. APGAR scores were 2, 6, and 8 at 1, 5, and 10 minutes, respectively. Spontaneous respiration was attained after 4 minutes of the bag and mask inflation breaths. Due to apneic episodes on CPAP, he was intubated using a size 3 ETT with conventional ventilation at a peak pressure of 24 cmH2O and positive end-expiratory pressure (PEEP) of 5 cmH2O. Surfactant was administered. Chest radiography (CXR) showed increased left lung opacity and low-lying ETT tip. This was withdrawn for effective ventilation.

At 3 hours of age, due to sudden loss of chest movements and volumes on ventilation, the neonate was re-intubated. There was ongoing respiratory distress and CXR confirmed a right-sided tension pneumothorax (Fig. 1A). Needle aspiration followed by tube tho-

racocentesis (TT) with the underwater seal was undertaken (Fig. 1B). The drain was placed on low-flow suction. One hour later, further desaturation and transillumination indicated a large residual pneumothorax, necessitating a second chest drain, also placed on low-flow suction. Ventilation improved and he remained on 25% FiO2.

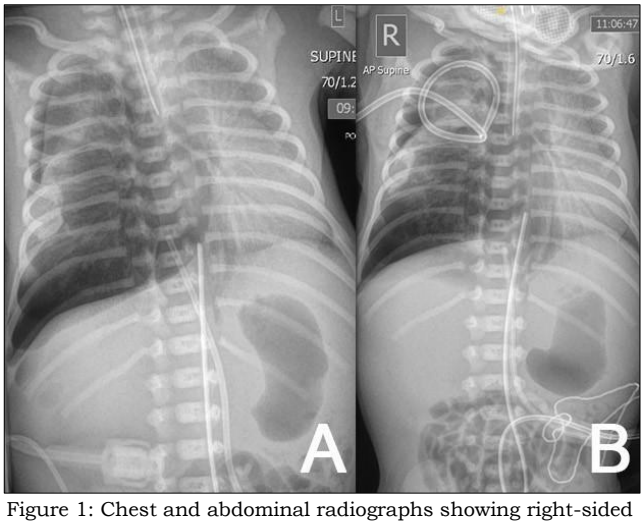

Figure 1: Chest and abdominal radiographs showing right-sided pneumothorax (first diagnosis) – before (A) and after (B) drain 1.

An iatrogenic tracheobronchial injury was suspected. On day 2, he developed a greater oxygen requirement; transillumination and radiography confirmed persistent pneumothorax, this time with pneumomediastinum and pneumoperitoneum, requiring a third chest drain. He was then transferred to the regional pediatric center. After a fourth TT (Fig. 2B) due to a massive ongoing air leak (Fig. 2A), high-frequency oscillatory flow ventilation (HFOV) was tried.

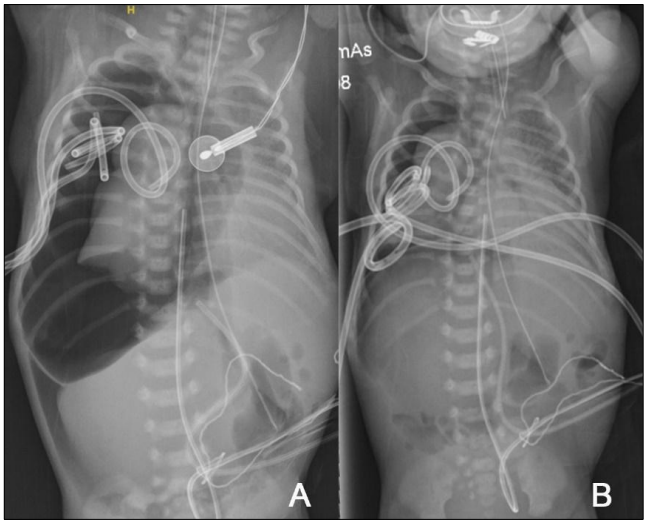

Figure 2: Chest and abdominal radiographs showing right-sided pneumothorax, pneumomediastinum, and pneumoperitoneum (massive air leak) – before (A) and after (B) drain 4

Pneumomediastinum, deemed to be secondary to pneumothorax, was conservatively managed without drain insertion. Intravenous antibiotics and dobutamine were commenced for suspected sepsis and hypotension respectively. Echocardiogram showed small pericardial effusion and normal contractility. The multidisciplinary team consensus was to adopt a conservative approach. Parenteral nutrition commenced.

On day 5, CXR showed improvement. 2 non-bubbling drains were clamped and later removed. However, due to clinical deterioration and re-accumulation on days 5, 6, and 7, three other TTs were required, with subsequent improvement. A repeat echocardiogram demonstrated signs of pulmonary hypertension. Nitric oxide, dobutamine, and adrenaline were adjusted to allow pulmonary vascular circulation dilatation and reduce systemic vasoconstriction and echocardiogram findings improved.

Extracorporeal membrane oxygenation was not deemed suitable and conservative management continued. The 5 chest drains remained in situ with varying effectiveness. On day 10, dobutamine was stopped, nitric oxide was weaned off and HFOV was de-escalated to conventional ventilation at a peak pressure of 26 cmH2O and PEEP of 7 cmH2O. Only one drain bubbled continuously and then was removed on day 13.

Enteral feeding was started on the next day. Serial cranial ultrasounds showed no intraventricular hemorrhage or ischemic injury.

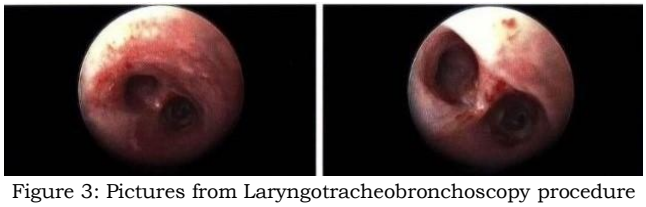

Figure 3: Pictures from Laryngotracheobronchoscopy procedure showing erythema at carina and possible old injury.

Laryngotracheobronchoscopy under general anesthetic identified no definite airway laceration, but erythema was seen at the carina which could indicate old injury (Fig. 3). By day 19, all chest drains were removed. He was extubated on day 24 and CXR appearances improved. He was discharged home on day 66

DISCUSSION

Due to high morbidity and mortality, awareness of the risk factors of neonatal pneumothorax is important. A birthweight of <2.5kg has a 10-times, and a 1-minute APGAR score of less than 7 has a 2.67-times increased risk of pneumothorax. [1] C-sections also increase the risk of neonatal pneumothorax. [2] These risk factors are relevant to our case.

The pneumothorax was suspected due to increased work of breathing, desaturation, and increased oxygen requirements and confirmed by transillumination and CXR. Transillumination is rapid but CXR is potentially associated with delayed management and harmful radiation. [1] Lung ultrasound (LUS) super-

sedes transillumination owing to a better diagnostic profile (Sensitivity: 96.7%, specificity: 100%) as it is rapid, repeatable, and detects even small non-tension pneumothorax. [1]

The literature review established different management techniques in neonates with pneumothorax and associated pneumoperitoneum. Conservative management is advised for nonsurgical pneumoperitoneum as it would resolve once the pneumothorax is managed. [3] Needle aspiration followed by TT is the emergency treatment for tension pneumothorax. A venous catheter, a 22-gauge cannula, connected to an underwater seal can also be used to drain a neonatal pneumothorax, reducing inpatient stay and surgical complications. [4] Due to persistent, very large pneumothorax, multidisciplinary and multi-center discussions occurred; he was considered unstable in the early stages for the CT scan. General anesthesia and bronchoscopy also carry potential risks and locating an airway injury can be challenging in such preterm or low birthweight infants. [5]

In patients with stable vital signs, absence of respiratory distress, less than 1cm tracheal laceration, and no sepsis, conservative management by placing the uncuffed tube distal to the injury is an option. [6] Aurilia et al. report successful treatment of significant pneumothorax with HFOV without TT in stable preterm infants. [7] Huseynov used an inexpensive blood patch safely to tape persistent air leaks in a newborn after 15 days of pneumothorax despite TT and continuous suctioning. [8] Other studies report using fibrin glue but with risks of hypercalcemia, diaphragmatic paralysis, localized tissue necrosis, and contralateral pneumothorax [9] or chemical agents, such as povidone-iodine, with unknown sequelae in children or significantly challenging selective bronchial intubation. [8] Surgical intervention is usually applied in unstable patients where bridging the defect is not feasible. Restino et al. describe a bedside emergency right thoracotomy and further dissection revealing an injury near the trachea bifurcation. Primary repair was undertaken with a chest tube left in place. [5]

Anticipating and preventing complications of pneumothorax is essential. Air leak raises intrathoracic pressure and decreases cardiac output, causing hypotension requiring inotropes, as in our case. Neurologically, up to 89% of very low birth-weight infants with air leaks resulting in hypotension are prone to grade 3 or 4 intraventricular hemorrhage secondary to cerebral ischemia at watershed zones. [10] Fortunately, this complication did not develop in our patient.

To summarize, pneumothorax is a life-threatening condition with potential iatrogenic causes. Massive air leak can extend to develop pneumomediastinum and pneumoperitoneum. Risk factors include prematurity, low birth weight, low APGAR scores, and C-section delivery. Therefore, very cautious airway instrumentation is required in neonates. The management is patient-specific. Pneumoperitoneum should not always warrant drains or exploratory laparotomy as nonsurgical pneumoperitoneum can occur in ventilated neonates and those with airway injury. Our case demonstrates the challenges of managing a massive air leak in a premature newborn. With adequate tube thoracocentesis and HFOV, he successfully recovered from presumed iatrogenic persistent pneumothorax and pneumoperitoneum.

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