Successful Treatment of Persistent Pneumothorax in a Very Preterm Neonate Using Autologous Blood Patch Pleurodesis: A Case Report from Western India

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ABSTRACT

Background: Autologous blood patch pleurodesis (ABPP) has been widely used in adults and pediatric population. Evidence are limited in it's application in neonates specially in preterm neonates.

Case Report: In our case, we report a successful and rare treatment with ABPP in a very preterm, low birth weight neonate with persistent pneumothorax lasting for 27 days.

Conclusion: ABPP is a safe, cost-effective, painless procedure for persistent pneumothorax. The results are satisfactory and it may be a feasible alternative to surgery when used in selected neonates in right time.

Keywords: Pneumothorax, Air Leak, ABPP, Neonates

ABBREVIATIONS

ABPP: Autologous Blood Patch Pleurodesis

APGAR: Appearance Pulse Grimace Activity and Respiration

CECT: Contrast-Enhanced Computerized Tomography

CXR: Chest X-Ray

FiO2: Fraction of Inspired Oxygen

HFOV: High-Frequency Oscillatory Ventilation

ICD: Intercostal Chest Drain

IFT: Infant Feeding Tube

KEMH: King Edward Memorial Hospital

NICU: Neonatal Intensive Care Unit

PAL: Persistent Air Leak

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PPN: Persistent Pneumothorax

PPROM: Preterm Premature Rupture of Membranes

RDS: Respiratory Distress Syndrome

SAS: Silverman-Anderson Score

SIMV: Synchronous Intermittent Mandatory Ventilation

SPO2: Peripheral Oxygen Saturation

INTRODUCTION

Pneumothorax is the most common cause of air leak. It occurs when the air trapped in the alveoli moves through the parietal pleura into the pleural space [1]. It is a well-known complication of lung disease in the neonate, with an incidence of 10% in extremely preterm infants, though much higher in the setting of preterm, premature, rupture of membranes (PPROM) with oligohydramnios. Majority of pneumothorax cases resolve spontaneously but symptomatic cases required Intercostal chest drain(ICD) for drainage of air [2]. The Society of Thoracic Surgeons defined persistent pneumothorax (PPN)/ persistent air leak (PAL) that persists for more than five days [3].

There is no optimal treatment for persistent pneumothorax in neonates. The most accepted treatment is pleurodesis. Chemical agents like providone iodine and fibrin glue, have been used for pleurodesis in neonates [4,5]. Autologous blood patch pleurodesis (ABPP) has been shown to be simple, highly successful and safe in adults but there is very limited data available on the use of ABPP in neonates and specially in very preterm neonates. There are only few cases reported till date and three cases were reported from India [6-9]. This case report strongly suggests the use of ABPP in persistent air leak in preterm neonates.

ABPP

Fresh arterial blood was collected from the radial artery (2ml/kg) and immediately injected into the pleural cavity through the chest tube, followed by 5 ml of air was injected to prevent clotting of the blood in the chest tube. The chest tube was suspended 50 cm above the chest level for 2 hours and allow pleural cavity to contract. The chest tube collecting device was placed on a water seal, negative suction was discontinued. The air leak was sealed within 24 hours of ABPP and the ICD was removed after 48 hours post autologous blood patch pleurodesis. The patient was discharged seven days after ABPP.

Case Report

A very preterm baby boy born at (30+1) weeks of gestation by Caesarian section (Indication: severe oligohydramnios) weighing 1660 grams and APGAR scores of 6 and 7 at one and five minutes of life, respectively.

The baby was admitted to our NICU due to respiratory distress, prematurity and low birth weight. The Silverman-Anderson score (SAS) was 6/10 at admission. Invasive ventilation was started with synchronous intermittent mandatory ventilation (SIMV) mode. One dose of surfactant (4ml/kg of beractant (Survanta) was given due to high FiO2 requirement (>40%) and increasing SAS (7/10) within 2 hours of life as per unit protocol. In view of rising oxygen requirement (FiO2 >90%) and low SpO2 (<70%) baby was taken on High Frequency oscillatory ventilation (HFOV).

Right sided pneumothorax was detected on X-ray after birth at 1 hour of life. Chest tube was inserted in the right pleura and placed to water seal. The neonate developed shock on day one and was supported with infusion of dobutamine and adrenaline to maintain blood pressure as per gestational age. In view of prematurity and shock, broad spectrum antibiotics was started as per unit protocol.

The baby was on HFOV till 3 days after birth, following which he was gradually weaned to SIMV and extubated on day 7 of life.

Due to persistence of pneumothorax and midline shift despite one ICD we have inserted a second ICD after 12 days in different plane. Following this, three-bottle continuous low pressure (-10 to -15 cm H2O) negative suction was tried for 7 days but no improvement was observed. Chest x-ray showed persistence and increase of right pneumothorax even after two ICDs are in place in different planes. Contrast-enhanced computerized tomography (CECT) was done on day 18 of life showed persistence of right sided moderate to gross pneumothorax with associated mediastinal shift towards left side with patchy areas of consolidation, ground glass densities and minimal interstitial thickening. CECT was not suggestive of any other congentinal abnormalities like congenital pulmonary airway malformation (CPAM).

In view of persistent air leak for 27 days, risk of infection and parental preference to avoid chemical agents, ABPP was selected to treat the persistent pneumothorax. Baby has achieved full enteral feeds of mother's expressed breast milk with fortification by day 25 of life and having normal screening

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head ultrasounds.

Fresh arterial blood was collected from the radial artery (2ml/kg) and immediately injected into the pleural cavity through the chest tube, followed by 5 ml of air was injected to prevent blood clotting in the chest tube. After the procedure, the chest tube was remaining suspended 50 cm above the chest level for 2 hours and allow pleural cavity to contract. The chest tube collecting device was placed on a water seal, negative suction was not used. No sedation was used, and oxygen saturation and vital signs were documented normal during the procedure. The baby was on room air during the treatment. The air leak was sealed within 24 hours of ABPP and the chest drain was removed after 48 hours of ABPP.

The patient was discharged after seven days of ABPP. Now the neonate is having adequate weight gain with no respiratory complications. Short term follow up was uneventful.



Figure 1: 1 hour post birth CXR

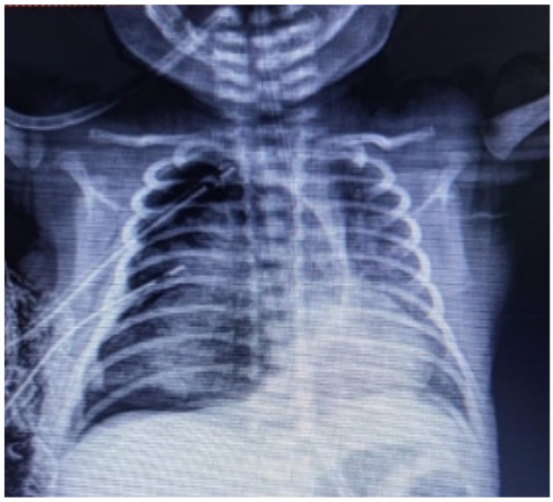


Figure 2: With Multiple ICDs



Figure 3: 48 hours post ABPP

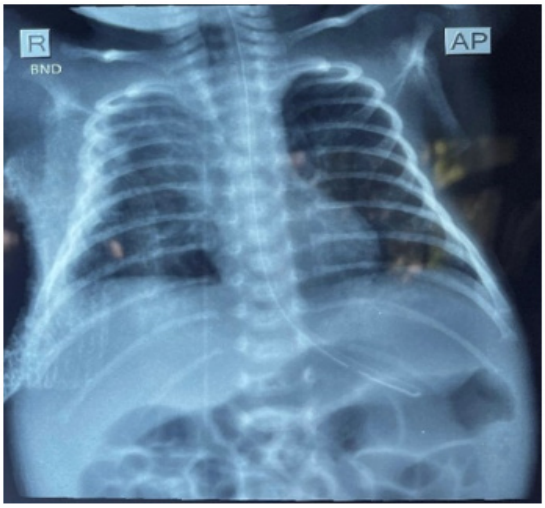


Figure 4: 24 hours post ICD removal

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DISCUSSION

Preterm neonates have higher incidence of pneumothorax ranging from 3.8% to 9%, and a higher rate of recurrence of 28% against 10% in term babies, with a mortality of 38.6% [6]. Premature infants with hypoplastic lungs secondary to severe oligohydramnios have a high mortality. Larger infants may be treated with thoracotomy. For infants that are too small for thoracotomy, there is few literature describing alternative treatments. Case reports showed available treatment options such as selective bronchial intubation, pleurodesis with sclerosing agents, and newer approaches with the use of fibrin glue [3,4]. This case describes a novel approach to the treatment of neonatal persistent air leak with an autologous blood patch.

ABPP is an evidence-based, safe procedure in the adult and pediatric populations. The exact mechanism of the ABPP in pneumothorax is not well established. Possible mechanisms of action:

1. Mechanical sealing of alveolar-pleural fistula by clot formation with coagulated blood (`blood patch effect`)

2. The localised inflammatory response and scarring leads to actual pleurodesis.

In neonates, the inflammatory response may be unpredictable due to immature immune response [2,9].

During our review of literature, we found only five case reports and one case series where ABPP was performed in newborns [2,6-10]. The first case reported from Turkey was a case of persistent pneumothorax of 17 days duration. This patient required three sessions of ABPP, with evidence of clinical improvement after 48 hours of the third patch [2].

The second was reported from India, a persistent pneumothorax that had persisted for 25 days and treated with ABPP. Two sessions of ABPP was performed and the pneumothorax resolved after 48 hours of the procedure [6]. The third case which was reported from India, a persistent pneumothorax that had persisted for 10 days was treated with ABPP, and the pneumothorax resolved after 72 hours of the procedure [7]. The fourth case, reported from New Zealand, was a persistent bilateral pneumothorax of 28 days duration in an extreme preterm which was treated with ABPP with high-frequency ventilation. The chest tube was successfully removed 72 hours later with no other complications [8]. In the fifth case report from Odisha, India, ABPP was done on 14th day of persistent pneumothorax and the chest tube was removed after 48 hours of blood patch [9]. The only case series from the USA described ABPP in three neonates, with clinical and radiological improvement in the first two cases; however, the third neonate required an extended thoracotomy and fibrin patch placement due to the persistence of an air leak [10].

In our case, ABPP was done on day 27 of persistent pneumothorax using an arterial blood patch in a very preterm infant with low birth weight. The use of arterial blood instead of venous blood prevents faster clotting during the blood patch procedure. In this case closure of air leak observed in a single setting of ABPP unlike multiple sessions required in previously reported cases and pneumothorax was resolved. The chest tube was removed after 48 hours of the procedure without any further recurrence. The unique nature of our case was the chest tube was hanged for 2 hours instead of 4 hours in previous reported cases under close clinical and radiological monitoring. The single session of ABPP in our patient resulted in complete resolution of pneumothorax. It was probably due to early intervention, proper expertise, optimal positioning of the chest tube and early stage pleural response. Further studies are needed to predict single session success in autologous blood patch pleurodesis in preterm neonates with low birth weight.

CONCLUSION

Autologous blood patch pleurodesis in our neonate was a safe and effective bedside procedure without any sedation and with no short term complications. Its therapeutic role in neonates specially in preemies are less explored. So far, results are satisfactory. It may be a feasible treatment in selected neonates with persistent pneumothorax instead of surgery. Further studies are required to determine the optimal timing of the procedure, number of sessions and clamping or suspension of the chest tube. Larger studies are needed to determine the safety and efficacy of ABPP in preterm neonates.

STATEMENTS

Informed Consent

The parents gave written consent for the publication of this case report.

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Ethics Statement

Ethics approval was not sought for a single retrospective case report as per institutional practice.

Conflict of Interest

The authors have disclosed no conflict of interest.

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Author Contributions

Authors have reviewed the final version of the case report to be published and agreed to be accountable for all aspects of the work.

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