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Autologous blood patch pleurodesis for persistent air leak related to parapneumonic hydropneumothorax: A case report

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Abstract

Introduction: Persistent air leaks are defined as lasting longer than five days and having consequences for morbidity, hospital length of stay, and health care costs. Autologous Blood Patch (ABP) pleurodesis is well-studied for the treatment of persistent air leaks in adults but remains understudied in children.

Case report: We present the case of an 8-year-old boy who presented to the Emergency Department with fever, tachypnea, and cough. Radiographs demonstrated a right hydropneumothorax. Despite antibiotics and chest tube placement, the hydropneumothorax persisted and he developed a persistent air leak. Computed-tomography scan revealed a multifocal, right-sided pneumonia with necrosis and cavitation. There were also multiple bronchopleural fistulae in communication with a large, loculated hydropneumothorax. After several multidisciplinary meetings, the decision was made to proceed with ABP pleurodesis. Using the methods described by Lillegard et al., we collected 1 cc/kg of autologous blood via a large bore peripheral IV. The blood was rapidly injected through the chest tube, which was clamped. After three hours, the drain was unclamped and placed to waterseal. His air leak resolved within 24 hours and his post-procedure radiographs were stable, so his drain was removed and he was ultimately discharged.

Conclusion: Multiple treatments have been described for treatment of persistent air leaks in adults, including chemical and mechanical pleurodesis, as well as surgical therapy. However, studies are lacking in the pediatric population. ABP pleurodesis may be a safe and effective treatment for persistent air leaks in children.

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Introduction

Persistent Air Leak (PAL), typically defined as an air leak lasting greater than 5 to 7 days, is an uncommon but clinically significant complication of pulmonary pathology and thoracic intervention. PAL is associated with prolonged hospitalization and increased health care utilization and cost [1]. The most recent management guidelines for PAL recommend early surgical evaluation and consideration of thoracoscopic intervention; however, they do not address treatment strategies for poor surgical candidates or newer non-surgical treatment options [2,3]. Additionally, there are no established guidelines for the management of PAL in the pediatric population.

Several non-surgical treatment modalities have demonstrated efficacy in adult patients with PAL refractory

to conservative measures, including chemical pleurodesis, Autologous Blood Patch (ABP) pleurodesis, and endobronchial valve placement. In children, however, the long-term effects of chemical pleurodesis remain uncertain and endobronchial valve placement may be precluded by anatomical constraints in smaller patients. ABP pleurodesis, in contrast, has emerged as a promising alternative for PAL in children and adolescents [4-6].

We report the successful use of ABP pleurodesis in a child with a parapneumonic hydropneumothorax and PAL secondary to a bronchopleural fistula. This manuscript was prepared following the CARE guidelines.

Case report

A previously healthy 8-year-old boy presented to the emergency department with a 1-week history of fever, dyspnea, and cough. Plain chest radiograph (Figure 1) revealed a large right-sided hydropneumothorax, likely secondary to underlying pneumonia. He was admitted to the hospital for parenteral antibiotics and underwent tube thoracostomy in the angiography suite, resulting in initial clinical and radiographic improvement; however, an air leak was noted on the chest tube drainage system post-procedurally. Pleural fluid culture ultimately grew *Streptococcus pneumoniae*.

Despite appropriate antimicrobial therapy and pleural drain replacement, the hydropneumothorax persisted and the patient developed a persistent air leak. This was concerning for a bronchopleural fistula, so intrapleural alteplase was not administered. Computed Tomography (CT) of the chest (Figure 2) was performed on hospital day 19, which revealed a multifocal, right-sided necrotizing pneumonia with multiple bronchopleural fistulae in communication with the large, loculated hydropneumothorax. In light of the PAL with failure of conservative management, the patient was evaluated for operative and non-operative interventions, including ABP pleurodesis, endobronchial valve placement, and thoracoscopy.

After 35 days of chest tube drainage and several multidisciplinary discussions, ABP pleurodesis was performed using the following methods described by Lillegard et al [4]. The procedure was performed at the bedside under sterile conditions. After clamping and disconnecting the chest tube from suction, it was cleansed and withdrawn slightly to confirm patency and freedom from adhesions. The treating surgeon then collected 1 mL/kg of autologous fresh whole blood via a large peripheral vein. The blood was immediately instilled into the pleural cavity through the existing chest tube and the tube was flushed with saline to prevent clot formation. The chest tube was clamped for 3 hours before being placed to waterseal. The patient was closely monitored for desaturations and he was repositioned several times to distribute the blood throughout the pleural cavity. The atrium was monitored for signs of an air leak and a chest radiograph was performed to evaluate for pneumothorax. In our case, the procedure was well-tolerated without complications. The air leak resolved within 24 hours and his post-procedure chest radiographs were stable; thus, the chest tube was removed on post-procedure day 2 and he was discharged home shortly thereafter.

At 10-month follow-up, he remained clinically well. Chest radiograph (Figure 3) demonstrated complete resolution of his hydropneumothorax with only mild residual pleural thickening and fibrotic changes.

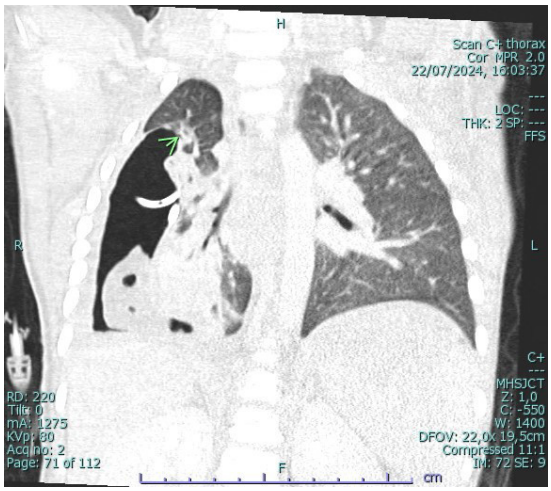

Figure 2: Commuted tomography performed on day 17 of treatment demonstrated a multifocal, right-sided pneumonia with a necrotic component in the right upper lobe. This was in continuity with a large peripheral zone of cavitation containing multiple bronchopleural fistulae (green arrow) in communication with a large, loculated hydropneumothorax.

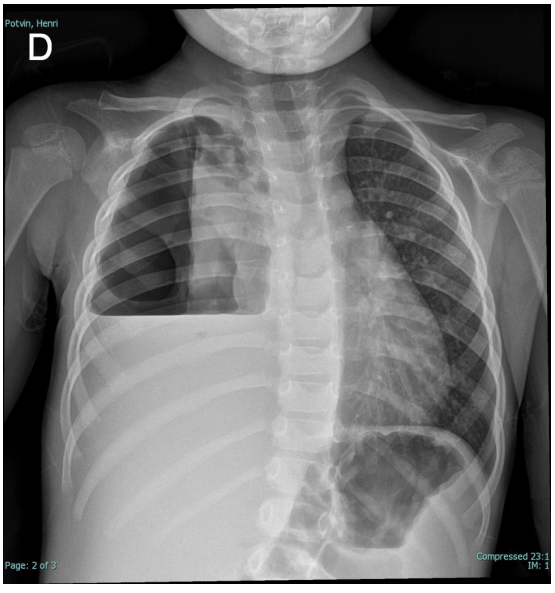

Figure 1: Chest radiograph performed as part of his initial evaluation revealed a large right-sided hydropneumothorax.

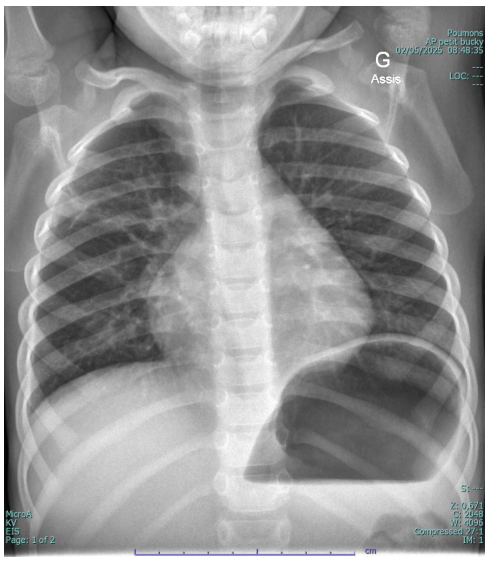

Figure 3: Chest radiograph at his most recent follow-up revealed complete resolution of his hydropneumothorax with only mild residual pleural thickening and fibrotic changes.

Discussion

PAL is a relatively uncommon but challenging complication of spontaneous pneumothorax, pleuropulmonary infection, and thoracic surgery. Due to its low incidence in the pediatric population, no guidelines currently exist to direct management. However, there is emerging evidence suggesting that ABP pleurodesis may be a safe, well-tolerated, and effective treatment option in children [4-6]. In our case, PAL resolved following a single, low-volume ABP pleurodesis without adverse events, providing further support for its utility in select pediatric patients. Despite these encouraging results, several important questions remain regarding the optimal timing and technique for the procedure.

While our patient responded to a single ABP pleurodesis, pediatric case series have reported lower success rates with a single procedure compared to the adult literature. In adults, a single ABP pleurodesis can achieve resolution of PAL in 48-100% of cases [7-10]. In contrast, the two largest pediatric case series have reported that 37-60% of children require multiple procedures to achieve PAL resolution [4,5]. Several factors may contribute to this discrepancy, including differences in underlying pulmonary pathology and variations in the volume of blood instilled. PAL in adults most often occurs due to secondary spontaneous pneumothorax or after pulmonary resection for lung cancer, whereas in children, infection is a much more common etiology. This distinction may affect the degree of inflammatory response required for PAL resolution and thus, contribute to the lower success rates of initial ABP pleurodesis observed in pediatric patients.

Blood volume used during ABP pleurodesis also differs significantly between children and adults. While adult procedures typically use fixed volumes of 50 to 150 mL, these amounts may not be feasible in small children. Pediatric protocols generally recommend weight-based dosing, most commonly 1-3 mL/kg [4-6,11]. Experimental animal models have demonstrated a positive correlation between the volume of blood instillation and the extent of pleural adhesion formation [12], suggesting that lower blood volumes may lead to a suboptimal inflammatory response and decreased efficacy. Thus, insufficient instillation volume may be a contributing factor to the reduced efficacy of a single ABP pleurodesis in children relative to adults.

The optimal timing of ABP pleurodesis also remains uncertain. Although our patient underwent successful ABP pleurodesis on day 35 of chest tube drainage, many authors advocate for the procedure to be performed early, typically between 5 and 9 days following diagnosis of PAL [13]. To date, no comparative studies have evaluated early versus late ABP, and no consensus exists on the ideal timing for the procedure. Proponents of early intervention argue that it may reduce the duration of chest tube drainage and hospital length of stay [10]. Interestingly, the available pediatric data suggests that delayed ABP may be associated with a higher likelihood of success with a single ABP procedure. For example, Lillegard et al. reported a 64% success rate after a single ABP pleurodesis when performed after a mean of 21 days, compared to a 40% success rate when Pruitt et al. performed the procedure after a median of only 7.5 days. This difference may reflect variations in timing of the procedure, blood volume, underlying pathology, or the natural history of PAL, which in some cases, may resolve without intervention.

Conclusions

While further investigation is needed to clarify the ideal timing and dosing strategies, ABP pleurodesis remains a promising, safe, and well-tolerated option for managing PAL in children.

Declarations

Authorship: All authors attest that they meet the current ICMJE criteria for Authorship

Informed consent: Informed consent was obtained from the patient or guardian.

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