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Autologous Blood Pleurodesis Through an Indwelling Pleural Catheter for the Management of Prolonged Air Leak in a Malignant Hydropneumothorax

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ABSTRACT

The British Thoracic Society guidelines recommend a surgical opinion in cases of prolonged air leak or failure of lung re-expansion after 3–5 days. The management of prolonged air leak in non-surgical candidates often proves to be more challenging, with no expert consensus guidelines on treatment options. There is a paucity of data for the treatment of patients with a prolonged air leak in the setting of a hydropneumothorax, who are not suitable surgical candidates. We present the case of a novel treatment approach for an 89-year-old male with a symptomatic, large malignant pleural effusion treated initially with a routine chest tube drainage. Subsequent management was complicated by a hydropneumothorax with a persistent and large volume air leak. He was treated successfully with an autologous blood pleurodesis using an indwelling pleural catheter. Here we describe a novel management approach for persistent air-leak in the setting of a malignant hydropneumothorax. Autologous blood pleurodesis via an indwelling pleural catheter appears to be a safe and effective treatment option for non-surgical candidates and allows ongoing long-term drainage of a malignant effusion and air leak.

1 | Introduction

There is increased evidence for the use of indwelling pleural catheters (IPC) for malignant pleural effusions, which reduce the frequency of subsequent procedures and hospital length of stay [1]. Similarly, for prolonged air leak (PAL), ambulatory devices including the use Heimlich valve have facilitated outpatient management and reduced hospitalisations [2]. The current literature provides little guidance on the management of prolonged air leak in the setting of malignant pleural effusion and hydropneumothorax [3].

Autologous blood pleurodesis (ABP) through a chest tube is often attempted in non-surgical candidates with PAL, with one study demonstrating a success rate of 82% [4]. The procedure is most frequently carried out in patients with a PAL following lung surgery to varying degrees of efficacy (27%–85%) [5–7]. However, there are no documented studies that describe ABP through an IPC.

This case presents an alternative approach to the management of PAL complicated by hydropneumothorax in non-surgical candidates, using an IPC, which enables a decreased length of hospital

stay and improved patient outcomes. In utilising this unique approach, a patient was able to fulfil their wishes to be discharged home safely, which otherwise would not have been possible.

2 | Case Report

An 89-year-old male presented to the hospital with a history of subacute breathlessness, worsening over the preceding week, accompanied by unintentional weight loss.

His medical history included congestive cardiac failure with a left ventricular ejection fraction of 28%, ischaemic heart disease, hypertension, non-insulin-dependent type II diabetes mellitus, and a previous ischaemic stroke. He was a lifelong non-smoker who had become increasingly frail prior to presentation and was nearly bedbound with a strong reliance on family assistance for personal care (Eastern Cooperative Oncology Group [ECOG] Performance Status 4).

Physical examination demonstrated reduced air entry throughout the entire left lung field, with dullness to percussion, consistent with a left-sided pleural effusion. There was no clinical evidence of cardiac failure, and he required 1 L/min of oxygen via nasal cannulae for hypoxaemia.

Chest x-ray (CXR) and computed tomography (CT) (Figure 1A,B) showed complete opacification of the left hemithorax from a large left pleural effusion, complete left lung collapse, and mediastinal shift to the right. A whole-body CT scan did not demonstrate evidence of malignancy elsewhere.

A 14-French intercostal catheter (ICC) was inserted basally and drained approximately 1750 mL in the first 48 h. Pleural fluid biochemistry demonstrated an exudative effusion, and cytology demonstrated malignant cells with features suggestive of a possible upper gastrointestinal (GI) tract malignancy, confirming the diagnosis of a malignant pleural effusion and metastatic cancer. Following a family discussion, a symptom-based approach was agreed upon, and the patient's desire was to be managed at home in the presence of family.

Following the drainage of the majority of the pleural effusion on the second day post-ICC insertion, the CXR demonstrated incomplete lung expansion with a hydropneumothorax (Figure 2A), suggestive of a trapped lung. Intermittent bubbling (Cerfolio Grade 2) was observed in the underwater seal drain with respiration, suggestive of an air leak.

A repeat CT chest after the effusion was completely drained was performed, which demonstrated small pulmonary nodules measuring up to 4 mm in diameter, but did not identify a definite location of the air leak. The ICC was placed on wall suction at $-20\,cmH_2O$, to determine if lung re-expansion would occur with air drainage. However, there was minimal lung re-expansion with a continuous air leak (Cerfolio Grade 4). Additionally, pleural effusion drainage persisted at a rate of at least 300 mL per day and did not slow over the subsequent days. A trial of ICC clamping was attempted on day 10 of ICC insertion to assess whether allowing re-accumulation of the fluid in the pleural space would reduce the air leak. This proved unsuccessful and was complicated by worsening breathlessness and oxygen desaturation over the subsequent 4 h. Chest x-ray imaging demonstrated an enlarging pneumothorax, requiring immediate unclamping of the ICC. This implied the rate of air leak was faster than the rate of effusion re-accumulation.

Given the patient's age, comorbidities, and high anaesthesia risk, he was deemed unsuitable for both surgical and bronchoscopic management of his hydropneumothorax. The rate of pleural fluid output prevented the safe use of a Heimlich valve, and the rapid accumulation of air following clamping meant that any drain occlusion or dislodgement occurring at home with a drainage device (e.g., mini atrium) could prove to be fatal. Furthermore, he was very symptomatic from his original pleural effusion; thus, allowing the pleural space to simply fill up again would result in significant breathlessness.

ABP was not attempted through the ICC given the drain had been in situ for 12 days and the insertion site appeared erythematous, conferring a high infection risk. A decision was made to insert another drain, this time an indwelling pleural catheter (IPC) (Pleurx), which would allow for long-term management of his malignant hydropneumothorax with less risk of drain dislodgement due to the tunnelled nature of insertion and the larger diameter (15.5 French) allowing a greater amount of air to be evacuated. To reduce the degree of air leak, promote pleurodesis, and reduce the risk of a fatal tension pneumothorax at home, ABP was performed through the new IPC. This was

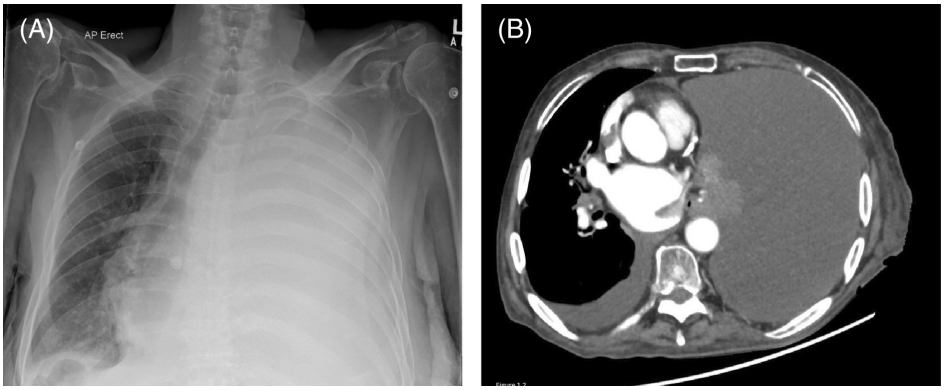

FIGURE 1 | (A) Initial chest x-ray demonstrating complete opacification of the left hemithorax. (B) CT chest confirming the presence of a massive left pleural effusion.

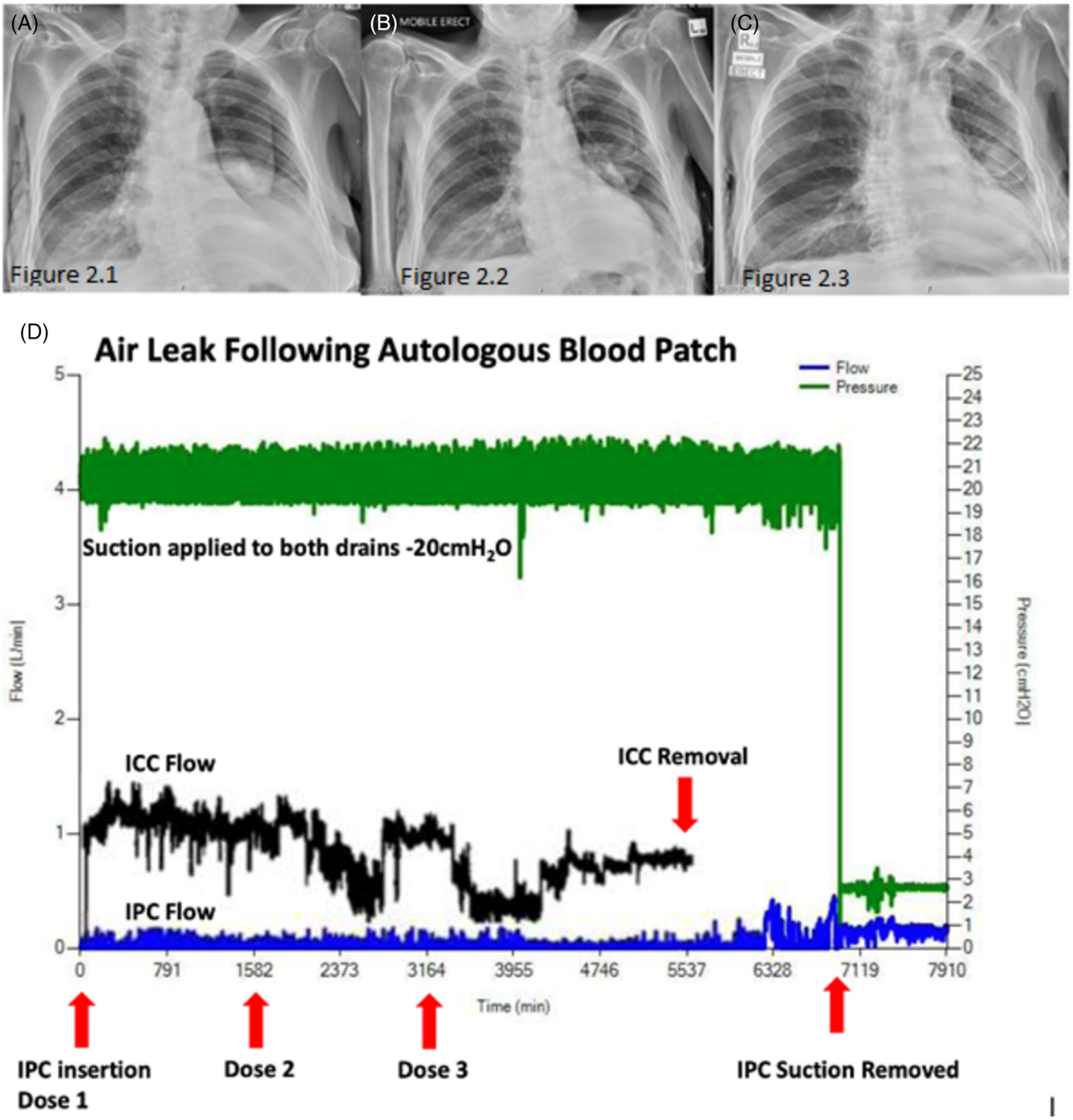

FIGURE 2 | A (top right)—Chest x-ray day 2 of ICC—moderate left-sided hydropneumothorax. (B) (top middle)—Chest x-ray after the first blood pleurodesis demonstrating persistent pneumothorax. (C) (top left)—Chest x-ray after the third blood pleurodesis demonstrating the expansion of the left lung. (D) (bottom)—Data from the portable suction unit (PSU) Rocket TM device after the first dose of autologous blood patch. This demonstrates a reduction in the rate of air leak from ICC following the 2nd and 3rd autologous blood patch doses. There was an ongoing observed reduced air leak ('less bubbling'), although the flow rate through ICC increased slightly on day 3, a successful trial of clamping was performed and ICC was removed, with only a minor increase in air leak from IPC, which settled after the removal of suction. Air leak never visually returned to pre-blood patch levels and there was no increase in pneumothorax size on serial radiographs upon clamping the ICC.

performed after utilising the basal ICC (original ICC) to fully drain the pleural space dry using manual fluid aspiration, after which 100 mL (1.5 mL/kg) of autologous blood was drawn from the patient using a new sterile intravenous cannula and flushed into the IPC. Both the IPC and basal ICC were looped over an intravenous pole for 2 h and left unclamped to keep the blood in the pleural space and simultaneously allow for the evacuation of air. As the first dose did not completely abolish the air leak, the procedure was repeated daily for a total of 3 doses. Both drains were connected to a Rocket digital drainage device for ongoing monitoring of the air leak and placed on $-20\,cmH_2O$ of suction to promote lung re-expansion (Figure 2D).

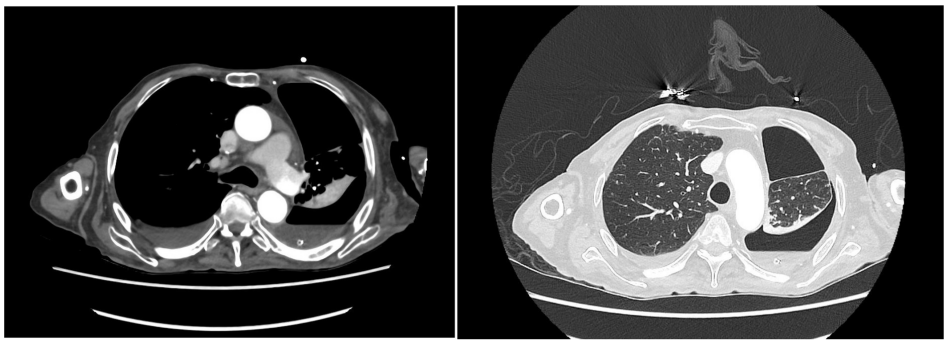

FIGURE 3 | Small residual hydropneumothorax on the left with the indwelling pleural catheter appropriately located within the effusion. Visceral pleural thickening of the left lung. Small pleural effusion on the right.

Following the third blood pleurodesis, CXR demonstrated expansion of the lateral left lung with apposition of visceral/parietal pleura. Only a small apical and basal pneumothorax remained (Figure 2C).

The basal ICC was able to be removed following a successful trial of clamping, without evidence of an enlarging pneumothorax after 4 h. The IPC was taken off suction, and there continued to be only minimal bubbling on coughing (Cerfolio Grade 1 at most), with an air leak of < 20 mL/min as demonstrated by the digital drainage device. The IPC was attached to a 500 mL Mini-Atrium Express drainage device. The patient was successfully discharged home with community nurse services and regular at-home emptying of the drainage device. The patient passed away 1 month later due to limb ischaemia; however, in that time, there were no complications related to the pleural effusion or evidence of worsening air leak. CT imaging performed on his terminal admission demonstrated visceral pleural thickening, with a small residual hydropneumothorax (Figure 3).

3 | Discussion

Tube thoracostomy, the insertion of an intercostal catheter into the pleural cavity, is a common treatment for both pleural effusion and pneumothorax. Whilst not documented as a frequent complication of intercostal catheter placement, a small American study concluded that after small-bore catheter placement for malignant pleural effusion, there was a resultant pneumothorax in 31% of patients [8], primarily due to trapped lung. However, there have been several case reports of hydropneumothoraces developing following drainage of malignant pleural effusions in patients, particularly those with mesothelioma [9].

The choice of management of PAL is determined by the volume, duration, and trend of the air leak, in combination with patient considerations. Small air leaks can often be managed conservatively with or without suction; however, larger air leaks often require further intervention. Current expert consensus recommends thoracic surgical consultation for video-assisted thoracoscopic surgery (VATS) or thoracotomy to manage an air leak persisting > 4 days [7]. Bronchoscopic management of PAL includes selective balloon bronchial occlusion, sealants, sclerosants, implants, and more recently, endobronchial valves [4]. If the patient is not a suitable surgical or bronchoscopic candidate, or deemed to be a high-risk anaesthetic candidate, other approaches such as chemical or ABP are utilised if appropriate. Chemical pleurodesis generally requires apposition of the visceral and parietal pleura to be successful. Rates of success in previously documented studies of ABP for PAL are variable and range from 27% to 85% [6] and up to 30% of patients may require multiple ABP procedures [10].

Malignant pleural effusion complicates many advanced malignancies, causing varying degrees of dyspnoea that can severely compromise a patient's quality of life. The use of an IPC in these patients has been proven to be a cost-effective intervention for symptomatic relief, avoiding prolonged hospitalisation and reducing subsequent procedures, whilst experiencing minimal adverse effects [11, 12].

While IPCs are commonly used to administer talc to promote pleurodesis [13], to the best of our knowledge, there are no previous documented successful attempts to perform ABP through an IPC. This case presents a novel approach in combining the use of an IPC to manage a malignant pleural effusion and utilising ABP in the management of PAL in a non-surgical and non-bronchoscopic candidate to enable facilitation of the patient and family's wishes to return home for symptom management.

In conclusion, IPC can be considered a treatment for malignant hydropneumothorax to drain both fluid and air. This is particularly important for non-surgical candidates and those unable to attend regular appointments for ambulatory management of short-term drains, that is, palliative and frail patients. Adjunctive intrapleural treatment, including both talc and autologous blood, can be given via IPC with no evidence of short-term complications. A 15.5F larger bore IPC may be more effective for facilitating concurrent air and fluid removal compared to conventional small bore drains alone.

Author Contributions

Vanessa Wong: manuscript writing and editing. **Bapti Roy:** manuscript reviewing and editing. **Sathya Balaguruswamy:** review of manuscript.

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Ethics Statement

The authors declare that appropriate written informed consent was obtained for the publication of this manuscript and accompanying images.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

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