Respiratory Medicine Case Reports 31 (2020) 101257

Contents lists available at ScienceDirect

Respiratory Medicine Case Reports

journal homepage: http://www.elsevier.com/locate/rmcr

Case report

Prolonged air leak after IPC insertion: An unusual complication

Malvika Bhatnagar [a,*], Robert Slight [b,d], Arun Brahmanya Prasad [a,c], Andrew Ewing Stanton [a]

[a] Department of Respiratory Medicine, Freeman Hospital, Newcastle Upon Tyne Hospitals NHS Trust, Freeman Road, High Heaton, Newcastle Upon Tyne, NE7 7DN, United Kingdom
[b] Department of Cardiothoracic Surgery, Freeman Hospital, Newcastle Upon Tyne Hospitals NHS Trust, Freeman Road, High Heaton, Newcastle Upon Tyne, NE7 7DN, United Kingdom
[c] Department of Respiratory Medicine, Royal Victoria Infirmary, Newcastle Upon Tyne Hospitals NHS Trust, Queen Victoria Road, Newcastle Upon Tyne, NE1 4LP, United Kingdom
[d] Newcastle University, Newcastle Upon Tyne, NE1 7RU, United Kingdom

ARTICLE INFO

Keywords:
Indwelling pleural catheter
Air leak
Visceral pleural disruption
Negative suction

ABSTRACT

Indwelling pleural catheters [IPC] have an important role in the management of malignant pleural effusions. We report the development of a significant air leak following IPC insertion with resultant extensive subcutaneous emphysema. The air leak developed, presumably, as a result of visceral pleural disruption, which occurred at the time of vacuum drainage of pleural fluid after IPC placement and not due to lung injury during insertion. The patient required insertion of a large bore intercostal drain connected to low-pressure negative suction. He was eventually discharged home with the aid of an ambulatory system. Although commonly seen in the surgical setting, we believe emergency and respiratory physicians should be aware of the risk of such a complication, and the challenges in its management.

1. Introduction

Indwelling Pleural Catheters [IPCs] are an important tool in the management of recurrent malignant pleural effusions [MPEs] [1]. They are particularly well established in the management of patients with a "trapped lung" wherein the lung is unable to expand completely following pleural fluid drainage due to either a thickened restrictive visceral pleural covering [1], or endobronchial obstruction.

Though relatively safe, IPCs can be associated with complications such as pleural infection, catheter blockage, and catheter tract metastases [2]. It is not uncommon to see a small pneumothorax on X-ray following IPC insertion as air can enter the pleural space during the procedure. Rarely, subcutaneous emphysema can occur post procedure, though this is mostly reported in patients undergoing video-assisted thoracoscopic surgery [VATS] or medical thoracoscopy [2,5].

We report a case of extensive surgical emphysema following IPC insertion in a patient with a trapped lung who did not have a prior thoracoscopic procedure. Though an infrequent occurrence, we believe this case lends some important learning points.

2. Case presentation

A 67-year old gentleman was referred to our pleural service for management of a large left-sided malignant effusion due to poorly differentiated adenocarcinoma of the lung [with PDL1 positivity measured at 60–70%]. Despite treatment with pembrolizumab, he developed a large symptomatic pleural effusion. An initial therapeutic aspiration of 700 mL of thick haemorrhagic fluid was performed with minimal symptomatic improvement and the post aspiration chest X-ray showed no pneumothorax. Accordingly, he was offered insertion of an IPC, to which he consented. Thoracic ultrasound confirmed a large free flowing effusion with maximum fluid depth of 9.2 cm at the point of pleural entry for the IPC. The IPC was inserted without any immediate complications, and 1.9 L of haemorrhagic pleural fluid was drained using two 1-Litre vacuum drainage bottles, immediately after inserting the IPC. A post procedure chest X-ray showed some reduction in the effusion but not complete resolution. There was no pneumothorax visualized, and he was discharged home that day (Fig. 1).

Approximately 36 hours later, he presented to the emergency department with voice change, facial and neck swelling, and breathlessness. He was found to have subcutaneous emphysema involving his

* Corresponding author.
E-mail addresses: malvika.bhatnagar@nhs.net (M. Bhatnagar), bob.slight@nhs.net (R. Slight), arun-brahmanya.prasad@nhs.net (A.B. Prasad), andrew.stanton@nhs.net (A.E. Stanton).

https://doi.org/10.1016/j.rmcr.2020.101257
Received 13 July 2020; Received in revised form 10 October 2020; Accepted 11 October 2020
Available online 16 October 2020

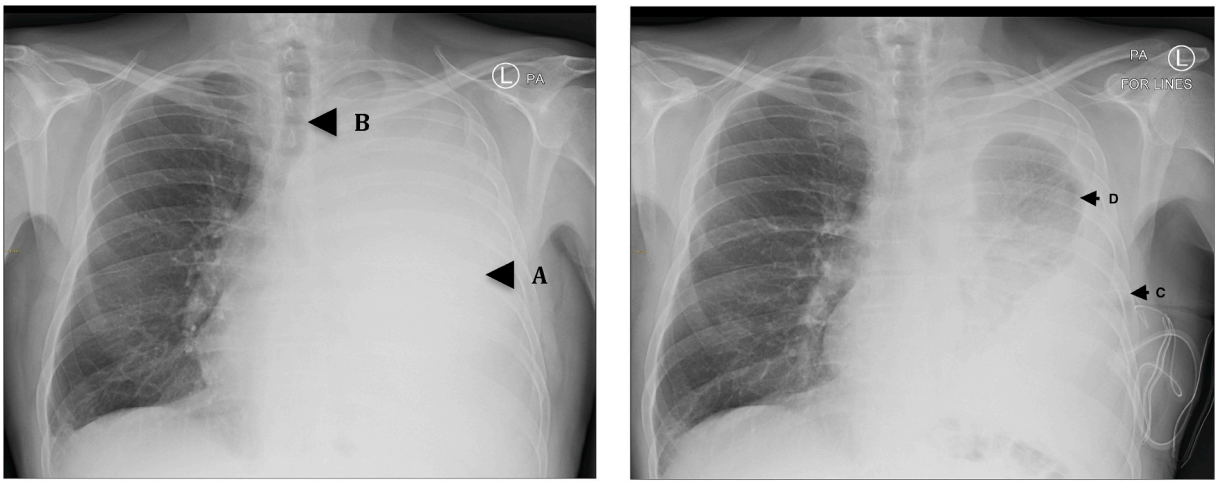

Fig. 1. Comparison of chest X-rays before and after IPC insertion; X-ray on left shows a large left sided pleural effusion [A] with tracheal deviation to the right [B]; X-ray on the right is after IPC insertion, showing left sided pleural catheter in situ [C] and improved aeration of left lung [D]. No pneumothorax or subcutaneous emphysema seen.

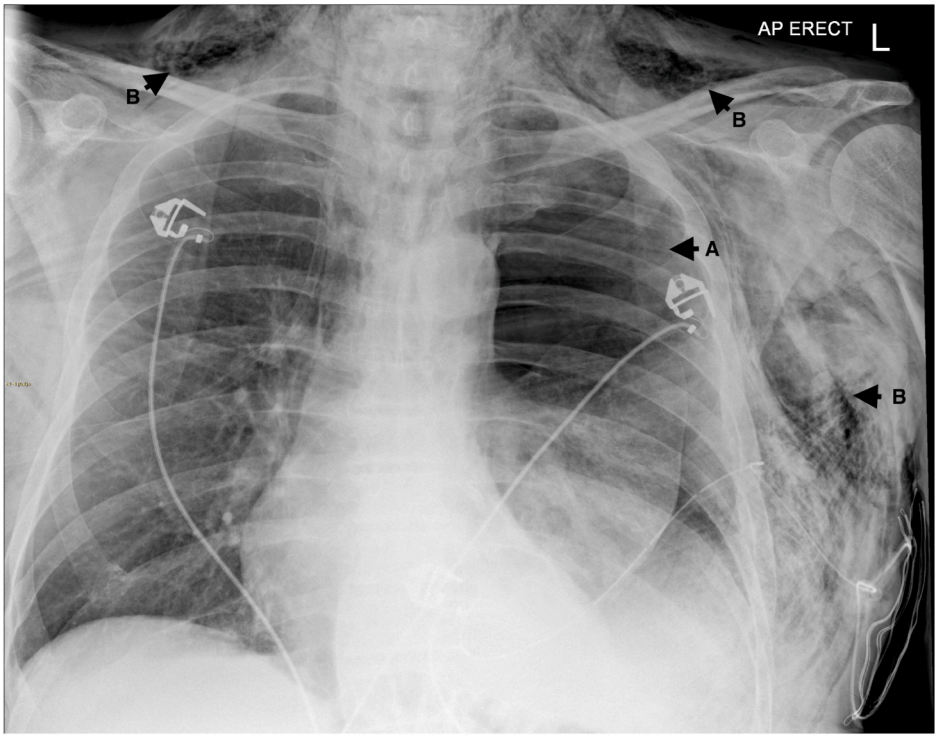

Fig. 2. Chest X-Ray done on presentation to the emergency department, showing left pneumothorax [A] with extensive subcutaneous emphysema [B] in the chest wall and extending to the neck bilaterally.

neck and face; however, he was saturating in excess of 94% on room air with no evidence of hypotension. A repeat chest X-ray demonstrated a moderate left-sided pneumothorax as well as extensive subcutaneous emphysema (Fig. 2). Although no domiciliary drainage from the IPC had been performed since insertion, the admitting team was able to flush and aspirate through the IPC with no leak evident at the drain exit site or through the incision above entry to pleural space. There was no evidence of dislodgement of the cuff or IPC displacement. The IPC was, thus, connected to an underwater seal, and a negative suction of −2.5 cmH2O was applied. A persistent leak was noted, and the negative suction was increased to −10 cmH2O.

Unfortunately, about 12 hours later, the subcutaneous emphysema progressed involving the eyelids and the patient was more breathless. A repeat chest X-ray demonstrated significant pneumothorax. A large bore 26 Fr intercostal drain was thus inserted on the left side.

3. Investigations

A CT scan of the chest showed a moderate left sided pneumothorax, with both the drains being well sited and no evidence of any bronchopleural fistula (Fig. 3). The left lower lobe tumor appeared unchanged and progression of pleural thickening was noted.

4. Differential diagnosis

The mechanism of development of such significant surgical

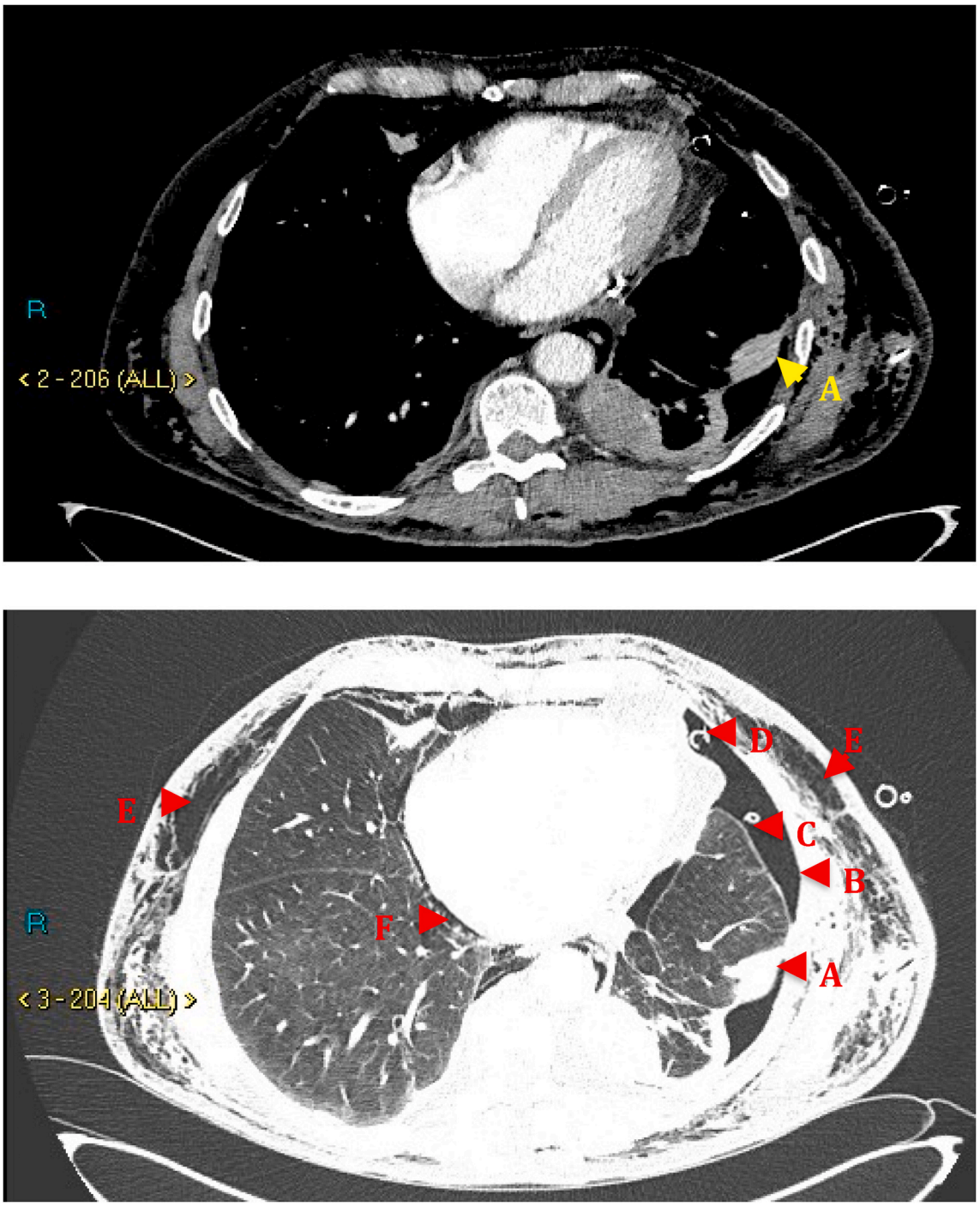

Fig. 3. CT Thorax; Mediastinal window [top] shows left pleural thickening [A]. Lung window [bottom] shows left sided pneumothorax [B] and pleural thickening [A]. Also seen are the two intercostal drains in the pleural space [C, D] and extensive subcutaneous emphysema [E] bilaterally along with pneumomediastinum [F].

emphysema in this patient was initially unclear to the admitting team. One potential reason for surgical emphysema post IPC insertion is poor placement with a fenestration sitting in the extrapleural space. However, this is unlikely in the absence of significant obesity assuming the subcutaneous tract of the IPC is not excessively long. Dislodgement may be another possibility, but this was not the case in our patient as the IPC was well sited and functional. Another important consideration is a bronchopleural fistula, which can develop if there has been lung injury during the procedure, particularly if the dilator is inserted too deeply in the context of a shallow effusion. This was felt unlikely, however, as at the time of thoracic ultrasound prior to IPC insertion, the effusion was almost 10 cm deep from the parietal pleura. Additionally, there was no air drained after the procedure and no pneumothorax was noted on the X-ray after IPC insertion. Finally, with no bronchopleural fistula seen on the CT scan, this explanation was thought to be unlikely.

A more remote possibility, perhaps, could be rupture of a pleural metastatic deposit or a pleural bleb (though there was no evidence of this on a previous CT scan) that coincided with the time of IPC insertion; but the likelihood of two such events occurring so close together would seem unlikely. Lastly, the final and most probable causality is that a visceral pleural tear would have occurred at the time of vacuum-assisted drainage of pleural fluid immediately after IPC insertion, subsequently

leading to the development of pneumothorax and air leak. Although this was not evident on immediate post procedure CXR, it seems most likely that this simply was not large enough to be immediately evident. The patient gave no history to suggest significant extreme changes in intra-thoracic pressure (e.g. straining at stool) to precipitate the event otherwise, but there is the possibility this could have aggravated the situation.

5. Treatment and follow-up

Over the next 5 days, the patient showed good clinical improvement and there was significant reduction in the surgical emphysema. Unfortunately, following an episode of acute delirium, both drains were dislodged a week after insertion. Therefore, a second 26 Fr intercostal drain was inserted, which was, again connected to an underwater seal and negative suction of −2.5 cmH2O. The patient continued to show clinical improvement along with reduction in the air leak, though this did not completely resolve. Therefore, an ambulatory system was connected to the drain, and after ensuring that there was no clinical or radiological worsening of the pneumothorax, the patient was discharged home with the drain in situ. At subsequent follow-up visits, the air leak was found to be reducing along with radiological improvement in the pneumothorax. Eventually, the drain and bag were removed, 2 weeks post discharge, and he resumed follow-up with the respiratory physicians, with an X-ray at that point showing complete re-expansion of the lung and no residual pneumothorax.

6. Discussion

With the expanding role of IPCs in MPE management, medical professionals working in emergency and acute medical services are likely to encounter patients with IPCs and should be aware of associated complications. Our case demonstrates an unusual albeit important complication that occurred following IPC insertion. The likely explanation for the development of extensive subcutaneous emphysema and air leak was thought to be due to a tear in the visceral pleura caused at the time of vacuum drainage of pleural fluid after IPC insertion.

It is known that under normal conditions, the pressure in the pleural space is negative, in the range of −3 to −8 cmH2O. This negative pressure allows for a balance between chest wall expansion and elastic recoil [3]. When fluid occupies the pleural space i.e. in a pleural effusion, the pressure in the pleural space becomes positive. In a normal lung, when thoracocentesis is performed, the pressure in the pleural space falls in a linear fashion as the fluid is removed, allowing complete expansion of the lung. However, in a partially trapped lung, such as in our patient, though the initial pleural pressure is positive and falls in a linear manner when draining the pleural fluid, there comes a point when there is a steep drop in the pleural pressure due to inability of the lung to expand further [4]. A vacuum device attached to a drain in the pleural space would continue to cause further reduction in pleural pressure. It is postulated that this reduction in pressure could cause tears in the lung cortex or visceral pleura (akin to having a painful foot callus that cracks), thereby resulting in an air leak. We drained a large volume at the time of IPC insertion because the prior therapeutic aspiration of 700 mLs of pleural fluid had no impact on symptoms, and hence, a larger drainage was clinically appropriate. Our patient tolerated this larger volume thoracocentesis at the time of insertion. A recently published retrospective study concluded that symptom-limited thoracocentesis of large volumes of pleural fluid using suction is generally safe, though about 4% of patients developed a pneumothorax post drainage, with MPE related to lung and breast cancer being at greater risk of having this complication [5].

This phenomenon has been reported after VATS and medical thoracoscopy [6], presumably due to the frequency of suction being applied to lung with visceral pleural thickening. Regardless of the underlying cause, air leaks can be challenging to manage. The BTS Guidelines for pneumothorax recommend use of negative suction for a persistent air leak in the context of spontaneous pneumothorax, but the value of routine use of suction is a source of debate [7]. This is applicable for post thoracic surgery patients as well, who may have developed an early postoperative air leak. Ongoing management is essentially conservative with adequate tube drainage of the pleural space to keep up with the air leak and to allow the lung time to heal, rather than any further thoracic surgical intervention [8]. In the context of presumed visceral pleural tear, suction should be avoided where possible but in our case, with such significant symptomatic subcutaneous emphysema, judicious use of this was needed.

In summary, this case highlights uncommon yet important sequelae of IPC insertion for acute, emergency and also respiratory physicians not undertaking thoracoscopy.

7. Learning points

The important learning points from this case are as follows:

1. Though rare, IPCs can be associated with the development of an air leak in the context of a trapped lung. The likely mechanism for this is a visceral pleural tear occurring as a consequence of vacuum drainage of pleural fluid.
2. If a patient with an IPC presents with subcutaneous emphysema, it is important to ensure that the drain is patent and not dislodged, and to check the site for leak. A chest CT may be helpful in determining if a fenestration is present in the extrapleural space.
3. Negative suction may potentially cause worsening of an air leak especially if the underlying pathophysiological mechanism is suspected to be a visceral pleural tear.

CRediT author statement

Malvika Bhatnagar: Conceptualization, Writing – Original Draft, Writing – Review and Editing.

Robert Slight: Writing – Review and Editing.

Arun Brahmanya Prasad: Writing – Review and Editing.

Andrew Ewing Stanton: Conceptualization, Writing – Review and Editing, Supervision.

Declaration of competing interest

None.

References

[1] A. Bibby, P. Dorn, I. Psallidas, J. Porcel, J. Janssen, M. Froudarakis, et al., ERS/EACTS statement on the management of malignant pleural effusions, Eur. Respir. J. 52 (1) (2018) 1800349.
[2] R. Bhatnagar, N. Maskell, Indwelling pleural catheters, Respiration 88 (1) (2014) 74–85.
[3] S. Lai-Fook, Pleural mechanics and fluid exchange, Physiol. Rev. 84 (2) (2004) 385–410.
[4] M. Pereyra, L. Ferreiro, L. Valdés, Unexpandable lung, Arch. Bronconeumol. 49 (2) (2013) 63–69.
[5] A. Sagar, M. Landaeta, A. Adrianza, G. Aldana, L. Pozo, A. Armas-Villalba, et al., Complications following symptom limited thoracentesis using suction, Eur. Respir. J. (2020) 1902356.
[6] T. Nicholson, B. Probyn, S. Scott, C. Daneshvar, A. Marchbank, The risk of surgical emphysema post VATS pleural biopsy and IPC, Thoracic surgery (2019).
[7] A. MacDuff, A. Arnold, J. Harvey, Management of spontaneous pneumothorax: British Thoracic Society pleural disease guideline 2010, Thorax 65 (2010) ii18–ii31.
[8] M.B. Marshall, M.E. Deeb, J.I. Bleier, J.C. Kucharczuk, J.S. Friedberg, L.R. Kaiser, et al., Suction vs water seal after pulmonary resection: a randomized prospective study, Chest 121 (2002) 831–835.