Official Case Reports Journal of the Asian Pacific Society of Respirology
Respirology Case Reports
OPEN ACCESS

Spontaneous fracture of indwelling pleural catheter

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Keywords
Complications, indwelling pleural catheters, spontaneous fracture.

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Received: 30 May 2018; Revised: 7 August 2018; Accepted: 14 August 2018; Associate Editor: Michael Hsin.

***Respirology Case Reports*, 6 (8), 2018, e00365**

doi: 10.1002/rcr2.365

Abstract

Indwelling pleural catheters (IPCs) are increasingly used for the management of symptomatic malignant pleural effusion worldwide. IPCs have been documented to reduce the number of hospital bed days in patients with malignant pleural effusion and thus are often used as the preferred mode of management in fit healthy patients with good performance status. Complications related to IPCs, mainly in the form of pleural infection and needle tract metastasis, are well reported in the literature. Similarly, fracture of IPCs is a recognized complication during the process of IPC removal. We report the first ever case of spontaneous fracture of IPC in a patient with Stage IV lung cancer with malignant pleural effusion who was undergoing active chemotherapy and symptomatic management of the pleural effusion with an IPC.

Introduction

Indwelling pleural catheters (IPCs) offer several advantages over talc pleurodesis and are thus increasingly used in the management of malignant pleural effusions, especially in the setting of a trapped lung [1,2]. IPCs are essentially silicon rubber tubes, where the fenestrated end is inserted into the pleural space and the shaft is tunnelled subcutaneously and secured with a pro-fibrotic polyester cuff, leaving the distal end with a one-way valve free ex vivo [1,2]. IPCs are designed to remain in situ indefinitely, allowing ambulatory fluid drainage with the primary goal of providing symptom relief in patients with malignant pleural effusion [1–3]. Although designed to remain in situ for a reasonable period of time, IPCs can be removed if it is not required for indicated use, for instance, if patient achieves auto-pleurodesis or there are serious adverse events directly related to the device [2,4]. Removal of IPC involves dissecting fibrous adhesions around the cuff followed by withdrawal of the tube, which occasionally requires the application of force [4]. Fracture of IPC is a recognized complication of IPC removal, with rates reported to be less than 10% [1,4,5].

We report, as far as we are aware, the first case of spontaneous fracture of IPC.

Case Report

A 67-year-old male, ex-smoker with a 60 pack year history, presented with an insidious cough, progressive dyspnoea with exercise intolerance, and weight loss. He was found to have a large right-sided pleural effusion. An intercostal chest catheter was placed, and the effusion was drained, resulting in symptom relief. The underlying trapped lung was identified. Pleural fluid was exudative, and cytology showed an adenocarcinoma stained for thyroid transcription factor 1 (TTF-1), Kirsten rat sarcoma viral oncogene (KRAS), and Anaplastic lymphoma kinase (ALK) fluorescence insitu hybridization (FISH). A diagnosis of stage 4 lung adenocarcinoma was made.

He has a background of dyslipidaemia, hypertension, L5 radiculopathy, peripheral vascular disease, and a recent transient ischaemic attack for which he is on therapeutic anticoagulation. He was commenced on palliative chemotherapy with carboplatin and gemcitabine. Two subsequent symptomatic right pleural effusion recurrences were managed with large-volume thoracenteses as the patient was reluctant about definitive treatment with an IPC as it interfered with his active lifestyle and swimming.

Finally, at six months post-diagnosis, he accepted definitive management. An IPC (Rocket IPC pleural or peritoneal catheter, Rocket Medical) was placed in the seventh

intercostal space in the anterior axillary line to the right pleural space under ultrasound guidance with standard Seldinger guide wire and tunnelled technique as a routine day case.

The insertion site was selected based on pleural fluid location and to allow appropriate exit site access for future self-care of the catheter. There were no technical difficulties with the placement and no immediate complications. Post-procedure chest X-ray confirmed that the intact catheter was in an appropriate position. Catheter care education was provided by the pleural nurse before discharge. He was followed up in clinic weekly for two weeks and thereafter by the visiting nurse for drainage.

Two weeks post-insertion, patient reported difficulty in maintaining dryness of the site and was noted to have a cellulitic exit site, which was managed successfully with five days of cephalexin orally and no other intervention.

He settled into a routine ambulatory drainage of approximately 400 mL weekly.

Ten-week post-insertion, community nurses reported an abrupt reduction in weekly drainage to 160 mL, with no further drainage in subsequent two weeks. The patient slowly developed worsening dyspnoea and cough similar to initial fluid presentation.

Blocked IPC was suspected, and a 50-mL saline flush was unsuccessful at unblocking the tube. The patient proceeded to have a repeat chest X-ray, which revealed a spontaneous fracture of the IPC (Fig. 1). There was no identifiable precipitant such as trauma, tugging, or tampering of the device. Enquiry from the patient revealed normal daily activities with no undue stress to the insertion site or drain.

Figure 1. PA chest X-ray showing fractured IPC.

Bedside thoracic ultrasound performed in the clinic showed an enlarging right pleural effusion, with visualization of fractured IPC in pleural space.

The free-floating fractured IPC fragment was removed with rigid pleuroscopy under deep sedation with anaesthetic support using the optical rigid forceps. The distal subcutaneous IPC fragment was removed in the usual fashion following blunt dissection around the cuff.

The IPC fragments were noted to have severed at the section immediately proximal to the cuff. The fracture site had a ragged edge with both ends fitting well, indicating there was no missing segment (Fig. 2). As discussed with patient, immediate insertion of new IPC was not undertaken to allow time for assessment of symptoms. Furthermore, on direct visualization of the pleural space, the patient had achieved auto-pleurodesis with only basal trapped lung.

The patient was followed up two weeks post-IPC removal in the clinic where he reported moderate exertional dyspnoea associated with reduced performance status and re-accumulation of right pleural effusion along with development of tense ascites. Patient underwent insertion of an IPC for malignant ascites for symptomatic benefit, and the small right pleural effusion is being kept under observation.

Figure 2. Severed IPC fragments.

Discussion

We report the first case of spontaneous fracture of IPC ever reported in medical literature. Insights into IPC complications are increasing as clinical experience with the device improves due to widespread use [4]. IPC fracture is a recognized complication during IPC removal and occurs mostly as a result of incomplete dissection of the cuff from the surrounding adhesions, which will then result in the device being adhered to the tissue, followed by traction applied by operator during removal, resulting in stretching of the shaft, which eventually leads to IPC fracture [4]. The product information states the device is designed to withstand a minimum of 15 Newton force; however, this is not routinely quantified during removal.

Other postulated factors that may play a role in IPC fracture during removal include distal placement of the cuff (beyond 1 cm from exit site), which may lead to difficulties in dissecting the fibrous adhesions from the cuff, thereby increasing the risk of severing the catheter. A longer subcutaneous tract (greater than 5 cm) may result in catheter fenestrations being located outside the pleural cavity, within the chest wall or subcutaneous tissue, permitting tissue ingrowth and impeding removal [6]. Similarly, material deterioration or disintegration as a consequence of changes to the manufacturing process can cause structural failure of the catheters, which was noted to be a factor in one report or even proposed that tumour infiltration may play a role in the fracture of the IPC [5,7,8].

Extrapolating from reports of spontaneous fractures of other indwelling medical devices, there are some similarities but important differences as well. In the case of permanent pacemaker lead fractures, wear and tear has been implicated as a factor leading to fracture and distal embolization [9]. Other factors are non-adherence to post-procedure instructions by patients performing overhead arm manoeuvres, such as weight lifting, or even direct trauma that may occur because of activities such as wearing bags with straps over the shoulders [10–12]. Another important mechanism described is due to the entrapment of the leads between the clavicle and the first rib – "subclavian crush syndrome" [13]. A similar mechanism affects vascular devices such as central venous catheters (CVC), and totally implantable venous access ports inserted via the subclavian vein are compressed between the first rib and the clavicle, which is identified radiologically with the "pinched off sign" that can result in a tear or even complete transection of the CVC [14]. Similarly, in the case of vascular access devices, injection of various drugs and pressures associated with flushing the device, especially with a smaller syringe, has been implicated as mechanism for fractured device [15].

In our case, there was no evidence of excessive adhesions on the cuff during dissection, and there was no evidence of tumour infiltration on either fragment to postulate these as the culprit of spontaneous fracture. The location of the break, which was proximal to the cuff, is unique. Various postulations can be hypothesized regarding the mechanism of spontaneous IPC fracture. Proximity of IPC to the rib and constant friction during respiration may have led to the disintegration of the IPC, leading to spontaneous fracture. The IPC exit site remains inferiorly situated, thus applying traction to the IPC and accelerating the deterioration of its integrity.

Other mechanisms that can be hypothesized include damage to IPC during the insertion process or structural or manufacturing defect in the segment of the IPC immediately proximal to the cuff, leading to spontaneous fracture, although there was no clear evidence of either situation in our patient. Likewise, based on our clinical assessment and assessment of community nurses involved in draining IPCs in the community, there were no evidence of tampering of IPC by the patient.

Whilst from previous reports of IPC fracture during removal, none of the patients with retained IPC fragments experienced any adverse effects, we felt removal to be necessary to gain insight into this unique situation. This report, as far as we are aware, is the first report of spontaneous fracture of the IPC. It highlights the importance of ongoing vigilance during follow up and investigation with imaging early in the event so that there is an abrupt reduction in drainage volumes during follow up or the drain does not aspirate pleural fluid appropriately.

Disclosure statement

Appropriate written informed consent was obtained for publication of this case report and accompanying images.

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