Chapter

Indwelling Pleural Catheters

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Abstract

Indwelling pleural catheters (IPC) are now being considered worldwide for patients with recurrent pleural effusions. It is commonly used for patients with malignant pleural effusions (MPE) and can be performed as outpatient based day care procedure. In malignant pleural effusions, indwelling catheters are particularly useful in patients with trapped lung or failed pleurodesis. Patients and care givers are advised to drain at least 3 times a week or in presence of symptoms i.e. dyspnoea. Normal drainage timing may lasts for 15–20 min which subsequently improves their symptoms and quality of life. Complications which are directly related to IPC insertion are extremely rare. IPC's are being recently used even for benign effusions in case hepatic hydrothorax and in patients with CKD related pleural effusions. Removal of IPC is often not required in most of the patients. It can be performed safely as a day care procedure with consistently lower rates of complications, reduced inpatient stay. They are relatively easy to insert, manage and remove, and provide the ability to empower patients in both the decisions regarding their treatment and the management of their disease itself.

Keywords: indwelling pleural catheters, recurrent pleural effusion, malignant effusion, pleurodesis

1. Introduction

Indwelling pleural catheters (IPC) are now being considered worldwide for patients with recurrent pleural effusions [1]. It is commonly used for patients with malignant pleural effusions (MPE) and can be performed as outpatient based day care procedure. Talc pleurodesis and indwelling pleural catheters are the standard of care therapeutic options for the patients presenting with symptomatic malignant pleural effusions. In malignant pleural effusions, indwelling catheters are particularly useful in patients with trapped lung or failed pleurodesis. IPCs are effective, both in terms of symptom control and costs, and can dramatically improve the quality of life for patients who have traditionally needed lengthy hospital admissions.

2. Background

Indwelling pleural catheter (IPC) is a multi-fenestrated flexible silicone elastomeric chest drain with a polyester cuff which envelops the medial portion of the

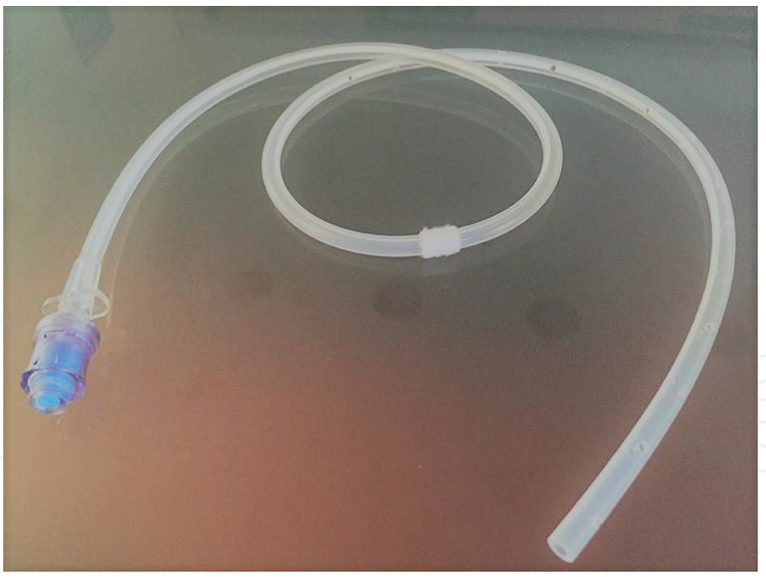

Figure 1.
Indwelling pleural catheter (IPC).

tube. The proximal end of tube has a one-way access valve designed to be attached to vacuum drainage bottles. Its distal part is tunneled through the subcutaneous tissue before placing it in the pleural space (**Figure 1**). Most widely used IPCs are pleurx catheter and IPC by Rockett medical. Pleurx catheter was approved by FDA in 1997 for patients with symptomatic malignant pleural effusions to relieve Dyspnea [2].

Before the advent of IPCs, conventional method for managing recurrent pleural effusions is to place a large bore chest drain with pleurodesis/multiple pleural aspirations. Some centers were able to offer more invasive procedures, such as parietal pleurectomy or pleuro-peritoneal shunting, but these inevitably carried a risk of morbidity and were limited to patients who were fit enough to undergo general anesthesia [3, 4].

3. History of indwelling pleural drains

A widely recognized precursor to indwelling pleural catheter was first described in 1994. Robinson et al. [5] treated 9 patients with recurrent MPE, who had previously failed pleurodesis, with a Tenckhoff catheter, which was tunneled into the pleural space under local anesthesia. Implantable Porta cath was also used in olden days for some patients for intrapleural immunotherapy used in mesothelioma [6].

4. Indications

- Recurrent pleural effusion predominantly due to malignant etiology.
- Trapped lung with symptomatic pleural effusions.
- Recurrent pleural effusion due to benign etiologies such as hepatic hydrothorax [7], chylothorax [8], CKD related effusions, loculated effusions [9], and empyema [10].

5. Contraindications

- Inability for the patient and care givers to handle or tolerate the drain.
- Significant coagulopathy.
- Parapneumonic effusion/empyema.
- Local cellulitis in the insertion site.
- Track metastasis over the proposed insertion site.
- Individuals in immunocompromised state due to systemic diseases.

6. IPC insertion

Most of this procedure can be performed as a day care procedure in outpatient settings. There is no need to admit the patient for IPC insertion unless clinically warranted. It is advisable to stop antiplatelet/antithrombotic medications before the procedure to minimize the risk of bleeding (Aspirin-withheld for 5 days, Clopidogrel—withheld for 7 days. IPC can be inserted in any position which is suitable for drainage. It is preferable to moniter his oxygen saturation and vitals during the procedure. Supplemental oxygen can be given to those patients who are dyspneic with hypoxemia. We often prefer to give supplemental oxygen to all our patients during the procedure.

It can be performed under conscious sedation with local anesthesia. The patient is typically placed in the lateral decubitus position, with the patient lying on the side contralateral to the effusion, although they can be inserted in other patient positions. Bedside ultrasound thorax is to be done which facilitates the site of entry and also helps to quantify the pleural effusion.

Under aseptic precaution, after local anesthetic (Lignocaine 1–2%) infiltration, two small incision are made, one at the pleural insertion point and another one 7–10 cm anterior to this, which will form the proximal end to the tunneled track. The IPC catheter is tunneled along this track with the pro-fibrotic cuff which promotes tissue growth and keeps the drain in-situ, situated approximately a third along the track.

The distal end of the catheter is then inserted into the pleural cavity, using the Seldinger technique. The incisions are then sutured closed, although the catheter itself is not sutured in place. A one-way valve on the external end is then attached to a drainage bag or vacuum bottle system.

7. Drainage

Patients and care givers are advised to drain at least 3 times a week or in presence of symptoms i.e. dyspnoea. Normal drainage timing may lasts for 15–20 min which subsequently improves their symptoms and quality of life. Drainage bottles are commercially available which are connected to proprietary one-way access valve on the external portion of the drain. Training to the patients and their family members has to be done for proper dressing and drainage by connecting the bottles with aseptic precautions. This drainage bottle is primed with a vacuum (**Figure 2**) in order to draw out the pleural fluid usually to a maximum of 1000 ml.

Figure 2.
Vacuum drainage bottles.

8. Complications

Complications which are directly related to IPC insertion are extremely rare [11].

9. Immediate complications

It is common to see a small pneumothorax in the post procedure chest X ray as a result of air being drawn into the chest during insertion. Such appearances may also be produced by trapped lung if significant volumes of fluid have been removed or trapped lung itself is seen in 20–30% of patients with malignant pleural effusion.

Large significant pneumothorax should prompt consideration of Iatrogenic injury to underlying lung and may warrant an extended period of observation before discharge.

Subcutaneous emphysema is also been documented post procedure. This demonstrates another reason why careful consideration should be given to track length, as if it is made too long there is the possibility of a fenestration remaining in the extrapleural space.

Post procedure pain can be seen in significant number of patients which can be usually managed with analgesics. Severe pain and discomfort should prompt concerns over irritation or damage to intercostal nerves. Patient may experience pain and discomfort at the end of drainage which indicates complete drainage of the pleural space which is often seen in those with underlying trapped lung. Wound Dehiscence in IPC is rarely reported.

10. Late complications

Initially there was a concern surrounding the risk of associated infections with indwelling pleural catheters. However, data from the observational and randomized studies have demonstrated a reassuring low incidence of associated infection

with one large multicenteric multinational retrospective study of over a 1000 patients, demonstrating a 4.8% IPC-related pleural infection rate [12]. Common organisms implicated are *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and Enterobacteriaceae which differ from the pattern what we usually expect in parapneumonic effusions [12].

Usually the infectious complications are reported after 6 weeks after the insertion of IPC which indicates they are not secondary to the insertion but due to later spread of pathogens from the patient's skin or lung parenchyma [13]. Proper care, IPC dressing and drainage techniques would help to minimize the risk. Reassuringly, the mortality rate from IPC-related infection is low (0.29%) and most of these patients can be managed with oral antibiotics [12]. There is no need to remove IPC as most patients responds very well to the therapy. If this approach is unsuccessful, then patient may require hospital admission for intravenous antibiotics and placing the catheter on continuous free-drainage to facilitate resolution of the infection. In case of loculated pleural effusions, Intrapleural thrombolytics like tissue plasminogen activator and DNAase can also be given via IPC [13].

In malignant pleural effusion insertion of IPC may lead to track metastasis usually occurs in malignant mesothelioma [14]. Reported cases in the literature are sparse, but the incidence of metastasis occurring appears to be just below 1% [15]. Diagnosis can be made clinically or using ultrasound-guided biopsy [16], followed by prophylactic radiotherapy to prevent track metastasis. There is nothing to suggest that radiotherapy damages the IPC [14] and treatment, based upon small case series, tends to be successful, obviating the need for drain removal [17].

IPC blockage is another concern one need to consider since patency of the tube is important for effective drainage. This can be managed by daily saline flushing and on rare occasions in presence of thick loculated collection, one may use intrapleural fibrinolytics. The loss of electrolytes, immune factors or proteins has occasionally been raised as a concern of the long-term use of IPCs [18].

Catheter fracture is rare and may occur when an IPC is removed. The polyester cuff promotes inflammation and fibrosis which leads to tight anchoring of the catheter makes it difficult to remove. The risk of catheter fracture is reported to be about 10% [19]. This is usually managed by surgical exploration or just leaving the catheter fragments inside the body. No complications have been reported from retained fragments of IPC.

11. Use of IPC in malignant pleural effusions (MPE)

Conventional approach to the patients with symptomatic MPE is therapeutic pleurocentesis and subsequent pleurodesis. Various pleurodesis agents can be used but the most commonly used agent is talc which can be guided by thoracoscopic talc poudrage or instillation via standard chest tube. Option of IPC insertion is given to the patients who had developed trapped lung. IPCs are the ideal way for palliative care as they can be sited easily and quickly, and can be drained as often as is required to alleviate symptoms, allowing for consistent improvement in the breathlessness which will afflict the vast majority of patients with a malignant effusion [20] and improvements seen even in those with trapped lung [21].

Davies et al. [22] compared the use of IPCs to standard talc slurry via chest drain in patients who had not previously undergone pleurodesis. The trial used self-reported dyspnoea scores as its main outcome measure, showing that 6 weeks after randomization there was no significant difference between the two treatment arms. Some of the secondary endpoints appeared more favorable in the IPC group, including the proportion of patients who achieved a clinically significant relief

in their symptoms (86 vs. 74%); the median length of initial hospital stay (0 vs. 4 days), and the median number of days spent in hospital for drainage over the following 12 months (1 vs. 4.5 days). Eventhough the study is underpowered, similar findings were reported elsewhere. Intrapleural Fibrinolytics can also be guided with IPC in case of multiloculated/septated effusion.

It also holds the potential to allow direct anti-cancer therapy. Sterman et al. [23] showing that patients with MPE or mesothelioma can be safely given both single- and repeated-dose interferon-β gene therapy and another group reporting the administration of monthly rituximab via an IPC for a patient with non-Hodgkin's lymphoma [24]. Jones et al. [25] and Rahman et al. [26] studied the use of Docataxel and Lipotechoic acid -T via IPC (Pleurx) respectively with favorable clinical response.

IPC can be combined with pleurodesis agents to achieve higher success rates and early pleurodesis in patients with high output effusion. Tremblay et al. [27] have demonstrated that low-level, repeated doses of intrapleural silver nitrate in a rabbit model can maintain the pleurodesis efficacy of a drug without raising the side effect profile. Dierdre B Fitzgerald et al. studied the use of talc via IPC with malignant pleural effusion and concluded that IPC combined with inpatient talc slurry pleurodesis, followed by daily home drainage provided good success rates [28].

12. Spontaneous pleurodesis

Spontaneous pleurodesis is also possible in patients with IPC which is an added advantage. In a study by Yuvarajan et al. [29] Spontaneous pleurodesis was achieved in 55% of the patients with hepatic hydrothorax who were placed on IPC. Mean time for spontaneous pleurodesis is around 120.8 days. Collated data from various studies suggest an overall spontaneous pleurodesis rate of around 45% for patients with MPE [15], however, some studies have reported significantly higher [30, 31] or lower values [32]. Higher pleurodesis rates, often exceeding 70%, have been noted when more aggressive drainage regimens (daily or more frequent) have been used, or when patients undergo a talc pleurodesis at the same time as IPC insertion [31].

13. Impact of chemotherapy in patients with IPC

Usage of IPC significantly improves the dyspneoa, quality of life and their performance status which is crucial for initiating chemotherapy, as chemotherapy is usually deferred in patients with poor performance status. In spite of this, there is huge concern in the risk of infectious complications post chemotherapy in those patients with IPC. There was no difference in the pleural infection rates in a retrospective analysis of 170 patients who were receiving chemotherapy with IPC when compared to those patients who did not receive chemotherapy [33]. But the decision to place an IPC in those who is already on chemotherapy needs multidisciplinary discussion with oncologist, oncosurgeon, pulmonologist and infectious disease specialist.

14. IPC in benign effusions

The most common causes for nonmalignant pleural effusions are Parapneumonic effusions, effusions due to congestive heart failure (CHF), hepatic hydrothorax (HH) secondary to cirrhosis of the liver and effusions due to renal failure. IPC's are

being recently used even for benign effusions in case hepatic hydrothorax and in patients with CKD related pleural effusions. Yuvarajan et al. [29] did a retrospective analytical study on the use of IPC in hepatic hydrothorax. 30 patients with hepatic hydrothorax were placed with indwelling pleural catheters. Spontaneous pleurodesis was achieved in 18 patients (60%) and IPCs were removed in these patients. Most of the patients (70%) who achieved spontaneous pleurodesis with IPC received at atleast one TIPS (Transjugular Intrahepatic porto systemic shunt) procedure. Mean time in which pleurodesis achieved was 120.8 days (range, 15–290 days). Thus TIPS procedure increases the success rate of pleurodesis with indwelling pleural catheters in hepatic hydrothorax.

IPC placement may be a reasonable clinical option for patients with refractory HH, but it is associated with significant adverse events in this morbid population. Potechin et al. [34] did a cohort study on IPC usage in patients who presented with recurrent effusion in end stage renal disease and concluded that IPC insertion for pleural effusions associated with end-stage renal disease appears safe and effective.

15. IPC removal

Removal of IPC is often not required in most of the patients. However, spontaneous pleurodesis is one of the potential causes for considering its removal. Other indications include pleural sepsis, nonfunctional/defective IPC and Severe pain with local cellulitis which cannot be managed with conservative approach. Removing indwelling pleural catheter is not an easy task. Since the polyester cuff attached to the drain is designed to promote local fibrosis and the removal of a drain can become more difficult with long standing IPC. In addition, advanced malignancy promotes ingrowth of fibrotic strands into the fenestrations of IPC further making the extraction of catheter difficult. For removal, one need to do careful and meticulous dissection of the fibrous material around the cuff following appropriate incisions. In those circumstances of difficulty in removal of IPC, an alternative is to simply leave the drain and to remove only the proximal portion. Fysh et al. [35] described 2 cases of this being undertaken in a small series of complicated removals. In none of the cases in which tubing was left intrapleurally did the patient experience any infective or pain-related complications during follow-up.

16. Conclusion

So IPCs plays a major role in patients with recurrent pleural effusions especially malignant pleural effusions. It is particularly useful in palliative care of the patients with trapped lung and failed chemical pleurodesis. It can be performed safely as a day care procedure with consistently low rates of complications, reduced inpatient stay and the recognition that significant improvements in patients' symptoms. They are relatively easy to insert, manage and remove, and provide the ability to empower patient's in both the decisions regarding their treatment and the management of their disease itself.

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