



Clinical outcomes of caregiver-led indwelling pleural catheter care and drainage at a Singapore tertiary referral hospital

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Background: Indwelling pleural catheters (IPCs) are an established first-line treatment option for symptomatic malignant pleural effusions (MPEs). However, community nursing support for IPC care and drainage is not available in many healthcare systems. In this study, we sought to evaluate IPC outcomes and complication rates in patients for whom IPC care and home drainage are performed by family members and caregivers.

Methods: Patients who underwent IPC insertions between January 2017 to December 2022 were included in this observational cohort study. Caregiver training were provided to all patients and appointed caregivers by pleural specialist nurse. All patients were assessed at regular intervals every 1 to 2 months, until death or IPC removal. Clinical outcomes and adverse events were recorded prospectively.

Results: We evaluated 140 patients with a median age of 68 years [interquartile range (IQR): 61–73 years]. MPE was the underlying etiology in 137 patients (97.9%). The most common causes of MPE were lung cancer (42.9%) and breast cancer (22.1%). The median duration of IPC placement was 64 (IQR: 36–120) days. About a third of patients (35.0%) had spontaneous pleurodesis allowing for removal of the IPC, with this occurring at a median of 78 (IQR: 52–144) days. The median length of survival from the time of IPC insertion was 102 (IQR: 41–308) days. IPC related complications occurred in 38 (27.1%) patients. Catheter malfunction, most commonly a non-draining IPC due to catheter blockage, occurred in 27 (19.3%) of patients, and 14 (10.0%) patients developed infective complications. Nine (6.4%) patients required hospitalisation for IPC-related complications. There were no bleeding complications or procedure-related deaths.

Conclusions: In healthcare systems without available community nursing services, IPCs remain a valuable treatment option for patients with symptomatic MPEs. Comparable clinical outcomes and safety profiles can be achieved even for patients where IPC care and drainage are primarily led by caregivers or family members, in the presence of appropriate support and caregiver training provided by a pleural service.

Keywords: Malignant pleural effusion (MPE); malignancy; indwelling pleural catheters (IPCs); caregiver

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Introduction

Malignant pleural effusions (MPEs) account for more than 125,000 hospital admissions per year in the United States and costs more than \$2 billion per year (1). Patients with MPE have an average survival of 4 to 7 months, as such, treatments are aimed at symptom control and reducing hospital length of stay (2). Indwelling pleural catheters (IPCs) are an established first-line treatment option for symptomatic MPE (3,4). Along with talc pleurodesis, IPCs are effective in relieving symptoms of dyspnea and improving quality of life in patients with MPE (5-7). Unlike talc pleurodesis however, IPCs are a definitive treatment option in patients' non-expandable lungs (4,8). IPCs also allow for ambulatory drainage of pleural effusions, leading to reduced hospitalisation days and future invasive procedures (5,6). IPCs have therefore gained popularity over the last decade, along with the increasing worldwide incidence of MPE.

Patients with IPCs often require adequate healthcare support, usually in the form of community nursing service, for IPC care and drainage, monitoring patients for IPC related complications (9,10), or to consider IPC removal following spontaneous pleurodesis (11). However, the availability of healthcare support or community-based services can vary significantly between different healthcare systems. In some countries, IPCs are managed by home nursing services while in many other countries, IPCs are managed solely by family

members or patients' caregivers (12,13).

There is a need to evaluate IPC outcomes and complication rates in institutions or countries that lack community nursing support. Unfortunately, there is a paucity of data regarding IPC outcomes from Asian centers, with most studies arising from North America, or centers in Europe and Canada where IPC drainages are largely performed by home nursing services (14). Therefore, the aim of this study is to describe the clinical outcomes and complications of IPC insertions in an Asian tertiary referral hospital, where IPC care and drainage are primarily caregiver-led. We present this manuscript in accordance with the STROBE reporting checklist (available at <https://jtd.amegroups.com/article/view/10.21037/jtd-24-1734/rc>).

Methods

We performed a prospective observational cohort study including all consecutive patients who underwent IPC insertions between January 2017 to December 2022 at Singapore General Hospital, which is a tertiary hospital with a 2,000-bed capacity. In our institution, having a caregiver who can care for and drain the IPC is a requisite for IPC insertion, and patients without a suitable caregiver are generally managed with therapeutic aspiration or drainage with talc pleurodesis. Clinical data including patient demographics, clinical characteristics and outcomes were recorded prospectively. Spontaneous pleurodesis was defined as having less than 50 mL drainage volume on three consecutive drainage attempts and exclusion of an IPC blockage or obstruction. Pleural infection was defined as the presence of positive microscopy or culture of pleural fluid, clinical signs and symptoms consistent with pleural infection and the need for antibiotic therapy. Patients were followed up until removal of the IPC or the patient's demise, whichever earlier. National electronic health records were accessed to determine the date of demise for the former.

IPC insertions were introduced in our hospital in January 2017. IPC (Rocket Medical, Washington, UK) insertions were performed during either inpatient or outpatient encounters in a dedicated procedure room by a respiratory physician, or an interventional radiologist. Prophylactic antibiotics were not routinely administered. A clinical review was routinely scheduled for patients within the first 2 weeks after IPC insertion for suture removal, site inspection, and review of their symptoms and fluid drainage. All patients were subsequently assessed at

Highlight box

Key findings

- With appropriate support and caregiver training provided by a dedicated pleural service, indwelling pleural catheters (IPCs) can still be an effective and safe treatment option for patients with symptomatic malignant pleural effusions (MPEs) in a healthcare system where community nursing support is unavailable.

What is known and what is new?

- IPCs are an established first line treatment for symptomatic MPEs but community nursing support is not always available in many countries.
- With adequate training for patients with dedicated caregivers, IPCs remains a viable option with good safety profile.

What is the implication, and what should change now?

- Despite the lack of community nursing support, IPCs can still be an attractive option for the management of symptomatic MPE, as long as adequate training is provided to patient and caregiver for ambulatory drainage.

Table 1 Baseline characteristics of study population

Characteristics	Value (N=140)
Age, years	68 [61–73]
Gender, female	76 (54.3)
Ethnicity	
Chinese	124 (88.6)
Malay	10 (7.1)
Indian	4 (2.9)
Malignant pleural effusion	137 (97.9)
New diagnosis of malignant pleural effusion	26 (18.6)
Known metastatic disease with malignant pleural effusion	95 (67.9)
Known cancer on curative treatment or cancer relapse	16 (11.4)
Number of previous ipsilateral pleural interventions prior to IPC insertion	1 [1–2]
Ipsilateral talc pleurodesis attempt prior to IPC insertion	24 (17.1)
Non-expandable lung	59 (42.1)
Septated pleural effusion prior to IPC insertion	23 (16.4)
Respiratory physician as procedurist	134 (95.7)
Site of IPC insertion: right hemithorax	73 (52.1)
Concurrent thoracoscopy and IPC placement	10 (7.1)

Data are presented in number (percentage) and median [interquartile range] for categorical and continuous variables respectively. IPC, indwelling pleural catheter.

regular intervals every 1 to 2 months, until death or IPC removal. During the study period, community nursing support to assist in IPC drainage was not available, and IPC drainages were performed at home by a family member or caregiver using either vacuum bottles or gravity bags. In our institution, patients were generally advised to perform IPC drainages two to three times per week initially and thereafter drainage frequency was guided by symptoms. Caregiver education and training for IPC care and drainage was provided to all patients and their appointed caregivers by a pleural specialist nurse. These education and caregiver training sessions were usually arranged on the same day of IPC insertion, and additional caregiver training sessions were provided at scheduled follow-up visits when required. Patients and their caregivers were also provided educational videos and materials, which focus on practical issues such as

dressing change, pleural fluid drainage in a sterile manner, and when to seek medical attention. A pleural nurse hotline was made available for patients and caregivers to call during office hours, when they encountered problems related to IPC care or drainage. For unblocking of IPCs, 2 mg of alteplase reconstituted in 2 mL of sterile water was instilled into the IPC and left to dwell for one hour, followed by a re-attempt at IPC drainage thereafter (15). The study was in accordance with the Declaration of Helsinki (as revised in 2013). The study protocol was submitted to the institutional review board of Singapore General Hospital. The informed consent was waived by the ethical committee and study was exempted from formal review as it was an observational study with subsequent deidentification of data.

Statistical analysis

Descriptive statistics of the variables were expressed with median and interquartile range (IQR), or numbers with percentage. All statistical analyses were performed using SPSS statistics software version 22.0 (IBM Corp., Armonk, USA). The study protocol was submitted to the institutional review board and exempted from formal review as it was an observational study with subsequent deidentification of data.

Results

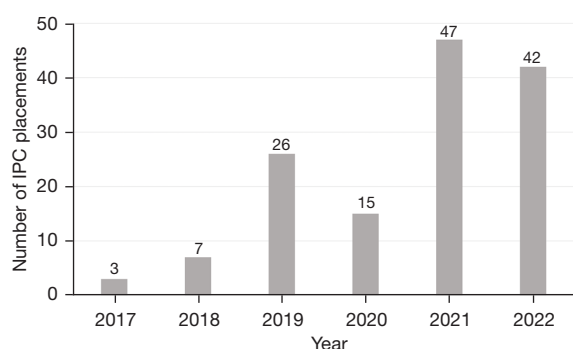
One hundred and forty patients were included during the study period, and their characteristics are summarized in *Table 1*. Their median age was 68 (IQR: 61–73) years, and most patients (97.9%) had MPEs. IPC insertions were performed by a respiratory physician in the majority (95.7%) of patients. Twenty-four (17.1%) patients had ipsilateral talc pleurodesis performed prior to IPC insertion, and almost half of the patients (42.1%) had a non-expandable lung. The etiologies of pleural effusions are listed in *Table 2*. The most common causes of MPE were lung cancer (42.9%) and breast cancer (22.1%). Three (2.1%) patients had non-MPEs, of which two had idiopathic chylothorax and one had tuberculous pleuritis. *Figure 1* illustrates the increasing number of IPC insertions performed over the study period.

Clinical outcomes following IPC insertion are summarized in *Table 3*. The median duration of IPC placement was 64 (IQR: 36–120) days. About a third of patients (35.0%) had spontaneous pleurodesis allowing for removal of the IPC, with this occurring at a median of 78 (IQR: 52–144) days. The median length of survival from the time of IPC

Table 2 Etiology of pleural effusions

Variables	Value (N=140)
Malignant pleural effusion	137 (97.9)
Lung	60 (42.9)
Lung adenocarcinoma	53 (37.9)
Breast	31 (22.1)
Upper gastrointestinal	7 (5.0)
Colorectal	6 (4.3)
Gynaecological	6 (4.3)
Head and neck	4 (2.9)
Melanoma	4 (2.9)
Haematological	3 (2.1)
Others	19 (13.6)
Non-malignant	3 (2.1)
Idiopathic chylothorax	2 (1.4)
Tuberculous pleuritis	1 (0.7)

Data are presented in number (percentage).

**Figure 1** Number of IPC placements performed each year over the study period. IPC, indwelling pleural catheter.

insertion was 102 (IQR: 41–308) days. *Figures 2,3* illustrate the overall survival and cumulative incidence of spontaneous pleurodesis rates respectively, in our study population.

Thirty-eight (27.1%) patients developed IPC-related complications. Catheter malfunction, most commonly non-draining IPC due to catheter blockage, occurred in 27 (19.3%) of patients. In 19 (13.6%) patients with non-draining IPC due to catheter blockage, two patients required IPC removal. Thereafter, adoption of the practice of intrapleural alteplase in our institution was successful in

Table 3 Clinical outcomes following IPC insertion

Variables	Value (N=140)
Duration of IPC before demise or spontaneous pleurodesis, days	64 [36–120]
Duration of IPC prior to spontaneous pleurodesis, days	78 [52–144]
Patient demised with IPC in place	80 (57.1)
IPC removed following spontaneous pleurodesis	49 (35.0)
Survival after IPC insertion, days	102 [41–308]
Complications	38 (27.1)
Infection	14 (10.0)
Cellulitis or wound infection	3 (2.1)
Tract site infection	3 (2.1)
Pleural infection	8 (5.7)
Catheter malfunction	27 (19.3)
Non-draining IPC due to catheter blockage	19 (13.6)
Dislodgement	4 (2.9)
Fracture	3 (2.1)
Leakage	1 (0.7)
Subcutaneous emphysema	2 (1.4)
Tract site metastases	1 (0.7)
Complications requiring IPC removal	10 (7.1)
Empyema or tract site infection	2 (1.4)
Non-draining IPC due to catheter blockage	2 (1.4)
Catheter fracture or dislodgement	4 (2.9)
Subcutaneous emphysema	2 (1.4)
Complications requiring hospitalisations	9 (6.4)
Empyema or tract site infection	6 (4.3)
Catheter blockage	1 (0.7)
Catheter fracture or dislodgement	1 (0.7)
Subcutaneous emphysema	1 (0.7)

Data are presented in number (percentage) and median [interquartile range] for categorical and continuous variables respectively. IPC, indwelling pleural catheter.

unblocking all subsequent cases. Fourteen (10.0%) patients developed infective complications. Cellulitis or tract site infections occurred in six patients, and pleural infection in eight patients. Pleural fluid microbiology patients with pleural infection isolated staphylococcus aureus in two

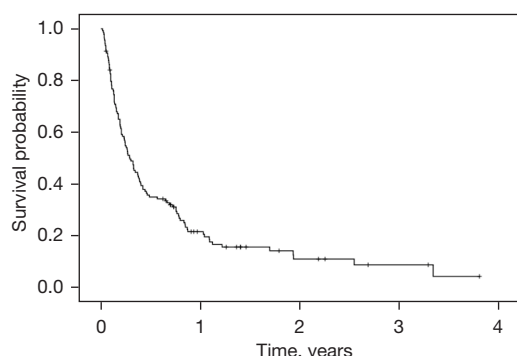


Figure 2 Kaplan-Meier curve for overall survival after indwelling pleural catheter placement.

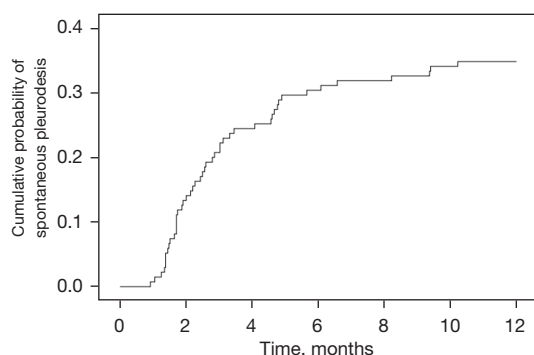


Figure 3 Cumulative incidence curve of spontaneous pleurodesis rate.

patients, streptococcus mitis in one patient, pseudomonas aeruginosa in two patients, klebsiella aerogenes in one patient, with a polymicrobial yield consisting of gram positive, gram negative and anaerobic organisms in the remaining two patients. There were no deaths from IPC-related infections, and two patients required removal of their IPC due to pleural infection in one patient, and a tract site infection in another. Nine (6.4%) patients required hospitalisation for IPC-related complications, most commonly due to IPC-related infections in six patients. There were no bleeding complications or procedure-related deaths.

Discussion

In this prospective cohort study, we report the outcomes and complications of patients with IPCs, which are similar and comparable to studies from established centres in IPC management. To our knowledge, this is the first study

evaluating IPC outcomes from a Southeast Asian center (16), and in a cohort of patients for whom IPC care and drainage is primarily led by their caregivers or family members. In Singapore, community or home nursing support for IPC care was not yet available during the study period, and patients' family members or caregivers took on the primary role of performing IPC drainages in the patients' homes. While this is not a trial that directly evaluates caregiver-led versus community nursing-led IPC care, we believe the results of this study support the notion that IPCs can still be a valuable treatment option in healthcare systems that do not have access to community nursing services.

Consistent with the higher prevalence of lung adenocarcinoma in an Eastern Asian population, almost 40% of our patient cohort had a diagnosis of metastatic lung adenocarcinoma (17,18). The median survival after IPC insertion was 102 days, consistent with the poor prognosis associated with MPE (19,20). We observed a spontaneous pleurodesis rate of 35.0%, occurring at a median of 78 days after IPC insertion. This is comparable to reported spontaneous pleurodesis rates observed in other patient cohorts, which ranged between 29–51% (18–21). Differences in cancer type, talc administration for pleurodesis and frequency of clinical follow up between different studies may affect the rate of spontaneous pleurodesis (6,13,22). A daily IPC drainage strategy, which is not routinely practiced in our center, has also been shown to increase the rates of spontaneous pleurodesis in two randomized controlled trials (6,22). In our center, IPC drainage frequency was generally guided by symptoms, instead of aggressive or daily IPC drainage in part due to the financial cost of the vacuum bottles, and to reduce the burden on caregivers. Instead, we continued to follow up patients at regular visits (every 1 to 2 months) to identify patients where IPC removal may be suitable due to spontaneous pleurodesis.

A concern with caregiver-led IPC care and drainage is the plausible increased risk of infections due to suboptimal care and handling of the IPC and drainage equipment. In our cohort, pleural infection, and overall IPC-related infection rates were 5.7% and 10.0% respectively. There were no cases of mortality (related to infection), and only two patients required IPC removal due to infection. Our results are also comparable with other centers, where IPC-related infections have been reported to range from 0–12% (10). In large single centre studies of 202 and 336 IPC procedures, pleural infection rates ranged from 5.4% to 7.7%, and IPC-related infections from 6.1% to 11.3% (20,23,24). Together,

the available data supports IPCs as a safe treatment option for symptomatic MPEs, even for patients who have their IPCs cared for and drained by a trained caregiver. It remains unclear if measures such as antibiotic prophylaxis or topical antibiotics can reduce the risk of IPC-related infections. Gilbert *et al.* reported a reduction in IPC-related infections from 8.2% to 2.2% following implementation of a care bundle involving preprocedural antibiotic prophylaxis, full sterile draping, and a dedicated procedural suite (25). A multi-centre randomized trial (AMPLE-4) is currently underway to evaluate the role of topical mupirocin in reducing IPC-related infections (26).

Catheter malfunction rates were common (19.3%) in our patient cohort. The most common cause of malfunction was non-draining IPCs due to catheter blockage or obstruction. This is consistent with other centers, where non-draining IPCs with symptomatic fluid re-accumulation are reported to occur between 5% to 18% of patients (5,15,27), and unlikely to be contributed by caregiver-led IPC care and drainage.

There are limitations to our study. It is a single center study and may not be generalizable to other countries or institutions. Between each center, there will be some degree of heterogeneity in patient profiles, cancer epidemiology, frequency of IPC drainages and clinical follow up, and home nursing versus caregiver-guided IPC drainages. All these factors may affect IPC outcomes, management strategies and complications. Nevertheless, our study provides useful data for centers in the region currently providing IPC care or planning to set up an IPC service. Of note, we did not include pain or discomfort during drainages as a complication, which is a recognised problem with IPC drainages, particularly in patients with non-expandable lung (7). There is also increasing recognition of issues faced by patients with IPCs, such as discomfort or problems with sleep, and the need for regular after care (28). More studies are needed to explore issues with IPCs, from the patient and caregiver perspective.

Conclusions

In conclusion, our prospective study demonstrated that in healthcare systems where community nursing is not available, IPC insertions can still be an effective and valuable treatment option for symptomatic MPEs, with a comparable safety profile. However, it is important that continued clinical follow up and adequate training are provided to both patients and caregivers. Moving forward, well designed

qualitative studies are needed to understand the perspectives and concerns that patients and their caregivers experience, to provide personalized and effective care.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at <https://jtd.amegroups.com/article/view/10.21037/jtd-24-1734/rc>

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study protocol was submitted to the institutional review board of Singapore General Hospital. The informed consent was waived by the ethical committee and the study was exempted from formal review as it was an observational study with subsequent deidentification of data.

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