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Research Article

# Indwelling Pleural and Abdominal Catheters (PleurX) for Management of Pleural Effusions and Ascites: A Single Centre's 10 Year Experience

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## Abstract

**Background:** Recurrent pleural effusions and abdominal ascites are seen in both malignant and non-malignant diseases, and can cause significant disease burden. Indwelling catheters for malignant pleural effusions are part of current accepted practice. Indwelling peritoneal catheters for malignant ascites have yet to be recommended by any society guideline. We aimed to evaluate outcomes in our patients who have had indwelling pleural and peritoneal catheters placed for malignant and non-malignant pleural effusions and abdominal ascites. **Method:** A retrospective cohort study of patients who had indwelling pleural and peritoneal catheters inserted over a 10 year period from 2011 to 2020 was carried out. Inclusion criteria consisted of all patients who had either a pleural or peritoneal indwelling catheter placed for any indication. We evaluated catheter-related complications. **Results:** There were 193 discrete indwelling pleural catheters for malignant pleural effusions, with a median dwell time of 41 days. The infection rate in these were 6.2%, and 12.4% of catheters had complications of blockage or dislodgement. There were 2 catheters inserted for parapneumonic effusions, further analysis was limited given the low number. There were 121 discrete indwelling peritoneal catheters for malignant abdominal ascites, with a median dwell time of 31 days. The rate of infection was 5.8%, and another 5.8% of catheters became blocked or dislodged. An additional 6 peritoneal catheters were inserted for non-malignant abdominal ascites, with a median dwell time of 28 days. Two cases of infection were found in this group. **Conclusion:** This is to our knowledge one of the larger patient cohorts in studies relating to indwelling peritoneal catheters for malignant abdominal ascites. Our data shows that indwelling peritoneal catheters have low complication rates on par with pleural catheters which are current accepted practice. The usage of indwelling pleural and peritoneal catheters may be considered for the management of refractory pleural effusions and abdominal ascites.

## Introduction

Patients with pleural effusions and abdominal ascites can be troubled by a variety of associated symptoms which can impair quality of life. These can include shortness of breath, reduction in exercise tolerance, impaired level of function, abdominal pain, and ileus. This study was conducted at an Australian metropolitan hospital which routinely used PleurX catheters for the management of refractory pleural effusions and abdominal ascites. Our single-site retrospective cohort study of patients over a 10-year period aimed to review the data on our patients who have had a PleurX catheter inserted for drainage of pleural effusion or abdominal ascites. The patient cohort encompasses a variety of both malignant and non-malignant indications for insertion of pleural and abdominal catheters.

We present our findings on complication rates and types, duration of catheter dwell times, with further data breakdown to

assess if particular patient cohorts were more likely to encounter drain complications. For our study, complications were defined as adverse outcomes attributable to the PleurX catheter itself, including (but not limited to) infection, blockage, dislodgement, bleeding, and pain necessitating drain removal. Indwelling catheters removed due to the achievement of pleurodesis or intentionally self-removed by patient were not included as complications.

Current practice of management of recurrent and refractory pleural effusions can include repeated thoracocenteses, placement of a long-term indwelling pleural catheter (IPC), or pleurodesis. A systematic review and meta-analysis comparing insertion of IPC versus pleurodesis for the management of malignant pleural effusions reveals pooled data showing improved outcomes of dyspnoea, shorter length of hospital stay, and reduced requirement for repeat interventions in patients who had IPC insertion [1]. Although there was no difference in mortality between the two groups, patients with IPC insertion had higher rates of infection (cellulitis).

Indwelling tunnelled catheters (which includes PleurX) are a currently accepted alternative to repeated thoracenteses for pleural effusions refractory to medical management. The British Thoracic Society notes that "ambulatory indwelling pleural catheters are effective in controlling recurrent and symptomatic malignant effusions in selected patients," [2] with grade B evidence. The American Thoracic Society [3] guidelines for management of malignant pleural effusions also suggests that indwelling pleural catheters are an acceptable alternative compared to chemical pleurodesis, with shorter hospital stays, but higher infection rates (2-4%).

Indwelling tunnelled catheters as part of management of malignant ascites do not appear in any guidelines, and there is a dearth of large-scale trials comparing its use versus repeated abdominal paracentesis. There is no mention of indwelling catheters for management of ascites from non-malignant causes such as liver failure in guidelines of the American Association for the Study of Liver Diseases, [4] nor from the European Association for the Study of the Liver [5]. However, indwelling catheters have been shown to be a safe alternative to repeated paracentesis in the management of malignant ascites [6]. There are no Australian society or guideline recommendations on indwelling catheters for refractory ascites management.

We conducted a literature review of previous systematic reviews and studies on patients with both malignant and non-malignant indwelling tunnelled catheters for refractory pleural effusions and abdominal. Databases searched included PubMed, Medline, and OVID. Search terms included "pleural effusion PleurX", "pleural effusion tunnelled catheter", "abdominal ascites PleurX", and "abdominal ascites tunnelled catheter". A total of 183 studies were identified, with all articles screened. Exclusion criteria consisted of studies not written in English, assessed a paediatric population, did not include complication rates, did not evaluate complications, or were of subject matters not relevant to our study. Results will be compared to our cohort of patients (Figure 1).

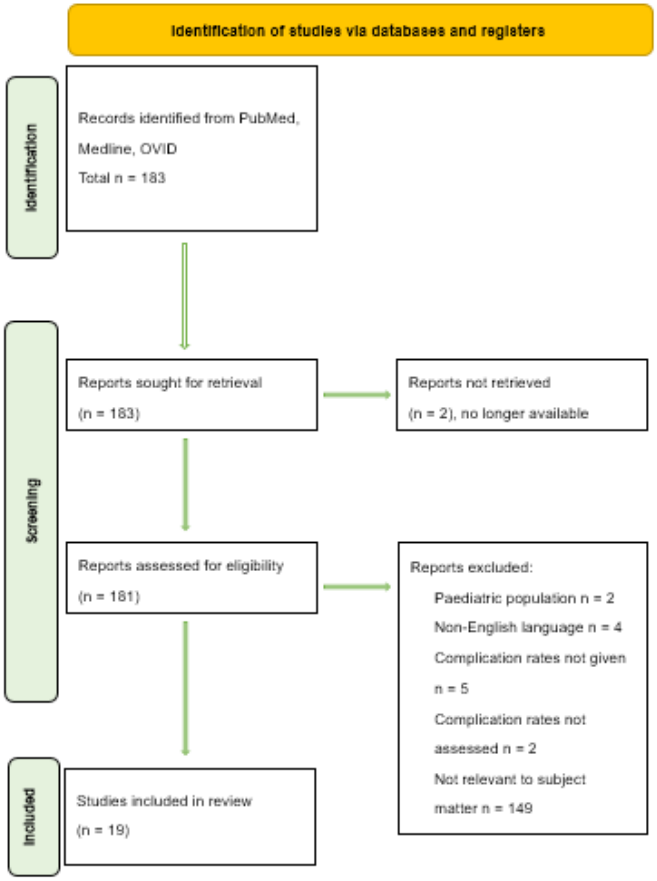


**Figure 1:** PRISMA diagram of literature review.

## Malignant Pleural Effusions

Previous studies of Indwelling Pleural Catheters (IPCs) show variable rates of different complications. More common complications include infection, loculation, and catheter malfunction (blockage, dislodgement).

A summary of studies assessing IPCs in malignant pleural effusions is summarized in Table 1. Given the relative heterogeneity of outcomes assessed in various studies, the information presented for each study varies. A systematic review of 1370 patients showed that 6.2% of catheters resulted in infection [7]. The largest cohort study is an international multi-centre retrospective study of 1021 patients of IPCs in the management of malignant pleural effusions

[8]. There was a 4.95% rate of IPC-related pleural infection with a 0.29% associated mortality rate as a result of infection. Risk factors for developing pleural infections included being older, male, and patients who perform their own drainages. There also appeared to be a positive correlation between frequency of drainage and rates of infection.

| Study | No. of catheters | Median time to complication (days) | Total Complication Rate (%) | Infection rate (%) | Catheter Issue | Median dwell time |
|---|---|---|---|---|---|---|
| van den Toorn 2005 [11] | 17 | - | 29.4% | 11.7% | 17.6% | - |
| Warren 2008 [12] | 231 | - | 7% | 2.2% | 4.8% | - |
| Sioris 2009 [13] | 53 | - | 20.8% | 7.5% | 5.7% | - |
| Chalhoub2011 [14] | 41 | n/a | 0% | 0% | 0% | - |
| Van Meter 2011 [7] | 1370 | - | - | 6.2% | - | - |
| Fysh 2013 [8] | 1021 | 62 | - | 4.95% | - | - |
| Gilbert 2015 [10] | 91 | - | 7.7% | 7.7% | - | 90 d |
| Meier 2016 [15] | 18 | - | 44.4% | 11.1% | 16.6% | - |
| Frost 2019 [9] | 448 | 33.5 | 13.4% | 5.6% | 5.4% | 1.2 months |
| Rajchgot 2021 [16] | 503 | - | 5.2% | 1.4% | 1.4% | - |

**Table 1:** Studies on Malignant Pleural Effusions.

A 10-year single centre retrospective observational study of 448 discrete IPCs in 395 patients from 2006 to 2016 found complications in 13.4% of IPCs, with 5.6% being infection, and 5.4% being catheter-related malfunctions. 34.2% of patients died within 30 days of IPC insertion. Of note, the mean dwell time of IPCs was 1.2 months, with pleurodesis being achieved in 28.6% of patients [9].

Haematological malignancies have limited representation in the above studies (<5% of patients). A retrospective study of IPCs in patients with haematological malignancies consisting of 91 patients reveals infection rates of 7.7%, with a 2.2% mortality due to infection. [10] An auto-pleurodesis rate of 23% was noted, as well as a mean dwell time of 90 days.

**Non-Malignant Pleural Effusions**

Comparatively, management of non-malignant pleural effusions with IPCs has fewer associated studies. A systematic review and meta-analysis of 325 patients across 13 studies assessed the use of IPCs in the management of non-malignant pleural effusions [17]. Almost 50% of IPCs inserted were for refractory congestive cardiac failure; less common reasons for catheter insertion included liver disease, renal disease, and chylothorax. There was a complication rate of 17.2%, which included an infection rate of 5% (2.3% empyema, 2.7% minor skin infection), IPC malfunction rate of 3.7% (dislodgement, blockage, pleural fluid leakage), and a 1.2% rate of pneumothorax. One death was attributable to empyema and resulting sepsis. There was a spontaneous pleurodesis rate of 51.3%.

One of the studies included in the systematic review [17] was a multi-centre observational retrospective cohort study involving a total of 57 IPC insertions [18]. Interestingly, whilst the complication rate of 16% is on par with other studies in the

systematic review, the infection rate in this study of 10.5% was much higher than the other studies. Catheter-related issues such as blockage, leakage, and dislodgement were also higher (Table 2).

| Study | No. of catheters | Complication rate (total) | Infection | Catheter Issue |
|---|---|---|---|---|
| Herlihy 2009 [19] | 5 | 60% | 40% | 20% |
| Chalhoub 2011 [14] | 23 | 4.3% | 4.3% | 0% |
| Harris 2012 [20] | 134 | 11.2% | 6.7% | 2.2% |
| Bhatnagar 2014 [18] | 57 | 16% | 10.5% | 6% |
| Patil 2017 [17] | 325 | 17.2% | 5% | 3.7% |

**Table 2:** Studies on Non-Malignant Pleural Effusions.

**Malignant Abdominal Ascites**

Literature review of the usage of indwelling peritoneal catheters for malignant abdominal ascites yields fewer results compared to catheters for pleural effusions. The majority are single-centre retrospective cohort studies. Studies on abdominal ascites generally also had lower patient numbers compared to studies on pleural effusions.

The largest cohort is of 170 patients in a single centre cohort study, which showed an overall complication rate of 7%, with a 2.5% infection rate and 4.5% of catheters having issues relating to blockage or dislodgement [21]. Other studies mostly involved less than 50 patients.

The rate of complications between studies varies significantly, with total complication rates between the studies involving more than 10 patients varying from 2.9% to 28.1%. Infection and catheter-related issues of blockage or dislodgement formed the majority of complications. Although mean catheter dwell times were not reported in all studies, data reported shows a varying mean dwell time of 40.7 days to 113 days. On review of the various studies, the reason behind the significant variation of complication rates is not clear (Table 3).

| Study | No. of catheters | Complication rate | Infection | Catheter Issue | Death in 30 days after insertion | Mean dwell time (days) |
|---|---|---|---|---|---|---|
| Richard 2001 [22] | 10 | 0% | 0% | 0% | - | 70 |
| Courtney 2008 [23] | 34 | 2.9% | 2.9% | 0% | - | - |
| Akinci 2011 [24] | 41 | 27.3% | 17.5% | 9.8% | - | - |
| Tapping 2012 [25] | 32 | 28.1% | 9.4% | 12.5% | 39% | 113 |
| Lungren 2013 [21] | 170 | 7% | 2.5% | 4.5% | - | 60 |
| Narayanan 2014 [26] | 38 | 13.2% | 5.3% | 7.9% | - | 40.7 |
| Meier 2015 [27] | 20 | 15% | 0% | 15% | - | - |

| | | | | | | |
|---|---|---|---|---|---|---|
| Chan 2020 [28] | 51 | 25.5% | 7.8% | 13.7% | - | - |
| Petzold 2021 [29] | 51 | 7.8% | 5.9% | 2.0% | - | 59.8 |

**Table 3:** Studies on Malignant Abdominal Ascites.

### Non-Malignant Abdominal Ascites

Management of refractory cirrhotic ascites is usually done via repeat large-volume paracentesis, transhepatic shunts, or liver transplant. There are less data on outcomes related to indwelling catheters for management of non-malignant causes of ascites compared to their usage for malignant ascites.

A literature review of 270 discrete catheters on the use of indwelling tunnelled catheters for the management of refractory non-malignant ascites showed a total complication rate was 15.9%, with a breakdown of 12.2% catheter-related peritonitis, 2.6% leakage, and 1.1% catheter malfunction [6].

Compared to indwelling catheters for malignant abdominal ascites, the rate of infection in the cohort of patients with non-malignant ascites appears to be higher. However, there is a significant variation of complication rates between individual studies, which may be due to the small numbers of patients in each study (Table 4).

| Study | No. of catheters | Complication rate (total) | Median time to complication | Infection | Catheter Issue |
|---|---|---|---|---|---|
| Lungren 2013 [21] | 13 | 7.7% | - | 7.7% | 0% |
| Reinglas 2016 [30] | 29 | 59% | 182 d | 48% | 24% |
| Caldwell 2018 [6] | 270 | 15.9% | - | 12.2% | 3.7% |
| Corrigan 2021 [31] | 25 | 52% | - | 20% | 16% |

**Table 4:** Studies on Non-Malignant Abdominal Ascites.

## Methodology

Our data was accessed from our pre-existing hospital database for PleurX patients, initially in place to provide ongoing clinical governance for patients with indwelling tunnelled catheters. The 10 years of data from 2011 to 2020 have been collected initially by research participant RD. Data recorded in the database includes: age, sex, location of drain (abdominal vs pleural), malignant vs non-malignant indication for catheter insertion, type of malignancy if applicable, date of insertion, date of removal, reason for removal, if repeat insertions were required and total number of catheter insertions, number of complications, types of complications, and outcome (e.g. if functional pleurodesis was achieved). All patients were followed-up until either death or PleurX removal.

PleurX catheter insertions were done either electively in an endoscopy unit, operating theatre, or in a procedure room on a hospital inpatient ward. Specific practices around PleurX insertion were left to the discretion of the proceduralist. Hence, there were variations on imaging-guidance for insertion, antibiotic usage, and the withholding of anticoagulation prior. We cannot confirm in our records which pleural and peritoneal catheters were done under imaging guidance. Records for mean volume of drainage were not kept. The frequency and volumes of each episode of drainage were left up to the individual treating specialists. Drainages were conducted by either hospital staff, community nurses, patients or their caregivers. However, data regarding specific personnel responsible for drainage of individual catheters were not kept.

## Results

### Indwelling Pleural Catheters (IPCs)

In our 10-year data period, there were a total of 215 discrete IPCs in 195 different patients. Three of these IPCs were inserted for non-malignant pleural effusions, all of which were in cases of parapneumonic effusions. Twenty patients were lost to follow-up owing to leaving the area health service. Of these patients, 19 had IPC insertion for malignant pleural effusions, whilst the other was for a parapneumonic effusion. Whilst longer-term outcomes are not known for these patients, there were no known complications prior to them leaving the area health service.

Out of the 195 discrete IPCs that were followed-up, 73 of these IPCs were inserted in the 30 days leading up to death for malignant pleural effusions, whilst 1 was inserted for a parapneumonic effusion.

### Baseline Characteristics

There were 125 catheters placed into female patients in the cohort followed-up, and 70 placed into male patients. Their mean age was 66.3 years, with a median age of 66 years. The most common reason for requiring IPC insertion was malignant pleural effusions secondary to non-small cell lung cancer (NSCLC), with n=62, followed by breast cancer, n=41. Instances of other malignancies were much fewer in number. There were 86 patients were under the age of 65, whilst 109 were aged 65 or above (Figure 2).

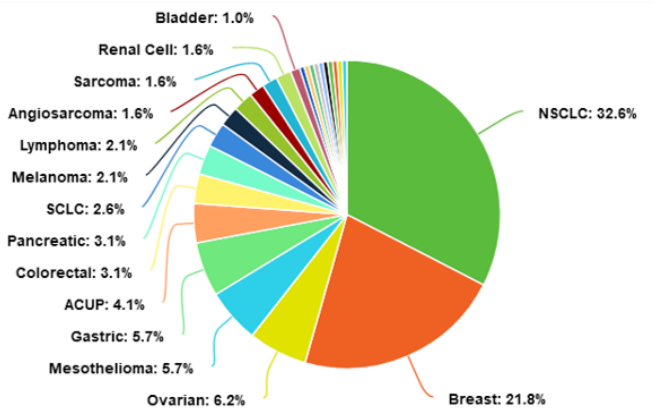


**Figure 2:** Primary malignancies as a percentage of total IPCs inserted for malignant pleural effusions.

### Dwell Time

The overall dwell times of IPCs inserted for malignant pleural effusions ranged from 1-429 days, whilst the dwell times for the 2 patients with parapneumonic patients were 19 days and 157 days. The dwell time of IPCs in malignant pleural effusions had a mean of 62.4 days and a median of 41 days.

### Outcomes

For drains that were inserted for malignant pleural effusions, 63.8% or 123 of these were in situ at time of patient death. A variety of reasons contributed to drain removal, including complications and pleurodesis. One out of the 2 drains inserted for non-malignant pleural effusions remained in situ at time of patient death.

### Subgroup: Females vs. Males

Mean dwell time for IPCs in females was 62.5 days, compared to 62.9 days in males. The median dwell time was 43 days in females, and 32 days in males.

### Subgroup: Insertion within, or not within, 30 days of death

Subgroup analysis of mean dwell times in patients who had IPC insertion within 30 days of death reveals a mean dwell time of 13.6 days for those with malignant pleural effusions. One patient with a parapneumonic effusion died 19 days after drain insertion. In patients who lived past the initial 30 days of catheter insertion, IPCs inserted for malignant pleural effusions had a mean dwell time of 92.1 days.

### Complications

Complications in patients who had indwelling pleural catheters inserted included infection, dislodgement, blockage, bleeding requiring blood transfusion, and bowel perforation. There were a total of 39 complications out of the 195 catheters available to be followed-up, an overall complication rate of 20% (Table 5).

| | Malignant n=193 | | Non-Malignant n=2 | |
|---|---|---|---|---|
| Total | 38 | 19.7% | 1 | 50% |
| Dislodgement | 16 | 8.3% | 0 | - |
| Infection | 12 | 6.2% | 1 | 50% |
| Blockage | 8 | 4.1% | 0 | - |
| Bleed | 1 | 0.5% | 0 | - |
| Bowel perforation | 1 | 0.5% | 0 | - |

**Table 5:** Complications in Indwelling Pleural Catheters.

### Dislodgement

Sixteen total cases of pleural catheter dislodgement occurred, with no documented cases of pneumothorax occurring after dislodgement. The time to complication for these cases is well documented, as these dates have been recorded as their removal dates. The mean dwell time (hence also the time to complication is) 55.5 days, with a median of 42 days. Seven instances of catheter dislodgement occurred in male patients, 9 in female patients. All of

these occurred in patients with malignant pleural effusions.

### Infection

There was a total of 13 cases of infection in patients with pleural drains inserted. Twelve of these occurred in those with an underlying malignancy, an infection rate of 6.2% of total catheters inserted. The other case occurred in a patient with a drain inserted for management of a parapneumonic effusion. Documentation reviewed showed that whilst his initial pneumonia and effusion responded well to treatment, the reason why the drain remained in afterwards was unclear. This patient developed cellulitis over the drain site at day 157, prompting its removal. A total of 10 cases of infection occurred in female patients, compared to 3 in male patients. The mean dwell time of this group of IPCs is 70.6 days, with a median duration of 49 days. The majority of these patients had non-small cell lung cancer. Eight cases of infection occurred in patients aged 65 or over.

### Blockage

There were 8 instances of catheter blockage, 6 in females, 2 in males. Whilst the exact time to blockage from insertion is uncertain, records kept note that blocked catheters were removed as soon as practical. The mean dwell time was 43 days, with a median of 46 days. Seven of these cases occurred in patients aged 65 or over.

### Bleed

There was 1 instance of a significant bleed requiring packed red blood cell transfusion in a 55 year-old male with non-small cell lung cancer. His IPC remained in for 42 days.

### Bowel Perforation

One recorded case of bowel perforation on IPC insertion occurred in a 69 year-old gentleman with prostate cancer. This patient died 2 days later.

### Subgroup Analysis: Sex

There were 25 total complications in female patients, and 14 in male patients. This closely follows the ratio of female to male patients in this cohort. There was no difference between female or male patients in complication rates, with 20% of female patients as well as 20% of male patients developing complications.

### Subgroup Analysis: Age

A division between patients under or over the age of 65 were also taken for further subgroup analysis. This age division has been chosen as it is used in our local Australian health care setting as defining geriatric age. Patients aged 65 or above had an overall 22.9% complication rate, whilst those in the younger age group had an overall complication rate of 16.3%.

### Abdominal Indwelling Peritoneal Catheters (IPCs)

There was a total of 133 discrete IPCs in 131 patients, as 2 patients had a second IPC inserted after the initial drain was removed due to infection. Of these IPCs, 127 were inserted for the recurrence of malignant abdominal ascites. There were 6 IPCs inserted for non-malignant ascites: 4 for alcohol-related liver cirrhosis, 1 for liver failure of other causes, and 1 for heart failure. There was a total of 6 patients lost to follow-up due to leaving the treating area health service, all of these patients had IPCs inserted for malignant ascites. Patient outcomes are unknown for these patients, although none had any known complications prior to leaving the area health service.

For IPCs inserted for malignant abdominal ascites, 43% (n=52) were inserted in the 30 days leading up to patient death. Out of these, 67% (n=4) were inserted within 30 days of patient death for management of non-malignant abdominal ascites.

### Baseline Characteristics

In total, there were 75 discrete IPCs in female patients and 58 discrete IPCs in male patients. The mean age was 62.9. The predominance of female patients may be explained by the primary cancer diagnoses in this cohort, including a larger proportion of breast and ovarian cancers. With the omission of sex-specific cancers of breast, ovarian, endometrial, uterine, fallopian tube, and prostate cancers, the imbalance reverses, instead consisting of 37 female patients versus 57 male patients. Sixty-eight of the abdominal catheters were placed in patients under the age of 65, whilst 59 were placed in those aged 65 or over (Figure 3).

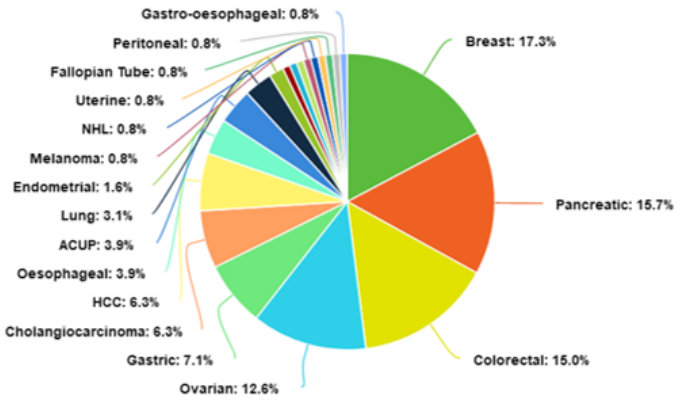


**Figure 3:** Primary malignancies as a percentage of total IPCs inserted for malignant ascites.

### Dwell Time

The overall dwell times of IPCs inserted for malignant ascites ranged from 2 to 231 days, whilst the range of dwell times for non-malignant ascites varied from 11 to 72 days. The dwell time of IPCs in malignant ascites had a mean 43.2 days and a median of 31 days. Dwell time of IPCs in non-malignant ascites had a mean of 31.2 days, and a median time of 28 days.

### Outcomes

The number of peritoneal catheters inserted for malignant ascites that remained in situ at the time of death was 96, or 79.3% of total IPCs inserted in this category. For IPCs inserted for non-malignant ascites 5 out of the 6, or 83.3% remained in situ at time of death.

### Subgroup: Females vs. Males

Mean dwell time for IPCs in all females was 49.5 days, compared to 33.7 days in all males. The median dwell time was 32.5 days in females, and 30 days in males.

### Subgroup: Insertion within, or not within, 30 days of death

Subgroup analysis of mean dwell times in patients who had IPC insertion within 30 days of death reveals a mean dwell time of 15.1 days for those with malignant ascites, and a mean dwell time of 19.5 days for those without.

In patients who lived past the initial 30 days of catheter insertion, IPCs inserted for malignant ascites had a mean dwell time of 63.9 days, median dwell time of 48.5 days. In the group with catheters inserted for non-malignant ascites who lived longer than 30 days post-insertion, one patient had a dwell time of 37 days, and the other 72 days.

### Complications

Complications arising in our cohort of patients with abdominal indwelling catheters included infection (either cellulitis or peritonitis), blockage, dislodgement, pain necessitating drain removal, and bowel perforation.

The total complication rate of discrete IPCs that were followed-up was 15%. A table of individual complications divided into malignant and non-malignant indications of IPCs is as follows, showing the number of each complication type and their percentage of total malignant ascites and non-malignant ascites IPCs (Table 6).

| | Malignant n=121 | | Non-Malignant n=6 | |
|---|---|---|---|---|
| Total | 17 | 14% | 2 | 33.3% |
| Infection | 7 | 5.8% | 2 | 33.3% |
| Dislodgement | 5 | 4.1% | 0 | - |
| Blockage | 2 | 1.7% | 0 | - |
| Pain | 2 | 1.7% | 0 | - |
| Bowel perforation | 1 | 0.8% | 0 | - |

**Table 6:** Complications in Abdominal Indwelling Peritoneal Catheters.

### Infection

There were 9 cases of infection in discrete IPCs, 3 in men, and 6 in women. The mean age of patients with infections related to IPCs who had cancer was 65.6. Infection of IPCs do not favour a specific malignancy. Dwell times for catheters inserted for malignant ascites ranged from 10 to 194 days, with a mean of 57.7 days, and a median of 48 days.

The mean age of patients with IPCs placed for non-malignant liver disease that developed infection was 61. Both cases had alcoholic liver disease with cirrhosis and refractory ascites. The dwell times of these 2 IPCs were 11 and 25 days. The patient with the IPC in for 11 days developed peritonitis shortly after insertion, and the IPC was left in to drain the infected ascitic fluid.

### Dislodgement

Five cases of dislodgement occurred in patients with IPCs placed for malignant ascites. Three of these occurred in male patients, and 2 in female patients. The mean age of this group was 64.8 years. Primary cancer diagnoses consisted of 2 cases of hepatocellular carcinoma, 1 colorectal cancer, 1 breast cancer, and 1 patient with gastro-oesophageal cancer. The time of IPC insertion to dislodgement ranged from 8 to 50 days, with a mean dwell time of 17.8 days.

### Blockage

A total of 2 cases of blocked IPCs requiring removal both occurred in patients with ovarian cancer. Their mean age was 54. The dwell times of these 2 catheters were 21 and 98 days, and both were removed within a few days after IPC blockage.

### Pain

Pain necessitating drain removal occurred in 2 patients, 1 male, 1 female. The mean age of this group was 64 years old, with 1 patient having pancreatic cancer, and the other melanoma. It is not clear from our data regarding the time of pain onset, and how this pain was managed prior to a decision being made to remove the IPC.

### Bowel Perforation

One case of bowel perforation occurred during IPC insertion in a female patient, aged 77, with endometrial cancer. The bowel perforation was conservatively managed, and the patient died 16 days later with the drain *in situ*.

### Subgroup Analysis: Sex

Twelve total cases of complications, or 16% of abdominal catheters occurred in female patients. Seven cases of complications, or 12% of total catheters occurred in male patients.

### Subgroup Analysis: Age

There were 7 instances of complications in patients aged 65 or over, and 12 in the group below 65, giving a comparison complication rate of 11.9% versus 17.6% respectively.

## Discussion

Our initial aims were to review our data over a 10-year period, and assess safety of longer-term indwelling catheters, the types of complications that may occur from them, and if particular patient groups were at increased risk of developing complications.

Whilst we would have preferred to evaluate outcomes in both malignant and non-malignant indications for pleural and abdominal catheters, early tabulation of data revealed lower than expected numbers of indwelling catheters in patients without cancer. Nevertheless, the results have been presented here.

### Pleural Catheters

The patient cohort consisted mostly of older female patients, which may be explained by the significant number of patients with breast cancer (21.3%), which is only surpassed by those with non-small cell lung cancer. The difference between the mean dwell time of 96.4 days and the median dwell time of 41 days may be attributable both to the number of catheters that remained in for long periods of time, and the minority of catheters being placed in patients who died within 30 days. Certainly, the mean dwell time of 92.1 days in patients who lived longer than 30 days post-insertion makes a case for the usage of longer-term indwelling catheters over repeated thoracocentesis.

The time to complication post-catheter insertion could not be accurately captured as data kept showed date of catheter removal rather than date of complication occurrence. In the cases of dislodgement, this date also corresponds to date of removal. However, for blockage or infection, hospital practice at the time was to remove the infected pleural catheter as soon as practicable, which could translate to a few days delay if the patient was in a community setting. Even taking this into consideration, the median dwell times before complications of infection, blockage, or dislodgement occur all range within the 40-to-50-day post-insertion period. Mean catheter dwell times varied more between the complication subgroups, but are also difficult to interpret given the relatively small numbers of each complication type.

There did not appear to be a difference in complication rates between male and female patients, as both had a pleural catheter complication rate of 20%. Patients aged 65 or over had higher total complication rates compared to those under the age of 65. On further review of data, it appears that this imbalance is mostly caused by the higher rates of catheter blockage in those aged 65 or over, whilst the rates for infection and dislodgement were not different between age groups.

It is difficult to assess if any particular malignancy was associated with higher complication rates given the overall low number of complications.

Our infection rate of 6.2% in pleural catheters for malignant pleural effusions is similar to those found in other studies, such as reviews of 1021 and 448 patients showing infection rates of 4.95% [8] and 5.6% respectively [9]. It also matches infection rates of a systematic review in 2011 of 1370 catheters, which also showed an infection rate of 6.2% [7]. Our rate of catheter related issues relating to dislodgement and blockage was not dissimilar from the 5.4% in the review of 448 patients [9] although our patient cohort is smaller. We did not find infection to be more common in men, or with those having a lung, breast, or mesothelioma primary as was identified in a systematic review in 2013, [8] although this may perhaps be explained by our lower patient numbers.

### Abdominal Catheters

The baseline characteristics of patients who had insertion of indwelling peritoneal catheters were not overly dissimilar to the pleural catheter group. These patients were again primarily female patients, although they were mostly younger than 65 years of age. Breast and ovarian cancers played a major role in disease burden of these patients. The infection rate of 5.8%, and catheter-related issue rate of 7.5% (blockage, dislodgement, pain requiring drain removal) are also similar to other reported studies found in the earlier literature review [25,26,28]. Of note, our results, along with other studies, all have a higher complication rate than a larger study of 170 patients which reported an infection rate of 2.5% and a catheter-related issue of 4.5% [21]. All catheter insertions in this study were done under radiological guidance, compared to

our peritoneal catheter insertions for which imaging guidance was left up to the discretion of the proceduralist. This may perhaps account for the difference in complication rates. Also notable in this study was that pancreatic malignancies were associated with a higher rate of catheter-related issues [21]. This was not reflected in our data, as there were no instances of catheter-related issues in patients with pancreatic cancer, despite pancreatic cancer being our second most represented cancer type.

The mean dwell time of 43 days is also similar to the cohort of 38 patients with a mean dwell time of 40.7 days [26], but shorter than that of other studies, which ranged from 59.8 to 113 days [25]. The reason for the significant variance between studies of mean dwell time remains unclear at present, although it is notable that many studies did not report data on dwell times.

Onset of complications after catheter insertion varied between the type of complication. We found that catheter blockage happened often within the first 3 weeks post-insertion, whilst cellulitis or peritonitis had the tendency to occur later on.

Our data subset was not large enough to comment on if a particular malignancy carrier a higher risk of complications, or if there were sex-specific differences in complication rates. Catheters placed for non-malignant causes of ascites were few in number, hence we are unable to draw conclusions with certainty.

## Limitations of the Study

There are certain limitations of our study. Firstly, our patient cohort is from one single hospital, and as such, may not be applicable across a wider patient population. There are also a proportion of patients lost to follow-up owing to moving out of the area health service, in some instances having moved overseas. These patients were excluded from calculations for complications and dwell times, although our available data states that they did not have any immediate post-procedural complications. We also did not have enough patients without an underlying malignancy who had indwelling catheters placed, and hence we are unable to offer a useful quantity of data for analysis.

The data that was collected did not include certain parameters which may have been helpful for further analysis, such as the frequency of drainage, mean volumes of drainage, and personnel conducting drainage (patient / carer versus community nursing). Hence, we are unable to evaluate the risk of complications between those which are patient / carer managed, versus those which were managed by healthcare professionals. There was also no data collected regarding outcomes of symptom improvement or quality of life, which although would be helpful, we appreciate this was not the aim of our retrospective review.

As discussed earlier, the time to complication onset is often not completely clear. This is especially true for complications such as infection. Given our catheter management policy of having our patients present to hospital as soon as practicable to remove any catheters with complications, it is likely that any delay of catheter removal is quite short. Nevertheless, this is an assumption, and the effects of this on our data of time to onset of complication can result in a slight overestimation of time to complication.

## Conclusion

Whilst our cohort size for patients with indwelling catheters for malignant pleural effusions is not significantly larger than other studies, our number of discrete indwelling peritoneal catheters place for malignant abdominal ascites numbers 127 after accounting for those lost to follow-up. This cohort size is much larger than most other retrospective cohort studies.

Through our data, it can be seen that that indwelling pleural and peritoneal catheters can safely remain in situ for longer periods of time. Whilst the total complication rates may seem high, further statistical breakdown reveals that the majority of complications are minor, relating to catheter issues of dislodgement and blockage. Major and potentially major complications such as infection are uncommon.

The use of longer-term indwelling tunnelled catheters for malignant pleural effusions can be considered as a acceptable alternative to current society guideline practices of recurrent drainage or pleurodesis. The use of longer-term indwelling peritoneal catheters can also be considered as a safe treatment approach for malignant abdominal ascites.

## Ethical Guidelines

Ethics approval was sought for and granted by our Hospital Research and Ethics Committee (2020/PID01416; 2020/ETH01287).

## Competing Interests

The authors declare no competing interests.

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