Original Article

Management of malignant pleural effusion by an indwelling pleural catheter: A cost-efficiency analysis

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Abstract:

BACKGROUND: For patients that are expected to survive for longer, the risk of complications combined with the need for more vacuum drainage bottles have become barriers to the placement of indwelling pleural catheter (IPC), since these could increase costs.

OBJETIVES: The objective of the current article is to determine the cost and efficiency of treating malignant pleural effusion (MPE) with IPC in Spanish hospitals.

METHODS: We compared the cost associated with the use of IPC per outpatient and per inpatient. We analyzed the number of consultations, length of hospital stay, and outcome of the procedure.

RESULTS: Fifty-five patients were recruited. Spontaneous pleurodesis was achieved in 34.4% of the cases. Post-catheterization complications were observed in 7.2%. Supplementary procedures were unnecessary and 87.7% of the patients reported improved dyspnea. In 64.9% of the cases, the IPCs were inserted during hospitalization with a median hospitalization time of 4 days (1-7.5). There were differences in the number of visits with more consultations being observed in the outpatient group. There was no difference in the number of vacuum drainage bottles used. The complications supposed a cost increase of €1045.6 per outpatient and €432.54 per inpatient. The overall average cost of treatment per outpatient was €3310.2 and €5450.3 per inpatient.

CONCLUSIONS: The treatment with IPC was effective, safe, without need of any more procedures and led to improved dyspnea in more than 85% of the patients. The cost is lower in the outpatient group, although complications represent an increased cost in both groups.

Key words:

Costs, efficiency, indwelling pleural catheters, pleural malignant effusion

Malignant pleural effusion (MPE) complicates many advanced malignancies. The prognosis for patients that develop MPE is poor and life expectancy is directly related to type of primary malignancy and patient functional status with life expectancies ranging from 3 to 18 months.[1,2] There are several treatment options for patients with MPE.[1,2] Guidelines recommend talc pleurodesis, but median hospitalization is 4-8 days.[1,3]

Indwelling pleural catheters (IPCs) are an increasingly popular alternative to pleurodesis. IPC can be inserted as an outpatient and offers rapid relief from dyspnea through ambulatory drainage of effusions. This avoids the admission to hospital associated with pleurodesis. IPCs were originally designed for patients with trapped lungs and large loculated effusions, previously failed pleurodesis attempts, advanced cancers with short life expectancies, and bilateral symptomatic effusions, as well as debilitated patients who could not tolerate pleurodesis.[4-7] However, the multiple advantages of IPCs have encouraged some experts to recommend their use as a primary therapy for all patients with symptomatic MPE.[4-7] IPCs are a safe, effective, and well-tolerated option for palliation in patients with MPE on an outpatient basis.[4-9]

Because of the ongoing expense of the drainage system and the need for home care, cost is considered as a potential barrier to the placement of IPCs; this holds particularly true for patients that are unable to self-drain and who have no available friends or family to assist them.[4]

In addition, the costs of the treatment are different, according to the articles published, depending on the heterogeneity of the patients included and their survival, or if the treatment is done as outpatients or inpatients. IPCs appear to be a cost-effective option according to current data.[10-14] Nevertheless, for patients that are expected to live longer, the risk of complications and the need for more vacuum drainage bottles could increase the costs. The objective of the current article is to determine

the cost and efficiency of treating MPE with IPC in Spanish hospitals.

Methods

Patients with IPCs were recruited prospective from January 2010 to June 2013 at two hospitals in Spain: Complexo Hospitalario Universitario de Vigo (CHUVI) and Complexo Hospitalario Universitario de Ourense (CHOU). For the purposes of this study, only patients having an IPC inserted into the pleural space with an underlying diagnosis of advanced malignancy were included.

The specific criteria for study inclusion were as follows:

1. A MPE defined as one with malignant cells identified in the pleural fluid or cytology or pleural biopsy specimen and
2. Patients with an active neoplasm with metastatic disease in other organs where cytohistologic confirmation did not influence the therapeutic decision for the tumor and exclusion of other treatable causes of pleural effusion.

Demographic data and symptoms such as dyspnea and performance status (PS) were recorded. A PS = 0 refers to a patient that is asymptomatic and fully functional; PS = 1 refers to a patient who is symptomatic and fully ambulatory; and PS = 2 refers to a patient who is symptomatic and in bed less than 50% of the time during the day. Other data were collected with regards to the reason for selecting IPC for the treatment of MPE and procedure outcomes, including complications. We compared data when the IPC insertion was performed as an outpatient or inpatient. IPC was inserted with imaging guidance and topical anesthesia (mepivacaine 2%) and conscious sedation (midazolam and fentanyl).

After placement of the catheter, patients and caregivers were instructed on self-drainage of their MPE when the patient had dyspnea. They were reviewed within 5-10 days after insertion of the catheter and additional visits were arranged if clinically indicated. The criteria for IPC removal were drainage of less than 50 ml on three consecutive attempts in the absence of increasing symptoms or when patients developed an IPC-related complication. The times from IPC insertion to death or termination of the study were recorded. We considered life expectancies to be short, when the survival was less than 3 months.[1,2]

In all cases we used a CPT Pleurx® (CardinalHealth) and 1 l vacuum drainage bottles.

For the calculation of the costs, we used the rates established by our health system.[15] To analyze the average cost per patient of the treatment of the MPE with IPC insertion, we took into account the following criteria: The initial consultation which included the cost of medical care, nursing, and pleural technique performed in the outpatients department; the number of days of hospitalization from the time the IPC was inserted in the case of inpatients; and for all patients the number of successive derived visits. We also included all later chest X-rays, and in the case of patients with complications, we also analyzed the combined costs and the days of hospitalization in the cases when it was necessary. The cost for an IPC insertion is set at €400 and a vacuum drainage bottle is €77.5.

The efficiency of IPC measured as: Outcome of the procedure (percentage success rate of pleurodesis and number of complications) and cost associated with the use of IPC (cost of hospitalization/consultations, diagnostic imaging, and cost complications.

The study protocol was approved by the local ethics committee and all subjects provided written informed consent.

Statistical analysis

The results were expressed as percentages and absolute frequencies for the qualitative variables and as median and interquartile range (IQR) for the numeric. Comparison of the quantitative variables was made using the Mann-Whitney test, since most of these variables did not follow a normal distribution, except the costs which were calculated from total and average per patient. Significance was considered to be $P < 0.05$. The analyses were calculated using the Statistical Package for Social Sciences (SPSS) 15.0 program (Chicago, IL, USA).

Results

Fifty-five patients underwent 57 IPC insertions (two patients underwent bilateral IPC insertion). Baseline characteristics of cases are shown in Table 1. In 13 (22.8%) cases, the patients had short life expectancies, in four (7.01%) cases treatment with pleurodesis failed; in four (7.01%) cases the patients were debilitated and could not tolerate pleurodesis, in two (3.5%) cases they had bilateral symptomatic effusions, in two (3.5%) cases bilateral IPC, and in one case (1.7%) the patient had respiratory failure. In 31 (54.3%) cases, they had a preference choice of pleurodesis. Nonexpandable lung was present at IPC insertion in eight (14%) cases. Thirty-seven (64.9%) cases had previously been admitted to the hospital for other reasons than the sole placement of the catheter (they are; need of oxygen therapy, tumor progression, or deterioration of the general condition). These patients had a mean hospitalization time of 4 days (IQR 1-7.5) from IPC insertion.

The median number of successive consultations and chest X-rays in the group that had IPCs implanted in an outpatient ward compared to the inpatient ward was higher, but was no significant difference [Table 2]. In the inpatient group, 11 patients could not be discharged and in six patients the

Table 1: Patient characteristics

Characteristics	Patients (*n* = 55) (%)
Age (median, IQR)	75 (64-79.5)
Sex	31 (57.1) ♂
Performance status (PS): 0	8 (14.5)
1	17 (30.9)
2	30 (54.5)
Cancer type	
Lung carcinoma	33 (60.2)
Breast carcinoma	8 (14.5)
Carcinoma of unknown origin	5 (9)
Ovarian carcinoma	2 (3.6)
Others*	7 (12.7)

*One each of lymphoma, renal sarcoma, gastric adenocarcinoma, clear cell adenocarcinoma, uterine sarcoma, and mesothelioma, IQR = Interquartile range

follow-up was only carried out in oncology. Although there were no significant differences, there was a tendency to use more vacuum drainage bottles in the outpatient group [Table 2].

Spontaneous pleurodesis and catheter removal occurred in 19 patients (33.4%). Four cases (7.2%) required early removal of the catheter due to complications [Table 3]. The median duration of the catheterization was 37 days (2-78.5). Overall median survival was 71 days (22-166). Outpatients had significantly longer survival times, 118 days (57-285) compared with the inpatient group 37.5 days (20.5-151.75; P = 0.001), respectively.

In forty-eight patients (87.7%), dyspnea improved. We did not observe progression of the pleural effusion after the removal of the catheter in any patient, and supplementary procedures for symptomatic control of the MPE were not needed.

We observed the following complications with need for hospital admission during the follow-up: In the inpatient group, one patient developed an empyema, which required 8 days in hospital and needed a computed tomography (CT) and new pigtail intrathoracic drainage. The IPC was removed due to this complication. Another patient presented a persistent pneumothorax after IPC insertion that needed 4 days in hospital to maintain continuous drainage, and was connected to suction through the IPC itself to get pulmonary reexpansion and pleurodesis. In the outpatient group, a patient developed an infection around the insertion site and needed 7 days in hospital on intravenous antibiotics and a CT. The IPC was removed due to pleurodesis. Another patient presented an empyema, which required 20 days in hospital and needed two CT scans and a new pigtail intrathoracic drainage. The IPC was removed due to this complication. Finally, a patient suffered hemothorax and 7 days in hospital, placement of an intrathoracic tube, and finally a thoracoscopy. The IPC was removed due to this complication.

The costs of all the tests, consultations, hospital admission, complications, and the average total cost of the entire process for each case treated are given in Table 4.

Table 2: Number of consultations/days of hospitalization, chest X-rays, and vacuum drainage bottles

Variable	IPC inpatients (n = 37)	IPC outpatients (n = 20)	P-value
Consultations	1 (0-3)	3 (2-5)	0.03
Days of hospitalization	4 (1-7.5)	—	—
Chest X-rays	2 (0-4.75)	3 (1-5)	0.09
Vacuum bottle	5 (2-9)	10 (4-18)	0.1

IPC = indwelling pleural catheter

Table 3: Outcome of the procedure

Outcome	Indwelling pleural catheter (n = 50)** (%)
Removal due to spontaneous pleurodesis	19 (33.4)
Removal due to IPC related complications	
Infection	2 (3.6)
Pain	1 (1.8)
Hemothorax	1 (1.8)
Dead with IPC	23 (40.4)
Removal due other reasons*	4 (7.2)

*In two cases (3.6%) the pleural effusion was resolved (3.6%) and in two (3.6%) cases the IPC was not attached to the subcutaneous tissue and moved. **Seven patients remained with the IPC at the end of the study. IPC = Indwelling pleural catheter

Table 4: Average cost per case of hospitalization/ consultations, diagnostic imaging, and complications among inpatients and outpatients

Cost	IPC inpatient (n = 37)	IPC outpatient (n = 20)
Days of hospitalization	€3608.2	—
Consultations	€88.81	€158.64
The first consultation	—	€169.97
Chest radiograph	€112.23	€144.9
Vacuum drainage bottle	€808.5	€1391.1
Catheter kit	€400	€400
Complications	€432.54	€1045.6
Average cost (without complications)	€5017.8	€2264.6
Overall mean cost	€5450.3	€3310.2

IPC = Indwelling pleural catheter

Discussion

The development of IPC has revolutionized the management of recurrent MPE. Our study demonstrates that the use of the IPC is an effective procedure to improve the symptoms of MPE and with few complications. The main advantage of this method in the management of the patients is that it avoids hospital admission, thus significantly decreasing the costs associated with other procedures such as talc pleurodesis.[8,10,11] These results are particularly relevant, since the ideal treatment for the patient with MPE will be one that provides symptomatic relief, avoids hospitalization, and has minimal side-effects or complications.[16]

Dyspnea is the most commonly associated symptom with MPE, and the majority of patients will be symptomatic. Previous studies have shown that MPE with the IPC treatment improves the dyspnea, quality of life, and the need for additional pleural procedures when compared with pleurodesis.[7-9,17] However, spontaneous pleurodesis was noted in 34.4% of patients, this is less than reported in other studies.[6,7] Spontaneous pleural symphysis and catheter removal is more likely in patients with breast or gynecologic primary tumors, absence of chest wall irradiation, cytologic positivity, and complete reexpansion of the underlying lung.[18] Dyspnea improved in 87.7% of the patients in our study, and in no cases we required additional procedures for the control of the MPE.

IPC appears to be a cost-effective option for the management of MPE,[8,10,11] especially in patients with a life expectancy of less than 3 months[11,12] or depending on the type of tumor.[13]

Other studies have suggested that treatment with IPC may be more cost effective in patients with a life expectancy of less than 3 months.[11,12]

Median survival in our study was 71 days. This can be explained by the degree of severity of our patients, up to

22.8% had estimated survival of less than 3 months and 54.3% had a PS of greater than 2. The survival of patients where the IPC was placed in the outpatient department was greater. This is probably due to the patients already being in a better functional and clinical situation. Moreover, the average cost of the whole process was comparatively lower than the cost of treatment for inpatients. The mean duration of stay post insertion was 4 days, but it was due to non-IPC related issues. Increasing the healthcare burden and hospital costs in this group of patients with poor prognosis requires the need to offer alternatives that allow outpatient management. The implementation of IPCs for outpatients decreased the cost of the procedure significantly, with savings of €2,140 as opposed to IPCs inserted during hospital admission, regardless of the number of vacuum drainage bottles used and consultations or additional tests that were performed. In our healthcare system, the costs of pleurodesis through thoracoscopy have not been evaluated directly. In a recent study conducted at our center (Communication SEPAR, Arch Bronconeumol 2013; 49:182), the direct costs of medical pleuroscopy and pleurodesis under local anesthesia and conscious sedation of patients with MPE was close to €5,000 per patient. We have not found Spanish studies that have assessed the costs of thoracoscopy and pleurodesis performed in the operating room under general anesthesia.

The most frequent complication is IPC-related infection.[4,19,20] The IPCs reduced the length of stay in hospital, but were associated with excess adverse events.[4,19-21] In our study, the complications accounted for an increase in the costs in both groups. A recent study compared the cost of IPC and talc pleurodesis for MPE. There is no significant difference in mean cost of managing patients with IPC compared with talc pleurodesis. For patients with limited survival, IPC appears less costly.[14]

Our article has limitations, some derived from the design of the study itself, since it is not a randomized study and use of the IPC was based on the decision of the physician and the patient. Another limitation is that it has not been compared with other treatment modalities for MPE such as talc pleurodesis.[1,2] An important aspect is that the results may not be extrapolated to other centers in different health areas which could limit their external validity. Cost-effective studies are necessary to compare different treatment options for MPE.

In conclusion, treatment with IPC was effective, safe, without need of any supplementary procedures and led to improved dyspnea in more than 85% of the patients. The cost is lower in the outpatient group, although complications represent an increased cost in the two groups.

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