ORIGINAL ARTICLE

A Comparative Study Between Conventional Chest Tube and Intrapleural Catheter Drainage in the Management of Malignant Pleural Effusion

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ABSTRACT

Objective: To compare conventional chest intubation versus intrapleural catheter drainage in the management of patients with malignant pleural effusion.

Study Design: Comparative cross-sectional study.

Place and Duration of Study: This study was conducted at the Department of Thoracic Surgery, Combined Military Hospital (CMH), Rawalpindi, Pakistan, from January 2025 to December 2025.

Methods: A total of 84 patients with malignant pleural effusion were divided into two groups of 42 each. Patients included in Group A underwent conventional chest tube insertion, while patients in Group B were managed with intrapleural catheter drainage. Both groups of patients were compared for dyspnea using the visual analog scale for dyspnea (VASD), pain score, and complications such as catheter blockage, pleural infection, catheter dislodgment, cellulitis, and pleurodesis failure at 2, 4, and 8 weeks of follow-up. SPSS version 25 was used for data analysis, and a *P*-value <0.05 was considered statistically significant.

Results: The overall mean age of patients included in the study was 55.9±8.3 years. There were 57 male patients (67.9%) and 27 female patients (32.1%). Both groups had comparable VASD scores at 4 weeks (*P*=0.738). The intrapleural catheter group had a lower VASD score at 8 weeks than the chest tube group (*P*<0.001). Moreover, pain score was significantly lower in the intrapleural catheter group as compared to the chest tube group both at 4 weeks (*P*<0.001) and 8 weeks (*P*=0.010), respectively.

Conclusion: Patients reporting with MPE can be treated effectively by choosing both the management modalities; IPC drainage is better than chest tube in terms of better symptomatic relief with a comparable complication rate.

Keywords: *Chest Intubation, Indwelling Pleural Catheters, Malignant Pleural Effusion.*

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Introduction

Malignant pleural effusion (MPE) is a common pathological condition presenting to thoracic surgery with a worldwide incidence of 70 patients per 100,000 individuals.[1] The leading cause of MPE is lung cancer. With around 2.5 million new cases and 1.76 million annual fatalities, lung cancer continues to be the commonest etiology of cancer-related deaths globally, making about 12.4% of all cancer cases.[2] According to estimates, lung cancer accounts for 5.9% of the new cases of malignancy in the Pakistani population, making it the second most common cancer in males and the third most common cause in females.[3] Lung cancer was the leading cause of tumor-related mortality amongst the male patients.[4]

Annually, approximately 1 million people worldwide suffer from MPE, which results in incapacitating dyspnea and a reduced life expectancy. The two most common causes of MPE in men and women,

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respectively, are lung and breast cancer, which account for 50–65% of all cases.[5] MPE is associated with poor quality of life due to severe dyspnea, discomfort, cachexia, exhaustion, and limited daily activity, as well as an extremely guarded prognosis with a median survival rate of 3-12 months.[6]

In 2023, the British Thoracic Society (BTS) updated its guidelines to treat MPE-related dyspnea, focusing on prognosis, lung re-expandability, patient priorities, and inpatient versus ambulatory management.[7] Thoracic surgeons recommend decisive intervention over repeat thoracentesis in cases of MPE. The various management options for patients with MPE include chest tubes, indwelling pleural catheters (IPCs), talc pleurodesis, partial or total pleurectomy, decortication or a combination of the above procedures.[8] The management plan varies from patient to patient.

Chest tubes have been routinely employed for thoracocentesis as well as for inducing pleurodesis. Chest tubes of larger size (>24 F) were more effective than smaller ones (12F) for pleurodesis in patients with MPE, according to the TIME1 trial.[9] Intrapleural catheter drainage with an indwelling pleural catheter (IPC) provides ambulatory benefits, efficient symptom management, shorter hospital stays, fewer subsequent pleural interventions, and a low complication rate. The procedure can be conveniently performed in an outpatient setting. The size of the catheter is 15.5 Fr.[10]

The rationale for this research protocol was the paucity of recent studies in the national and international literature on this topic. In the current era of evidence-based practices, the results of this study will not only help to determine the better option for patients presenting with MPE but will also pave the way for encouraging further study protocols on this topic.

Methods

A comparative cross-sectional study was conducted at the Department of Thoracic Surgery, Combined Military Hospital (CMH), Rawalpindi, Pakistan, from January 2025 to December 2025 on a total of 84 patients presenting with MPE after approval from the Institutional Review Board of the hospital, vide letter no: 1011 dated 12th January 2025. Written informed consent was obtained from all patients before they joined this study. The study by Mehta D et al. was taken as the parent study for sample size estimation using the WHO sample size calculator.[11] The level of significance was taken as 5%, power of test as 90%, anticipated population proportion 1 as 26%, and anticipated population proportion 2 as 2% (catheter blockage). The sample size was calculated to be 42 patients in each group. Thus, the total sample size was 84 patients. We used non-probability consecutive sampling techniques.

Patients were included if presenting to the thoracic surgery department above the age of 20 years, belonging to both genders, with the diagnosis of symptomatic MPE confirmed on cytological examination of the pleural fluid in a known case of cancer, with an Eastern Cooperative Oncology Group (ECOG) performance status ≤2.

The exclusion criteria were based on whether patients with a previous history of any surgical intervention for MPE, bilateral effusions, coagulopathies (INR>1.5), high-dose chemotherapy causing neutropenia, active infection, or those who were lost to follow-up were excluded from the study.

The demographic details of all patients were documented on a proforma. Two groups, each consisting of 42 patients, were formed. Non-random allocation was done on the basis of clinical expertise and patient preference, mimicking real-world practice to enhance generalizability. In order to ensure that no patient is lost to follow-up, the contact numbers of guardians or close relatives were documented.

Patients included in Group A underwent chest tube insertion (28 Fr) under local anesthesia (Lignocaine 2%), ensuring strict aseptic measures. Once the drainage had dropped to less than 100ml in 24 hours (typically after 48-72 hours), talc slurry pleurodesis (4-5 g sterile talc in 50 ml normal saline) was instilled, followed by tube clamping for 1-2 hours and removal after confirmation of lung expansion via chest X-ray. Patients were administered standard analgesia in the form of intravenous paracetamol 1 g.

Patients in Group B underwent IPC insertion (15.5 Fr) under local anesthesia (Lignocaine 2%), ensuring strict aseptic measures. A stab incision was given (5-7mm) in the extended triangle of safety, and IPC was inserted in the 6th or 7th intercostal space above the rib. Post-insertion, patients and guardians were trained in intermittent home drainage (200 ml every

2 hours, with clamping for 2 hours afterward). When three successive attempts yielded minimal or no fluid, the patient presented to the thoracic surgery department for pleurodesis and catheter removal.

The follow-up visits of patients were planned after 2 weeks, 4 weeks, and 8 weeks' intervals. The baseline visual analog scale for dyspnea (VASD) was calculated at the time of presentation on a scale from 0 to 100 mm and then on follow-up visits at 4 and 8 weeks. Pain score as per the visual analog scale (VAS) will be measured an hour after the procedure. Pain score will also be determined at follow-up visits at 4 and 8 weeks. Complications, including catheter blockage, pleural infection, cellulitis, catheter dislodgment, and failed pleurodesis, were recorded in both groups.

The Statistical Package for the Social Sciences (SPSS) version 25.0 was used to analyze the data. For numerical variables like age, VASD score, and pain score, mean and standard deviation were determined, while frequencies and percentages were determined for categorical variables like gender, and various complications. An independent-samples t-test was used to compare quantitative variables between the two groups, and a Chi-Square test was used to compare qualitative variables. A *P* value of less than 0.05 was taken as statistically significant.

Results

A total of 84 patients with MPE were divided into two equal groups of 42 patients each. The overall mean age of patients included in the study was 55.9±8.3 years. Patients in Group A had a mean age of 57.2±7.5 years, while those in Group B had a mean age of 54.6±8.8 years; the difference between the groups was non-significant (*P*=0.159). There were 57 male patients (67.9%), while 27 patients (32.1%) were female. There was no difference between the two groups in terms of gender distribution (*P*=0.483). The right pleural cavity was involved in 53 patients (63.1%), and the left pleural cavity in 31 (36.9%), with no significant difference between the two groups (*P*=0.821).

The baseline mean VASD score at the time of presentation was 61.2±8.6 in the chest tube group and 63.1±8.0 in the IPC group (*P*=0.302). The baseline mean pain score at the time of presentation was 6.6±0.9 in the chest tube group and 6.9±0.8 in the IPC group (*P*=0.176). There was improvement in symptoms in both groups of patients at follow-up visits scheduled at 4 weeks and 8 weeks. The comparison of both groups in terms of VASD scores and pain scores is shown in Table 1 as follows.

Patients in both groups were also followed for the

Table 1: Comparison of the groups in terms of VASD and Pain scores

Timeline	Variable	Group A Mean ± SD	Group B Mean ± SD	*t*-test	*P*-value
Baseline	VASD Score	61.2±8.6	63.1±8.0	0.323	0.302
	Pain Score	6.6±0.9	6.9±0.8	4.037	0.176
At 4 weeks	VASD Score	24.4±8.1	23.6±6.2	0.732	0.738
	Pain Score	3.1±0.9	2.4±0.8	4.051	<0.001
At 8 weeks	VASD Score	12.5±2.9	9.0±3.2	8.353	<0.001
	Pain Score	1.9±0.6	1.5±0.6	2.635	0.010

Table 2: Comparison of both groups according to complications

Variable	Result	Group A N (%)	Group B N (%)	*Chi-Square* test value	*P*-value
Catheter blockade	Yes	3	9	3.500	0.061
	No	39	33		
Cellulitis	Yes	3	5	0.553	0.457
	No	39	37		
Pleurodesis Failure	Yes	2	1	0.346	0.557
	No	40	41		
Catheter dislodgement	Yes	1	2	0.346	0.557
	No	41	40		
Pleural Infection	Yes	2	5	1.403	0.236
	No	40	37		

development of any post-procedural complications. The different complications observed in our patients are expressed in Table 2. Moreover, the hospital readmission rate was also compared between the two groups. The readmission rate was 7 out of 42 patients (16.7%) in the chest tube group versus 3 out of 42 patients (7.1%) in the IPC group, with no statistically significant difference (*P*=0.332).

Discussion

MPE affects an approximate 15% of all patients with malignancies, with the most common etiologies being lung cancer, breast cancer, lymphoma, and malignant mesothelioma, amongst others. With an annual 150,000 new cases reported in the United States, and with 100,000 in Europe, it represents a significant burden on the healthcare system.[12] The exact number of cases in our country remains unknown. Since the median survival rate in these patients is between 3 and 12 months from the time of diagnosis, the management remains mainly palliative with the aim of managing symptoms (dyspnea and pain) to improve quality of life.[13]

In this research protocol of ours, we compared chest tube and IPC for the management of patients with MPE. This is the first study of its kind to compare these modalities in the Pakistani population. The mean age of our patients was 55.9±8.3 years with a male gender preponderance (67.9%). Mehta D et al. reported comparable mean ages of 59.7±6.3 years in the chest tube group and 56.4±7.7 years in the IPC group.[11] A study by Muhammad R et al. reported that 75% of the patients presenting with MPE were males. The study compared small- and large-bore chest drains and reported a younger mean age of 45.8±15.7 years among patients undergoing chest tube drainage.[14]

The management of MPE is aimed at alleviating symptoms of dyspnea and breathlessness, followed by pain and cough. Even small effusions can cause significant dyspnea. Both chest tube and IPC drainage help drain these effusions and provide symptomatic relief.[15] In our study, we compared the two groups in terms of improvement in both VASD scores and pain scores. The two groups of patients had comparable scores at the start of the study. The results expressed in Table I above show that in terms of improvement in VASD score for dyspnea, both groups had comparable results at 4 weeks follow-up (*P*=0.738); however, the IPC group reported a lower VASD score at 8 weeks follow-up as compared to the chest tube group (*P*<0.001). Moreover, the pain score was significantly lower in the IPC group than in the chest tube group at 4 weeks (*P*<0.001) and 8 weeks (*P*=0.010).

Mehta D et al. also reported that there was no difference in both groups in terms of dyspnea score at 6 weeks (*P*=0.56), the dyspnea score at 3 months follow-up was significantly lower in the IPC group as compared to the chest tube group (*P*<0.05).[11] A study by Saricam M et al. compared chest tube drainage versus IPC in patients with benign pleural effusions,the mean pain score was 3.94 for IPC drainage versus a mean pain score of 6.21 for the chest tube group respectively, which was a statistically significant difference (*P*<0.001).[16]

Moreover, the financial and economic burden of managing MPEs is also significant in a developing country like ours. A study by Ost DE et al. published in 2024 reported that management of MPE with IPC was significantly cheaper than chest tube drainage and thoracentesis (*P*<0.001).[17] Coming over to the complications, although catheter blockage (*P*=0.061) and pleural infection (*P*=0.236) were slightly higher in the IPC group, the two groups differed, but the difference was not statistically significant. Mehta D et al. reported that catheter blockage was only 2% in the chest tube group as compared to 26% in the IPC group, respectively, the difference being statistically significant (*P*<0.05).[11]

IPCs are a well-established management option for MPE-induced symptomatic dyspnea, especially in outpatient settings, as was done in our study. In most patients, an IPC is a safe alternative to a chest tube for alleviating symptoms and improving quality of life.[18] In this setting, IPCs have emerged as an important strategy in the management of MPE, providing long-term symptom alleviation while reducing the need for recurring hospitalizations. IPCs further complement talc pleurodesis to improve outcomes.[18] A study by Zadeh HK et al. compared IPCs for MPE and non-MPE cases and found that IPCs provided effective symptomatic relief in both groups of patients.[19]

The results of our study revealed that both management options are effective modalities in the treatment of MPE. IPCs were better than chest tubes

for pain relief and dyspnea improvement, albeit with a comparable complication rate. The findings of our study are in agreement with those previously reported in international literature.[11,19,20] The limitations of this study were that the study had a smaller sample size and only early follow-up data were included. We recommend further prospective comparative studies, including randomized controlled trials with larger sample sizes, to validate previous findings and develop evidence-based guidelines for managing patients with MPE, ultimately helping provide a better standard of care for these patients.

Conclusion

Patients reporting with MPE can be treated effectively by choosing both the management modalities; IPC drainage is better than chest tube in terms of better symptomatic relief with a comparable complication rate. IPC can be conveniently inserted in an outpatient setting and is better tolerated by the patients; therefore, we recommend its use in managing patients with MPE.

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Author Contributions

AYP: Conception, design of the work, and approval for final submission
FAM: Data acquisition, curation, statistical analysis, and approval for final submission
AW: Validation of data, interpretation, write-up of results, and approval for final submission
WA: Writing the original draft, proofreading, and approval for final submission
AZ: Manuscript writing for methodology design, investigation, and approval for final submission
MA: Revising, editing, supervising for intellectual content, and approval for final submission
WA is the nominated guarantor and takes full responsibility for the overall content and integrity of the work