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Research Article

Efficacy of drainage of pleural effusion using small bore pleural catheter and conventional thoracostomy using large bore chest tube: a comparative study

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ABSTRACT

Background: Pleural effusions commonly occur in patients with advanced cancer and tuberculosis. Pleural aspiration by the conventional tube thoracostomy using large bore chest tube-intercostal drain (ICD) - can often cause discomfort to patients. The aim of this study is to compare the efficacy of drainage of pleural effusions using flexible small bore Pleural Catheter (PC) and ICD.
Methods: In this prospective study, 101 patients (age 16-65 years) with pleural effusions were divided into PC (n=60) and ICD (n=41) groups. Responses were evaluated and analyzed statistically.
Results: The PC group was equally efficacious as ICD with regard to complete re-expansion of lung. The most common complication in the PC group was block (9/60 i.e. 15%). Difference in the mean number of days on drain in the PC (4.9 days) and ICD group (5.8 days) as well as the mean number of times analgesics administered in the PC (2.85 days) and the ICD group (7.53 days) were statistically significant ($p < 0.05$). Similarly, the complications such as surgical emphysema, haemorrhage, desaturation and hypotension were high in the conventional group when compared to that of PC group ($p < 0.05$).
Conclusions: Flexible small bore intercostal catheter is a valid and safe option for drainage of pleural effusion when compared to the conventional tube thoracostomy.

Keywords: Pleural effusions, Thoracostomy, Tuberculosis, Pleural catheterization, Dyspnoea, Hemothorax, Desaturation, Emphysema

INTRODUCTION

Pleural effusion is a common entity in the practice of Pulmonary Medicine. Moderate and massive effusions cause distressing dyspnoea and cough to the patient that they warrant therapeutic aspiration. Thoracostomy tubes are a mainstay of treatment for removing fluid or air from the pleural space. Placement of a chest tube is, however, an invasive procedure with potential morbidity. Complications include hemothorax, perforation of intrathoracic organs, diaphragmatic laceration, empyema, pulmonary edema, and Horner's syndrome.[1] We have developed yet another modality for therapeutic pleural aspiration using a smaller bore catheter. The aims of our study were to compare between pleural catheter insertion and conventional tube thoracostomy (ICD) in therapeutic drainage of pleural effusions and to determine whether Pleural Catheter (PC) insertion is a better modality over conventional tube thoracostomy in therapeutic drainage of pleural effusions.

METHODS

In this prospective study, all patients with pleural effusion admitted in the Department of Pulmonary Medicine, during the period between January and December, 2014 were included. Patients with history suggestive of a pleural disease were subjected to thorough clinical examination and chest X-ray evaluation. After confirming an anatomical diagnosis of moderate/massive pleural effusion, these patients were subjected to either PC or ICD insertion on a random basis. Medical records of patients meeting the inclusion criteria were analyzed. The study protocol was approved by the institutional research committee and ethics committee.

Patients of age less than or equal to 12 years, patients who succumbed to death while on pleural drain, those not willing for the procedure, those with minimal pleural effusion (no clinical signs of pleural effusion), patients with loculated pleural effusion, patients in whom no free pleural fluid could be aspirated on applying negative pressure and those with hydropneumothorax were excluded from the study.

The procedure of pleural drainage

A single lumen central venous catheter (no: 14 size) was used as the pleural catheter. The area of the thorax with maximum dullness to percussion was selected for the insertion of the catheter. After infiltrating the chest wall and parietal pleura with 2% lignocaine, the presence of free fluid was ensured by aspirating a minimal volume by applying negative pressure using the same syringe and needle which was used for applying local anaesthetic agent. If free fluid could not be aspirated, the procedure was abandoned. Such patients were subjected to ultrasound localization and were excluded from the study. In those patients with free fluid, the catheter was inserted into the pleural cavity through the inferior aspect of the intercostal space. Seldinger technique was used for insertion.[2] It was secured to the skin with sutures and connected to an underwater seal using 3-way valve.

For conventional tube thoracostomy using large bore chest tube, the site selected was the triangle of safety. A thoracic catheter (no: 28 French size) was used. After infiltrating the chest wall and parietal pleura with 2% lignocaine, the catheter was inserted into the pleural cavity using technique described by Laws et al.[3] The catheter was connected to an underwater drainage system.

In both the patient groups, a check X–ray was taken immediately after the procedure to ensure that the drains are correctly positioned. All the patients in the study were examined by the investigators daily till the day of discharge. Daily pleural drain was recorded. Number of analgesics was titrated according to the pain reported by the patient. The smooth functioning of the drainage system was ensured. Blocked catheters were flushed with normal saline. Displaced catheters were discarded and similar new ones reintroduced at the same site.

Statistical analysis

Statistical analysis was done using the software, software SPSS version 16. Chi-square test, Mann- Whitney U test, Students t test and Fishers exact test were used to compare the two groups. p value less than <0.05 was considered as significant.

RESULTS

The total number of subjects included in the study was 101. Out of this 60 underwent pleural catheterization and 41 underwent ICD insertion. The commonest age group was 56 to 65 years (26.7%). The least common age group was 16 to 25 years (3.9%). Males dominated (72.2%) and the number of females was 27.7%. Among 101 patients, 49 (48.5%) had right sided and 39 (38.6%) had left sided pleural effusion. Bilateral pleural effusion was present only in 13 patients (12.87%).

In the PC group, an etiological diagnosis was attained in 37 patients (61.66%) with pleural fluid analysis alone. While in the ICD group an exact diagnosis was attained in 38 patients (92.68%) with fluid analysis and with or without pleural biopsy. The difference was statistically significant (p = 0.001).

In the PC group, less than 1000 ml fluid was drained in 28 patients (46.66%). 1000-2000 ml was drained in 17 cases (28.33%). More than 2000 ml fluid was drained in 15 patients (25%). In the ICD group, less than 1000 ml fluid was drained in 10 patients (24.39%). 1000 – 2000 ml was drained in 19 out of 41 cases (46.34%) and more than 2000 ml fluid was drained in 12 patients (29.26%). The difference was not statistically significant (p = 0.06; Fischer's test). In draining even large volumes of pleural fluid, the PC was comparable with ICD (Figure 1).

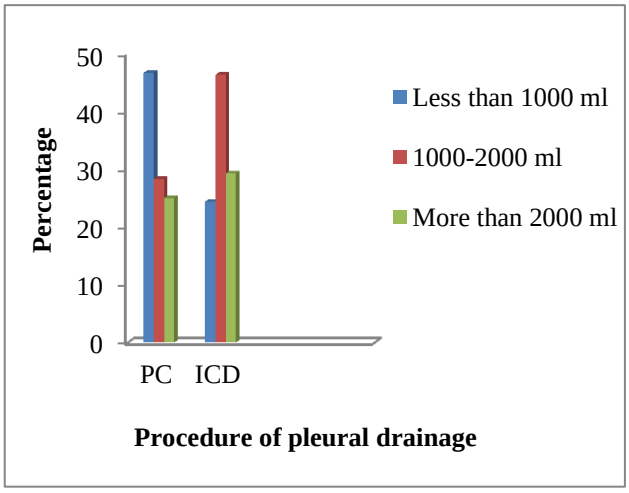

Figure 1: Pleural fluid drained in both methods.

In the PC group, the mean number of days on drain was 4.9, whereas in the ICD group it was 5.8. Applying the Mann-Whitney U test, the difference was significant (p = 0.023). So the PC group had a significantly lesser number of days on the pleural drain (Table 1). In the PC group, 8 patients (13.33%) required ICU stay and in the ICD group this was 8 (19.51%). Applying the Chi-square test the p value is 0.404. The difference is not significant. In the PC group, mean number of times analgesics had to be administered was 2.85 and in the ICD group it was 7.53. The difference was statistically significant (p = 0.0001; Students t test) (Table 1).

Table 1: Complications in the small bore pleural catheter (PC) and conventional intercostal drain (ICD) procedures.

Groups	Days on drain	Analgesics administered (times)	Complications					
			Block	Surgical emphysema	Haemorrhage	Desaturation	Desaturation and hypotension	Hypotension
PC (n=60)	4.96	2.85	9 (15%)	0	0	2 (3.33%)	0	0
ICD (n=41)	5.87	7.53	0	5	2 (4.87%)	3 (7.31%)	1 (2.43%)	2 (4.87%)

Values in parenthesis indicate the percentage

Among the 60 PC cases, 42 completely re-expanded (70%). Among the 41 ICD cases 22 completely re-expanded (53.65%). The difference was not statistically significant (p = 0.09; Chi square test). This means that PC is equally efficacious as ICD with regard to complete re expansion of lung

In the PC group, 13 patients (21.66%) had some complication or the other (Table 1). The most common complication of PC was block (9/60 i.e. 15%). Others were desaturation (2/60 i.e. 3.33%) and displacement (2/60 i.e. 3.33%). However, none had haemorrhage, surgical emphysema or hypotension.

In the ICD group, 18 patients (43.90%) had some sort of complication. The most common complication in the ICD group was surgical emphysema (5/41 i.e. 12.19%). Other complications were haemorrhage (2/41, 4.87%), desaturation (3/41, 7.31%), desaturation and surgical emphysema (1/41, 2.43%), hypotension (2/41, 4.87%), desaturation and hypotension (1/41, 2.43%) and displacement (4/41, 9.75%). However, none had block of the ICD. The difference in complication rates was found to be significant (p = 0.001, Chi square test).

DISCUSSION

To the best of our knowledge, no published data are available regarding the use of the catheter described in this study for draining pleural effusion. Most of the studies have been done with commercially available indwelling tunnelled pleural catheters. The advantage of the novel technique demonstrated is that it is definitely cheaper than the commercially available technique using large bore chest tube.

Lin et al. compared the effectiveness and complications between chest tube and pigtail catheter thoracostomy for drainage of parapneumonic pleural effusion in children.[4] They found no significant differences in either drainage days or hospitalization days between the chest tube group and pigtail catheter group. They concluded that the effectiveness and complications of the pigtail catheter were comparable to those of the chest tubes. Similarly in our study, the effectiveness of both the techniques was quite similar. The pleural catheter was equally efficacious as a conventional large bore ICD in attaining complete re expansion of lung as well as draining even large volumes of pleural fluid. But with regard to the complications, unlike the previous study, we found the patients on pleural catheter had lesser complications, lesser number of days on drain and lesser requirement of analgesics than the ICD group.

Gammie et al. conducted a retrospective study on the effectiveness and complications of pigtail catheters in pleural effusions and pneumothoraces.[5] There were no complications related to pigtail catheter insertion. Clinical success rates in the effusion and pneumothorax groups were 86 and 81 percent, respectively. The results are in agreement with our study. In another study published by Lambert and Gurgacz in Australian Safety and Efficacy Register for New Interventional Procedures - Surgical (ASERNIP-S),[6] the authors conclude that Pleurx® catheter is relatively safe, improves symptoms for patients with malignant pleural effusions and may be associated with shorter hospital stays as compared to pleurodesis.

Akçay et al.,[7] compared the ultrasound unaided pleural catheters with ultrasound guided pigtail catheters in cases of pleural effusion. The patients with Pleuracan® catheters showed trends towards shorter catheter stay and

larger drainage volume than pigtail group, but the differences were not statistically significant. The results showed that small-diameter chest drain kits that do not require ultrasound guidance for placement can be used effectively to drain pleural fluid similar to the conventional ultrasound- guided drainage system. The study also revealed that closed system chest drain kits for percutaneous placement of small-diameter tubes are as safe as ultrasound-guided systems.

Sudharshan et al. demonstrated the effectiveness of tunneled pleural catheters in malignant pleural effusions. [8] They concluded that tunneled pleural catheter placement is a safe and effective approach to the treatment of pleural effusion. The advantages of tunneled pleural catheter placement include symptomatic relief and improved quality of life.

The results of the randomized investigational trial leading to approval of the Pleurx by the FDA were reported by Putnam Jr et al.[9] Two-thirds of 144 patients received the Pleurx and one-third was treated with conventional doxycycline sclerotherapy through a chest tube. Equivalent safety and efficacy were shown and there was no difference in median survival. The Pleurx group had a trend toward greater improvement in dyspnea after exercise at 1 to 3 months but similar improvements were seen in quality of life. The median hospitalization time was 1 day for Pleurx patients, the minimum mandated by the study design. The sclerotherapy group had a significantly longer median hospitalization time of 6.5 days. The severity of pain was similar between the two groups, as was the 10 to 14% rate of early, in-hospital complications. Late complications occurring with the Pleurx were mostly minor and either easily treated or of little consequence to the patient's overall condition.

In a comparative multicentre prospective study by Fysh et al.,[10] patients with malignant pleural effusion were treated with Indwelling Pleural Catheter (IPC) or talc pleurodesis, based on patient choice. Key end points were hospital bed days from procedure to death (total and effusion-related). Complications, including infection and protein depletion, were monitored longitudinally. one hundred and sixty patients were recruited, and 65 required definitive fluid control; 34 chose IPCs and 31 pleurodesis. Total hospital bed days (from any causes) were significantly fewer in patients with IPCs. Effusion-related hospital bed days were significantly fewer with IPCs. Patients with IPCs spent significantly fewer of their remaining days of life in hospital. Fewer patients with IPCs required further pleural procedures. There was no difference in rates of pleural infection and protein or albumin loss. More patients treated with IPC reported immediate (within 7 days) improvements in quality of life and dyspnea**.** The authors concluded that patients treated with IPCs required significantly fewer days in hospital and fewer additional pleural procedures than those who received pleurodesis. Safety profiles and symptom control were comparable.

Jain et al. studied the efficacy and complications of percutaneous small bore pigtail catheters for tube thoracostomy.[11] The procedure was successful in 92% cases. Fibrinolytic therapy and pleurodesis was successful through these tubes. Complications included blockade in 8%, small pneumothorax in 20% and chest pain at tube thoracostomy site requiring analgesics in 60%. Small bore pigtail catheters are safe, comfortable, cost effective and have few complications especially in loculated pleural effusions.

Bediwy et al prospectively evaluated efficacy and safety of pigtail catheter (8.5-14 French) insertion in 51 cases of pleural effusion of various etiologies.[12] Malignant effusion cases had pleurodesis done through the catheter. Duration of drainage of pleural fluid was 3-14 days. Complications included pain (23 patients), pneumothorax (10 patients), catheter blockage (two patients), and infection (one patient). Overall success rate was 82.35% (85.71% for transudative, 83.33% for tuberculous, 81.81% for malignant, and 80% for parapneumonic effusion). Nine cases had procedure failure, five due to loculated effusions, and four due to rapid reaccumulation of fluid after catheter removal. Only two empyema cases (out of six) had a successful procedure. The authors concluded that pigtail catheter insertion is an effective and safe method of draining pleural fluid. They encourage its use for all cases of pleural effusion requiring chest drain except for empyema and other loculated effusions that yielded low success rate.

CONCLUSION

Flexible small bore pleural catheter is a better modality than conventional large bore intercostal tube in therapeutic drainage of pleural effusion. Short duration and less sample size are the major limitations of this study.

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