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Study Of Intercostal Tube Drainage Versus Pigtail Drainage For Management Of Malignant Pleural Effusion

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Abstract

Background: Malignant pleural effusion (MPE) is common in advanced cancer disease. Treatment consists of sequential thoracentesis or tube thoracostomy but the use of pigtail catheters have become increasingly common.

Aim : To compare intercostal tube drainage and pigtail drainage regarding pain score, duration of hospital stay, duration of drainage and the success rate of pleurodesis in patients with malignant pleural effusion .

Methods: A prospective study was conducted in chest department, Kasr El-Aini hospital, Cairo University in the period from June 2018 to January 2020. It included 40 patients with MPE were classified into Group A: 20 patients underwent thoracoscopic pleural biopsy with intercostal tube insertion. Group B: 20 patients underwent US guided biopsy with pigtail insertion. The pain score assessed during the procedures using visual analogue scale VAS. Duration of hospital stay and duration of drainage were recorded. pleurodesis was done by Doxycycline (vibramycin) .

Results: Both groups were similar regarding success rate of pleurodesis .Pigtail catheters were associated with minor complications. Regarding chest pain using VAS group B (VAS 1.7 ± 1.34) was lesser than group A (VAS 7.3 ± 0.98), duration of hospitalization and duration of drainage was shorter in group B (6.55 ± 1.23 days) and (3.95 ± 0.83 days) respectively .

Conclusion: Small bore catheter is a good alternative to chest tube for drainage of MPE as it's equally effective and significantly less painful. Moreover, pigtail catheter drainage reduces the length of hospital stay .

Key words: MPE, Pigtail catheter, Chest tube .

Introduction

The diagnosis of malignant pleural effusion (MPE) is based on the accumulation of exudative fluid in the pleural cavity associated with the presence of malignant cells or tumor tissues **(1)**.

Lung cancer in males and breast cancer in females are the most common causes of metastatic MPE **(2)**. While mesothelioma is most common primary pleural tumor causing MPE **(3)**.

Despite the recent advances in cancer therapy, the treatment of MPE is palliative including drainage of the pleural fluid followed by pleurodesis using chemical agent such as bleomycin, doxycycline ,tetracycline or talc poudrage through thoracoscopy or through chest tube (slurry), also mechanical pleurodesis can be performed during surgery **(4)**.

Minimally invasive procedure using small bore ,flexible pigtail catheter can be used as an alternative for intercostal tube for drainage of MPE .It is less traumatic , causing less pain and smaller scar which allow better patient mobility after the procedure **(5,6)**.

The current study aimed to compare intercostal tube drainage versus pigtail drainage for management malignant pleural effusion regarding pain score, duration of hospital stay, duration of drainage and the success rate of pleurodesis .

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Material and methods

A prospective observational cross sectional study to compare intercostal tube drainage(after medical thoracoscopy) and pigtail drainage (after chest ultrasound guided biopsy) regarding pain score, duration of hospital stay, duration of drainage and the success rate of pleurodesis in patients with malignant pleural effusion .

The study was conducted in chest department, Kasr Al-Ainy hospital, Cairo University during the period from June 2018 to January 2020. It was carried on 40 patients. The research ethical committee of Cairo University approved the study (IRB : N-57-2018). All patients were informed with the full details of the procedure and informed consent was obtained.

Inclusion criteria:

1.Patients with malignant pleural effusion.

2.Patients accept to participate in the study.

Exclusion criteria:

1. Hemodynamically unstable.
2. Non-malignant pleural effusion.
3. Multi-loculated malignant pleural effusion.
4. Respiratory failure.
5. Bleeding disorders that interfere with the procedures.
6. Uncontrolled cardiac disorder as recent myocardial infarction .

Patients were classified in to two groups: **Group A:** Included 20 patients underwent thoracoscopic pleural biopsy with intercostal tube insertion. **Group B:** Included 20 patients underwent US guided biopsy followed by pigtail insertion.

All patients were subjected to history taking ,clinical examination, routine laboratory investigations , CT scan of the chest without contrast , pleural fluid aspiration with cytological analysis.

Procedures

Group A: medical thoracoscopy was done using KARL-STORZ rigid thoracoscopy. The examination was performed while the patient lying on the healthy side. The puncture site is usually in the mid - axillary zone between the third and sixth intercostal spaces. Choice of the point of entry varied depending on the site of dullness and guided by CT chest **(7)** The single-entry technique for medical thoracoscopy was performed in all cases.

The procedure includes; complete sterilization of the site of procedure using Povidone-iodine, local anesthesia is performed in three steps: anesthesia of the skin, the rib periostium, and the pleura using about 15-20 ml of Lidocaine 2% , careful aspiration of pleural fluid to ensure entry of pleural space, Opening about 1.5 cm of skin and subcutaneous layer using scalpel ,blunt dissection of the intercostal tissues and muscles by artery clamp and the parietal pleura was gently penetrated by the clamp ,the rigid trocar and obturator of the medical rigid thoracoscope were inserted through the incision, collection of multiple biopsy samples under direct vision from suspicious sites on parietal (especially posterior costodiaphragmatic recess) or diaphragmatic pleura but not from visceral pleura, biopsies were sent for histopathological analysis **(3).**

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Chest tube insertion : at the end of the thoracoscopy procedure chest tube was inserted in place and connected to under water seal bottle. The chest tube was fixed to the skin of the patient at its exit from the chest wall by suture. Another suture (stay suture) was taken. Clear dressing was placed over chest tube **(3).**

Group B: Transthoracic ultrasonography (TUS) was done using Hitachi 7000. All cases were examined with curvilinear transducer (3.5 MHz) and linear array transducer (7.5 MHz).

Procedure: Screening of the patient's chest using the low frequency probe , the presence of pleural effusion or pleural thickness, masses or nodules was detected , the biopsy site was subsequently identified, biopsies were taken using Tru-cut needle under direct TUS guidance .Under the sterile technique and local anesthesia(as described in medical thoracoscope),biopsies were sent for histopathological examination, screening the patient post biopsy to detect the presence of any complications **(3)**.

Pigtail catheter insertion: (after histopathological confirmation of malignancy);The site of catheter insertion was determined by ultrasound guidance. In most cases, the site of insertion was in the 5th or the 6th intercostal space in the mid-axillary line, just above the top of the rib to avoid injury of the intercostal bundle and introduction performed under complete aseptic measures , local anesthesia about 5 to 10 mL of lidocaine 2%, a small needle (18-gauge) was employed before inserting the catheter to confirm the site of effusion, small incision in the skin (usually of less than 5 mm) was made, Pigtail catheter (DIALLI 12F- 30 cm) with trocar and needle was used (figure 1), insertion of pigtail was done by pushing the needle, trocar and catheter as one unit until reaching the pleural cavity and then the needle and trocar was withdrawn gradually while simultaneously introducing the catheter which was then connected to a collecting bag via a triple way valve. pigtail was fixed to the skin of the patient at its exit from the chest wall by suture and another suture (stay suture) was taken. Chest X-ray was done after the procedure to confirm the catheter being in place and to exclude any complications like pneumothorax . Flushing was done regularly every 12 h. **(8)**

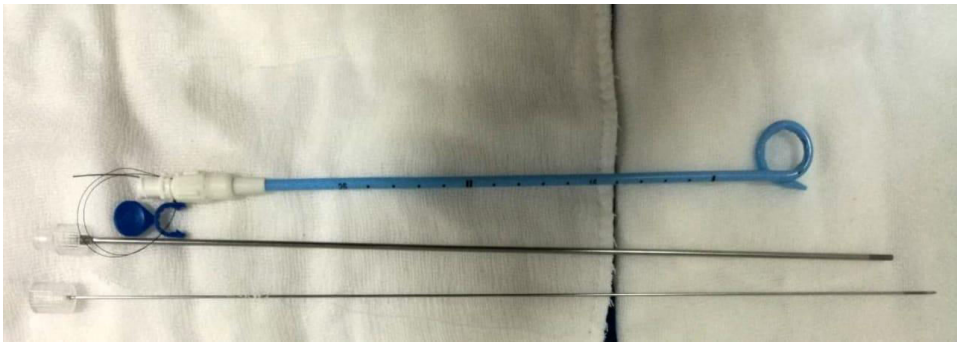

Figure (1) : Pigtail catheter with trocar and needle

For both groups;

1- **Pain Score (during the procedures)**
Using VAS (Visual Analogue Scale) for pain intensity , the Wong-Baker Faces Pain Rating Scale (figure 2). This pain scale describes serial faces ranging from a happy face at 0, which means "no hurt", to a crying face at 10, which represents "hurts like the worst pain imaginable". Based on the faces, the patient chooses the face that best describes the severity of pain **(9)**

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Figure (2) : Visual Analogue Scale

2- Chemical pleurodesis:

Chemical pleurodesis was done using Doxycycline (vibramycin) When the amount of drained fluid decrease to 150 ml or less per day, the lung is fully expanded against the chest wall by CXR and biopsies confirmed to be malignant **(3)**.

Procedure: Injection of 20ml of 2% lidocaine into the pleural space through the ICT or pigtail followed by injection of the sclerosing agent doxycycline (15-20) mg/kg of dissolved into 50 ml of normal saline injected in to the pleural space through the tube or pig tail followed by 20 ml of normal saline to flush the drain .Clamp chest tube for 2 hours, after that the tube was opened. The chest tube was removed when the drainage was less than 150 ml/24 hour and a chest X-ray was obtained **(10)**

By the end of a 4 weeks follow-up period, the radiographic response (CXR) was classified as follows:

A- Successful pleurodesis if no radiographic evidence of fluid re-accumulation.

B-Failed pleurodesis if there is a radiographic evidence of fluid re-accumulation .

Statistical methods

The data collected tabulated and statistically analyzed using the following methods; **Descriptive statistics;** Continuous data was represented as mean and standard deviation (SD), while categorical data as number and percentage (%). **Analytic statistics: Independent t-test:** used to compare between two independent groups**. Chi square test:** used to compare two group with categorical data nature. All statistical tests were two sided, P considered significant if < 0.05.

Results:

This study conducted on 40 patients with malignant pleural effusion (16 patients were diagnosed mesothelioma and 24 patients were diagnosed metastatic adenocarcinoma). Patients were classified in to two groups; Group-A: Included 20 patients underwent thoracoscopic pleural biopsy with intercostal tube insertion, Group-B: Included 20 patients underwent US guided biopsy followed by pigtail insertion. The primary aim of the study was comparing pain score, duration of hospital stay and duration of drainage in each group, furthermore, secondary outcomes were evaluated as the outcome of pleurodesis and complications.

Both groups were matched regarding age (63.7±9.88 for Group-A and 62.9±7.54 for Group-B) ,sex , smoking index and clinical presentations (cough ,shortness of breath and chest pain) . Considering the site of effusion either RT or LT, the both groups were equally distributed, P = 1 .

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In cytological examination of pleural fluid, malignant cells were equally distributed in both groups, P = 0.3 , visualization assessment of pleura, either by thoracoscope in group-A or by US in group-B, pleural masses were equally found in both group, P = 0.6, while nodules were significantly detected in group-A, P = 0.03 (Table 1)

Table (2) Shows comparison between both groups redarding pain score, duration of drainage and duration of hospital stay, they were significantly lower in group-B than group-A with P < 0.001, 0.004 and < 0.001 respectively.

The rate of successful pleurodesis was equal in both groups, P = 0.45 as described in Table (3).

Table (4) Described the complications reported in both groups, minor complication (blocked drain) was significantly associated with pigtail insertion, while major complications (surgical emphysema 5 cases, air leak 1 case and hypotension 1 case) were significantly reported with intercostal tube insertion, P = 0.04 and 0.008 respectively.

Case 1 : Figure (3a) showed CXR of female patient with left sided massive pleural effusion. Ultrasound guided biopsy was done revealed metastatic adenocarcinoma. Pigtail was inserted. Pain score was 2 , duration of hospitalization 6 days and the duration of drainage 4 days. No reported complication. The pleurodesis was successful (3b).

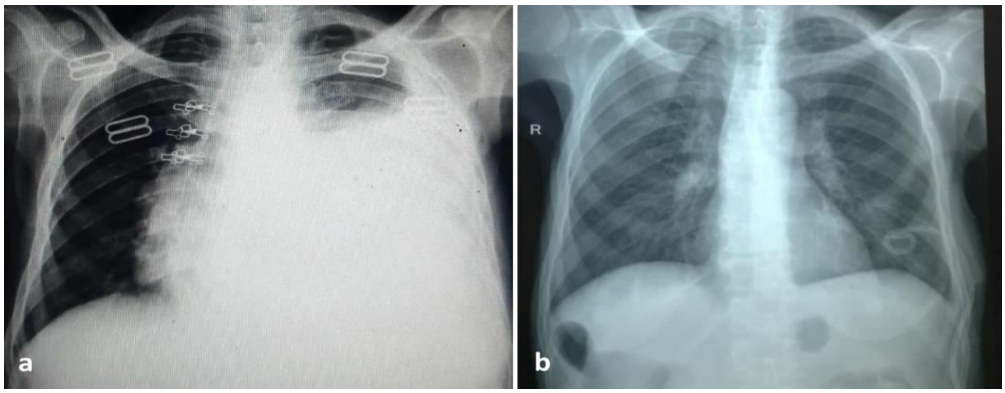

Figure (3) : (a) CXR at presentation (b)Follow up CXR (after 4 days)

Case 2 : Figure (4 a) showed CXR of female patient with massive right side pleural effusion. Medical thoracoscopic pleural biopsy was done. ICT was inserted. The patient was diagnosed epithelial mesothelioma. Pain scorewas 8 ,duration of hospitalization 9 daysand the duration of drainage 4 days. No reported complication. The pleurodesis was successful (4b).

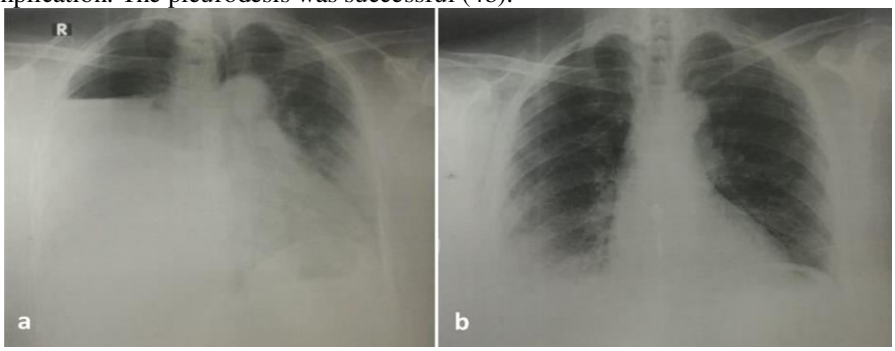

Figure (4) : (a) CXR at presentation (b) Follow up CXR (after 4 days)

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Discussion:

About 15% of all cancer patients are suffering from malignant pleural effusion (MPE) . It was noticed that the incidence of MPE increases as the global cancer incidence rises. The most common presenting symptoms of MPE is breathlessness and most of patients will suffer from pleural fluid re-accumulation after simple aspiration , so definitive interventions such as tube drainage and pleurodesis are needed **(4)**.

The use of small bore , flexible pigtail catheter for management of MPE is safe , less traumatic , associated with minimal complications ,could be considered effective alternative for intercosal tube drainage **(5)**

This study included 40 patients with malignant pleural effusion with pathological diagnosis of metastatic adenocarcinoma in 24 patients and mesothelioma in16 patients , patients were classified in to two groups; Group-A: Included 20 patients underwent thoracoscopic pleural biopsy followed by intercostal tube insertion, Group-B: Included 20 patients underwent US guided biopsy followed by pigtail insertion .

The mean age of studied groups was (63.7±9.88 for Group-A and 62.9±7.54 for Group-B). This was close to results of some authors who studied the efficacy of pleural fluid drainage using small bore catheter and chest tube, where the age range was between 56 and 65 years **(11).**

Considering clinical presentations ,the main presenting symptom in both groups was dyspnea which occurred in 19 patients (95%) in each group followed by chest pain and cough with no statistically significant difference between the two groups. These results were matched with literature where dyspnea, chest pain, and cough are the most common symptoms associated with malignant pleural effusion **(12)**.

In our study 10% of Group A and 20% of Group B had malignant cells in pleural fluid cytological analysis(table 1). The diagnostic accuracy of pleural fluid cytological examination shows wide variations between different studies , ranging from 40-87% **(13)**.

Using the VAS for pain intensity experienced by every patient at the time of chest drain insertion, the pigtail catheter (VAS 1.7± 1.34) is significantly less painful than the large bore chest tube (VAS 7.3 ± 0.98) with **P-value < 0.001** and better tolerated (table 2) .This was matched with the results of another study in which VAS was 2.1 ± 1.5 for the pain experienced by patients at the time of insertion of small bore catheter and 6.3± 1.4 for large bore drain **(14).**

These results seems logic if we recognize that the intercostal space in adults measures about 8.8 ± 1.4 mm at the 5th intercostal space in the mid-axillary line. A 24 F chest tube has an outer diameter of 8 mm; while 32 F chest tube has an outer diameter of 10.7mm this results in pain due to compression of the neurovascular bundle. On the other hand , small bore catheter 12 F has a diameter of 4 mm, so doesn't compress the neurovascular bundle so, it causes less pain and is more tolerable **(15)**.

The duration of patients' hospitalization was shorter in group B (6.55 days ± 1.23) than group A (10.3 days ± 3.8) with **P-value < 0.001** (table 2) . Some authors found that the duration of hospital stay was (4.48 days ± 1.73) for pigtail group and (11.52 days ± 1.90) for large drain group which is close to our findings **(16)**

In group B, the mean duration of drainage was (3.95 days ± 0.83), whereas in group A it was (6.15 days ± 2.92). The difference was significant with **P-value < 0.001** (table 2)

Many authors had studied the duration of drainage of small bore catheter and reported fewer days of drainage than wide bore catheters , This may be due to early mobility and less pain experienced in the pigtail group **(11, 17).**

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Regarding the success rate of pleurodesis, our study reported a success rate of (85%) in group A and (75%) in group B with no significant difference (table 3). This was similar to results of previous studies , they found that small bore catheter was as effective as chest tube regarding success rate of pleurodesis without statistically significant difference **(18,19).**

Concerning complications reported in both groups, A minor complication (blocked drain) was significantly associated with pigtail insertion, while major complications (surgical emphysema 5 cases, air leak 1 case and hypotension 1 case) were significantly reported with intercostal tube insertion, P = 0.04 and 0.008 respectively.

Researchers had previously studied pigtail catheters for drainage of pleural effusions of different causes , they reported complications in 3% of the patients included in the form of infection , displacement of the drain , hemothorax , wound bleeding and lung puncture **(17).**

On the other hand other researchers found higher percent of complications with pigtail insertion for drainage of effusion in the form pain in 45% , blocked drain in 4% , infections in 2% and pneumothorax in 19.2% but pnemothoraces were resolved spontaneously by the same drain **(20).** Their results were not matched with our study ,this could be explained by the use of different techniques of pigtail insertion as they used seldinger maneuver while we used a single puncture technique.

Conclusion

Pigtail catheters could be considered a safe, easy, tolerable and effective method for drainage of MPE with the advantages of being smaller in size, more flexible, less painful, easier in insertion, and are associated with lower complication rates.

Conflict of interest: No.

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Table (1): Procedure findings and cytological examinations of both groups

Factors	Group A (n=20)		Group B (n=20)		P
	N	%	N	%	
Pleural fluid cytology					
Malignant cells	2	10	4	20	0.3#
No malignant cell	18	90	16	80	
Finding					
Nodules	20	100	17	85	**0.03#**
Masses	4	20	3	15	0.6#

N: number, #: chi square test, P consider significant if < 0.05.

Table (2): Primary outcome of both procedures

Factors	Group A (n=20)		Group B (n=20)		P$
	Mean	SD	Mean	SD	
Pain Score (VAS)	7.30	0.98	1.70	1.34	**< 0.001**
Duration of drainage	6.15	2.92	3.95	0.83	**0.004**
Duration of hospital stay	10.30	3.80	6.55	1.23	**< 0.001**

Continuous data represented as mean and SD, SD: Stander deviation,
N: number, $: independent t-test, P consider significant if < 0.05.

Table (3): Outcome of pleurodesis

Factors	Group A (n=20)		Group B (n=20)		P#
Outcome of pleurodesis	N	%	N	%	
Success	17	85	15	75	0.45
Fail	3	15	5	25	

Categorical data represented as number and percentage (%), N: number, #: chi square test, P consider significant if < 0.05.

Table (4): Complications in each technique

Factors	Group A (n=20)		Group B (n=20)		P
Complications	N	%	N	%	
Minor complication (Yes)	0	0	5	25	**0.04***
Major complications (Yes)	7	35	0	0	**0.008***

Categorical data represented as number and percentage (%), N: number, *: Fisher Exact test, P consider significant if < 0.05.