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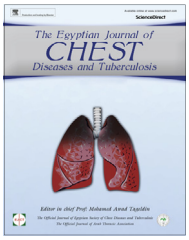

ORIGINAL ARTICLE

Usefulness of pigtail catheter in pleurodesis of malignant pleural effusion

Adel H.A. Ghoneim [1], Howida A. Elkomy [2], Ashraf E. Elshora [*], Mohamed Mehrez [3]

Chest Department, Faculty of Medicine, Zagazig University, Egypt

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KEYWORDS

Pigtail;
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Abstract The management of patients with malignant pleural effusion (MPE) remains problematic. Various modalities are available in the management of MPE. However, optimal treatment is still controversial and there is no universal standard approach. Management options include observation, thoracentesis, indwelling pleural catheter (IPC) or chest tube placement and pleurodesis.

The aim of the study: To evaluate the efficacy, safety and tolerability of pigtail catheters in comparison to intercostal tubes in pleurodesis of malignant pleural effusions.

Patients and methods: This study was carried out at Chest Department, Zagazig University Hospitals during the period from January 2012 to September 2013. The study included 100 patients (39 males and 61 females with a mean age of 61.8 ± 11.3 years) with pleural effusion of malignant etiology. Patients were classified into two groups *Group I*: included 50 patients 18 males and 32 females with a mean age of 63.8 years who were subjected to pigtail catheter drainage then pleurodesis. *Group II*: included 50 patients 21 males and 29 females with a mean age of 61.8 years who were subjected to tube thoracotomy drainage then pleurodesis.

Results: As regards pleurodesis outcome, there was a high frequency of success in group I (33 patients, 66%) when compared with group II (27 patients, 54%). However, the difference is not statistically significant. As regards pleurodesis complications the higher frequency of complications

* Corresponding author. Mobile: +20 1223595477.
E-mail addresses: adelghoneim@yahoo.com (A.H.A. Ghoneim), howidaelkomy@hotmail.com (H.A. Elkomy), drshora68@yahoo.com (A.E. Elshora), rawan_mohammad_mehriz@yahoo.com (M. Mehrez).
[1] Mobile: +20 1005404473.
[2] Mobile: +20 1001576944.
[3] Mobile: +20 10646122885.

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was in group II (22 patients, 44%) when compared with group I (43 patients, 86%). These differences were statistically significant ($P < 0.05$).

Conclusion: Pigtail catheters could be considered a safe, easy, tolerable and effective alternative method in comparison to the traditional intercostal tubes in pleurodesis of malignant pleural effusions.

Introduction

When the pleural effusion has been proved to be malignant and the patient is not a surgical candidate the type of palliative therapy is considered, taking into account the patient's general condition, symptoms and expected survival [1].

The most cost-effective method of controlling a malignant pleural effusion is chest tube or catheter drainage and intrapleural instillation of a chemical agent. Many antineoplastic and non-antineoplastic chemical agents have been used for pleurodesis with variable success. Currently, the most successful and widely used agents include talc by slurry, the tetracyclines (minocyclin and doxycyclin) and bleomycin [2]. Tetracycline is a low-cost effective therapy that is easy to use and has a proven safety record. The recommended dose by Thomas [3] is one gram of tetracycline hydrochloride in 50 ml of normal saline. Reid and Rudd [4], have recommended a dose of three grams in 50 ml of normal saline.

The main side effects of tetracycline pleurodesis are fever and pain [3].

Pigtail catheter is a long, flexible tube that can be guided into the body. The design of this catheter includes small holes that allow for drainage and a coiled end that acts to hold the catheter in place. It can also be used to slow the flow of fluids injected through the catheter so that they do not burst out in a jet and cause injuries or obscure a medical imaging study [5].

The aim of the study was to evaluate the efficacy, safety and tolerability of pigtail catheters in comparison to intercostal tubes in pleurodesis of malignant pleural effusions.

Patients and methods

This study was carried out at, Chest Department, Zagazig University Hospitals during the period from January 2012 to september 2013. The study included 100 consecutive patients (39 males and 61 females with a mean age of 61.8 ± 11.3 years) who proved to have pleural effusion of malignant etiology.

**These patients were admitted, signed an informed consent, and subjected to the following*

1- Thorough medical history, stressing on smoking history and history of occupational exposure.
2- Full clinical examination both general and local (chest) examination.
3- Routine investigations (CBC, ESR, blood sugar, serum ALT, AST and creatinine) to evaluate the patient general condition.
4- Plain chest radiography, Chest computed tomography (CT). The pleural fluid was considered small, moderate, or massive according to BTS (2003) guidelines for the investigations of pleural effusion [6].
5- Pleural tapping and the aspirated fluid was sent for chemical, bacteriological and cytological examinations.
6- Abram pleural biopsy if pleural fluid investigations were not diagnostic.
7- Thorascopy if Abram pleural biopsy and pleural fluid investigations were not diagnostic.
8- Fiberoptic bronchoscopy was done in selected cases.

Exclusion criteria

- Atelectasis due to endobronchial obstruction.
- Empyema (pH < 7.2).
- Prior intrapleural therapy.
- Significant irradiation to the affected hemithorax.

Patients were classified into two groups

- **Group I (GI)**: included 50 patients; 18 males and 32 females with a mean age of 63.8 years, subjected to pigtail catheter drainage then pleurodesis.

Pigtail catheter insertion

Pigtail catheters were inserted percutaneously using the Seldinger technique. The pleura was initially punctured with a hollow needle trocar attached to a syringe; fluid was aspirated to confirm placement. The syringe was removed and a guidewire was advanced through the needle lumen. The guidewire stayed in place while the needle was removed and a dilator was passed over the guidewire to enlarge the opening through which the catheter would be placed. Next, the dilator was removed, the pigtail was uncoiled, and the catheter was threaded over the guidewire and into the pleural space. Finally, the guidewire was removed as the distal end of the catheter curling inside the chest. The catheter was then connected to a drainage device [7].

- **Group (GII):** included 50 patients; 21 males and 29 females with a mean age of 61.8 years, subjected to tube thoracotomy drainage then pleurodesis.

Tube thoracotomy

1- An incision about 2 cm was done in the fifth or sixth intercostal space in the midaxillary line. The incision was made at the upper border of the rib below, and parallel to the rib.
2- A tube and trocar (a sharp-tipped metal rod which extended through the distal end of the plastic tube) were inserted into the incision site and forced into the pleural space under direct pressure and a twisting motion. The

tube was directed superiorly and posteriorly after insertion into the pleural space, the tube was clamped at the proximal end with forceps.

3- After appropriate positioning, fixation of the tube was done by the suture; the loose ends of the suture were wrapped around the end of the tube and tied off, anchoring the tube to the chest wall. Then dry gauze and adhesive plaster were applied to cover the wound and anchor the tube.
4- The chest tube was connected to underwater seal to allow slow drainage of the effusion, not more than one liter during the first 30 min to avoid post-thoracocentesis (reexpansion) pulmonary edema [8].

**Pleurodesis*

Both groups were subjected to pleurodesis when the fluid in the catheter or the tube was less than 100 ml on three successive days with no fluid reaccumulation. 500 mg of tetracycline mixed with 100 cm^3 of sterile saline was used [8].

When the fluid drain decreases (100–150 ml/24 h) or completely ceases, the chest tube or the catheter would be removed [9].

- Follow up of chest radiographs was done every 24 h till removal of the tube.
- The patient was discharged and followed up clinically and radiologically by chest X-ray weekly for one month and monthly for three months. Pleurodesis would be considered effective if no effusion relapse occurred within 3 month period [10].

Pigtail catheter insertion, tube thoracotomy and pleurodesis were performed by a trained chest physician in the course of palliative management of cases.

The effectiveness of pleurodesis was considered as follows: [11]

- Complete response (CR): Total resolution of pleural effusion.
- Partial response (PR): Appearance of symptomatic loculated effusion.
- No response (NR): Re-accumulation of pleural effusion near the same amount seen at presentation.

Statistical analysis

Statistical analysis was performed with SPSS version 19 software package (SPSS, Inc. Chicago). P value < 0.05 was considered significant.

Results

Table 1 shows that metastatic breast cancer represented the most common cause of malignant pleural effusion in the studied patients (34%) followed by metastatic lung cancer (32%) and malignant pleural mesothelioma (16%). No statistically significant differences were found between the studied groups regarding the frequency of the reported pathologies.

Table 2 shows no statistically significant differences between the studied groups regarding the pleural fluid characteristics.

Table 1 Comparison between the studied groups regarding the underlying pathologies.

	GI $n = 50$	GII $n = 50$	Total $n = 100$	Chi-square test	
				X^2	P
Metastatic Breast Cancer	20 (40%)	14 (28%)	34	2.5	0.64
Metastatic Lung Cancer	14 (28%)	18 (36)	32		
Malignant pleural mesothelioma	8 (16%)	8 (16%)	16		
Metastatic gynecological tumors	4(8%)	3(6%)	7		
Other tumors	4(8%)	7(14%)	11		

Table 2 Comparison between the studied groups regarding the pleural effusion characteristics.

Pleural effusion characteristics		GI $n = 50$	GII $n = 50$	Total $n = 100$	Chi-square test	
					X^2	P
Effusion size	Small	15(30%)	17(34%)	32	0.25	0.88
	Moderate	30(60%)	29(58%)	59		
	Massive	5(10%)	4(8%)	9		
Pleural fluid cytology for malignant cells	+ve	34(68%)	39(78%)	73	1.26	0.26
	−ve	16(32%)	11(22%)	27		

				Student t test	
				T	P
pH	7.26 ± 0.22	7.28 ± 0.22	7.27 ± 0.22	−0.35	0.72
Protein	4.02 ± 1.58	3.78 ± 1.32	3.9 ± 1.45	0.81	0.41
Glucose	96.6 ± 47.05	85.9 ± 53.3	91.2 ± 50.3	1.06	0.28
LDH	1271.3 ± 36.8	1277.6 ± 38.6	1274.4 ± 37.6	−0.84	0.39

Table 3 comparison between patients with negative pleural fluid cytology for malignant cells and diagnosed malignant by other methods.

	Group I $N = 16$	Group II N = 11	Total N = 27	X^2	P
Abram's biopsy	8 (50%)	4 (36.3%)	12(44.4%)	1.02	0.58
Thoracoscope	5 (31.2%)	3 (27.4%)	8(29.6%)		
Bronchoscopy	3 (18.8%)	4 (36.3%)	7(25.9%)		

Table 3 shows that there is no significant difference between groups regarding other methods of diagnosis of malignancy.

(Table 4) as regards pleurodesis outcome, there was a high frequency of success in GI (33 patients, 66% succeeded) when compared with GII (27 patients 54%). However, the difference is not statistically significant.

(Table 5) as regards pleurodesis complications there is a high frequency of complications in GII (22 patients, 44%) when compared with GI (43 patients 86%). These differences are statistically highly significant ($P < 0.0004$).

Table 6 shows that patients with successful pleurodesis had significantly higher frequency of small and moderate effusions and significantly higher pH when compared with patients with failed pleurodesis.

Table 7 shows successful pleurodesis was significantly higher in patients with small to moderate effusions and significantly higher pH when compared with patients with failed pleurodesis.

Discussion

The management of patients with malignant pleural effusion (MPE) remains problematic. The prognosis of these patients varies with the histological type of the primary tumor; in general, 65% of patients with MPE die within 3 months and 80% die within 6 months. Significant palliation of the dyspnea associated with the pleural effusion can be achieved by procedures

Table 4 Comparison between pleurodesis outcome in the studied groups.

		GI $n = 50$	GII $n = 50$	Total $n = 100$	Chi-square test	
					X^2	P
Pleurodesis	Success	33(66%)	27(54%)	60(100%)	1.5	0.22
	Failure	17(34%)	23(46%)	40(40%)		

Table 5 Comparison between pleurodesis complications in the studied groups.

Pleurodesis complications	GI $N = 50$		GII $n = 50$		Total $n = 100$		Chi-square test	
	N	%	N	%	N	%	X^2	P
Tachycardia	10	20	18	36	28	56	4.5	0.03
Pain	5	10	10	20	15	30	1.96	0.16
Fever	4	8	5	10	9	18	0.12	0.72
Dyspnea	3	6	7	14	10	20	1.77	0.18
ARDS	–	0	1	2	1	2	1.0	0.31
Hypotension	–	0	1	2	1	2	1.0	0.31
Mortality	–	0	1	2	1	2	1.0	0.31
Total	22	44	43	86	65	65	13.5	<0.0004

Table 6 Comparison between patients with successful and failed pleurodesis in GI regarding the pleural effusion characteristics.

Pleural effusion characteristics		Success $n = 33$	Failure $n = 17$	Chi-square test	
				X^2	P
Effusion size	Small	14 (42.4%)	1 (5.8%)	7.2	0.027*
	Moderate	16 (48.8%)	14 (82.2%)		
	Massive	3 (9%)	2 (11.7%)		
Pleural fluid cytology for malignant cells	+ve	20 (60%)	14 (82.3%)	2.4	0.12
	−ve	13 (39.3%)	3 (17.6%)		

			Student t test	
			t	P
pH	7.31 ± 0.2	7.16 ± 0.23	2.39	0.02*
Protein	3.9 ± 1.67	4.17 ± 1.43	−0.47	0.63
Glucose	89.3 ± 49.9	110.8 ± 38.4	−1.54	0.12
LDH	1273.8 ± 35.2	1266.2 ± 40.2	0.68	0.49

Table 7 Comparison between patients with successful and failed pleurodesis in GII regarding the pleural effusion characteristics.

Pleural effusion characteristics		Success $n = 27$	Failure $n = 23$	Chi-square test	
				X^2	P
Effusion size	Small	13	4	7.2	0.028*
	Moderate	11	18		
	Massive	3	1		
Pleural fluid cytology for malignant cells	+ve	19	20	1.99	0.16
	−ve	8	3		

			Student t test	
			t	P
pH	7.35 ± 0.2	7.2 ± 0.21	2.54	0.014*
Protein	3.6 ± 1.2	3.9 ± 1.4	−0.72	0.47
Glucose	87.8 ± 54.5	83.6 ± 52.8	0.28	0.78
LDH	1274.9 ± 39.8	1280.9 ± 37.8	−0.54	0.59

that eliminate the pleural fluid accumulation [12]. Various modalities are available in the management of MPE. Careful consideration of the patient's expected survival and quality of life is needed when deciding the optimum treatment modality in such patients [13].

However, optimal treatment is still controversial and there is no universal standard approach. Management options include observation, thoracentesis, in-dwelling pleural catheter (IPC) or chest tube placement, pleurodesis, and surgical pleurectomy [14].

Pleurodesis aims to obliterate the pleural space by producing extensive adhesion of the visceral and parietal pleura in order to control relapse of either pleural effusions (mostly malignant) or pneumothorax [15]. Pleurodesis can be induced through the insertion of pleural catheters, as well as through surgical procedures (such as thoracotomy). There are various recommended sclerosing agents, including talc (which is the most widely used), silver nitrate and, recently, proliferative cytokines [16]. Thoracostomy tubes are the 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 [17].

Recently, the use of pigtail catheter (flexible and small bore) by the Seldinger technique has emerged as an effective alternative for thoracostomy and pleural drainage. Being a less-traumatic procedure, this method creates less pain and smaller scar during and after the placements and possibly fewer procedure-associated complications [18].

Motivated by these data, the present study aimed to evaluate the efficacy, safety and tolerability of pigtail catheters in inducing pleurodesis of malignant pleural effusions in comparison with conventional intercostal tubes. To get this target accomplished, the study recruited 100 patients with malignant pleural effusions indicating pleurodesis. They were randomly assigned to one of the equal 50 patients' therapeutic groups; GI utilizing the pigtail catheter and GII using the conventional intercostal tube.

Regarding the reported pathologies in the present study (Table 1), it was found that that metastatic breast cancer is the most common cause of malignant pleural effusion in the studied patients (34.0%) followed by metastatic lung cancer (32.0%) and malignant pleural mesothelioma (16.0%). No statistically significant differences were found between the studied groups regarding the different reported pathologies.

This is in harmony with the findings of Terracciano et al. [19], who studied new approaches in the diagnostic procedures of malignant pleural effusions. In their study, 35 malignant pleural effusions were documented: 13 breast cancers, 12 lung cancers and 2 mesotheliomas in addition to other primary tumors. Also, in the study of Brega-Massone et al. [20] breast cancer followed by lung cancer were the commonest locations of primary cancers in the studied patients.

Regarding the success rate of pleurodesis in the studied groups (Table 4), the present study reported a success rate of 66.0% in the GI group. This figure is close to what was found by Liang et al. [18], who conducted a retrospective review of adult patients (>/=18 years) who underwent ultrasound-guided pigtail catheter drainage of pleural effusions in the ICUs. The reasons for pigtail drainage are as follows: thoracic empyema ($n = 59$, 44%), massive transudative pleural effusions ($n = 33$, 25%), postoperative pleural effusion ($n = 29$, 15%), malignant pleural effusion ($n = 18$, 14%) and traumatic hemothorax ($n = 3$, 2%).

In the present study, comparison between the studied groups regarding the success rate had shown a higher success rate in the GI group; however, the differences are statistically non significant (Table 4).

These results were confirmed by the study of Lin et al. [21] who conducted a retrospective review of mechanically ventilated patients who underwent pigtail catheter drainage as their initial therapy for malignant pleural effusion in the emergency department and intensive care unit. In this study, the success rate of pigtail catheter drainage was 68.6%.

Also, in the study of Aziz et al. [22] the authors concluded that the use of pigtail catheters is usually very successful in draining the pleural fluids. Less time consumption, lower cost and bedside technique make it superior to conventional chest tube placement in many aspects. However, this was a retrospective case series that did not include a comparison with ordinary chest tubes.

However, in another study performed by Cantinet et al. [23] to evaluate the safety and usefulness of pleural drainage under radiological guidance for pleural effusion and pneumothorax, the success rate of pigtail catheters in management of pleural effusion was as high as 88.0%. However, pleural effusion in

this series was a consequence of hepatic disease. In addition, the tubes were inserted under CT guidance.

Regarding the reported complications in the present study (Table 5), tachycardia was the most commonly reported complication followed by pain, dyspnea and fever. These data are similar to that found by Brant and Eaton [24].

Comparison between patients with successful and failed pleurodesis in GI regarding the pleural effusion characteristics (Table 6) patients with successful pleurodesis had significantly higher frequency of small to moderate effusions and significantly higher pH when compared with patients with failed pleurodesis. This agrees with Yildirim et al. [25], who found that pleural fluid pH and volume are significant predictors for successful pleurodesis.

Conclusion

Pigtail catheter could be considered a safe, easy, tolerable and effective alternative method in comparison to the traditional intercostal tubes in pleurodesis of malignant pleural effusions.

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