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Transthoracic sonographic scores in evaluating the success of different sclerosing modalities in patients with malignant pleural effusion

Agmy Gamal, Mohamed F. Adam, Safaa Ahmed El Sagheir and Manal A. Mahmoud*

Abstract

Background: Malignant pleural effusions (MPE) mostly arises from metastases to the pleura from other sites. Management of malignant effusions aims to palliate dyspnea and prevent the reaccumulation of pleural fluid to improve patients' quality of life. Pleurodesis is the most common palliative treatment for patients with refractory MPE. This study was carried out to evaluate the performance of transthoracic sonographic (TUS) scores (pleural sliding and pleural adherence score) in predicting the success of pleurodesis by different modalities in patients with malignant pleural effusion. One hundred malignant pleural effusion patients were enrolled to an interventional clinical trial from September 2019 to April 2021 for palliative management of dyspnea. Pleurodesis for palliative treatment of dyspnea was done either spontaneously by the intercostal chest tube or by a sclerosing agent such as tetracycline solution or tetracycline poudrage or iodopovidine. Patients were randomly allocated to one of these four groups where each group included 25 patients. Transthoracic ultrasound was performed at baseline, and 1 month after pleurodesis and the lung sliding score and pleural adherence score were evaluated.

Results: Majority of patients (78%) had high baseline lung sliding score (7-8). Post pleurodesis only 11.4% had high scores ($p<0.001$), also the mean lung sliding score decreased significantly in comparison to the baseline values ($p<0.001$) in the spontaneous, tetracycline solution, tetracycline poudrage, and iodopovidine groups (7.04 ± 1.02 vs. 4.85 ± 1.60, 7.28± 0.98 vs. 4.48± 1.75, 7.20±0.96 vs. 4.44 ± 1.45, 7.04±0.93 vs. 3.35±1.81, respectively). Iodopovidine pleurodesis group in comparison to the other modalities showed the highest pleural adherence score (12.64 ± 2.98) and absent lung sliding in 72.7% of cases and 70 % success rate. Pleural adherence score at cut off ≥ 12 showed 92.75% sensitivity, 89.47% specificity, 92.1 accuracy, and 0.911 area under the curve (AUC) for predicting successful pleurodesis.

Conclusion: TUS scores is a feasible, bedside, and accurate method to detect the outcome of pleurodesis. Iodopovidone was more effective than tetracycline solution, tetracycline poudrage, and spontaneous pleurodesis.

Trial registration: ClinicalTrials.gov. NCT04074902. Registered on 29 August 2019

Keywords: Malignant pleural effusion, Transthoracic sonography, Pleurodesis, Lung sliding

Background

Malignant pleural effusion (MPE) is the accumulation of a considerable amount of fluid in the pleural space, associated with the existence of malignant cells or tumor tissue. Dyspnea, chest pain, and reduced physical

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activity are the common presenting complaints [1]. Most cases of MPE are metastatic, mostly from lung cancer in males and breast cancer in females (50–65% of all MPE) [2]. Mesothelioma is the most common primary pleural tumor, and more than 90% of cases are accompanied by MPE [2]. Despite the advances in cancer treatment protocols, the management of cases with MPE is usually palliative with a median survival range of 3 to 12 months [3]. Pleurodesis, by definition, is the adherence between the parietal and visceral pleurae to hinder further fluid accumulation into the pleural space [4].

TUS can detect the presence of pleural effusions, pleural adhesions, and/or thick pleural peel. Therefore, it plays an important role in predicting long-term outcome of pleurodesis in MPE [5]. The to and fro movement exhibited by the visceral pleura "pleural sliding sign" is one of the easiest signs identified during transthoracic ultrasound examination [6–8].

This study aimed to assess the performance of TUS scores [pleural sliding and pleural adherence score] in predicting the success of pleurodesis by different modalities in patients with malignant pleural effusion.

Methods

This interventional clinical trial included 100 MPE patients admitted to the Department of Chest Diseases and Tuberculosis, Assuit University Hospital, for palliative management of dyspnea by pleurodesis during the period between September 2019 and April 2021.

Patients were randomized to one of four groups (25 patients in each).

Group 1: Spontaneous pleurodesis (using the intercostal tube)

Group 2: Tetracycline solution pleurodesis

Group 3: Tetracycline poudrage pleurodesis

Group 4: Iodopovidine pleurodesis

Inclusion criteria

Patients with MPE eligible for palliative treatment by intercostal tube fluid drainage.

Exclusion criteria

-Age ˃18 years old

-Incomplete re-expansion "partial" of the lung after intercostal tube insertion

Defined as ≤90% pleural apposition on frontal chest radiographs obtained immediately post-procedural [9].

-Multiloculated effusion or cases with previous pleurodesis failure

-Presence of hemorrhagic diathesis (The patient's platelet count should be > 60×10^9/L and the international normalization ratio (INR) should be ˂ 1.2, blood urea nitrogen (BUN) levels (>30 mg/dL) or creatinine levels (>3 mg/dL), and liver insufficiency [10], antiplatelet drugs such clopidogrel should be discontinued 5–7 days prior to the procedure [11].

All participants underwent the following:

1. *Screening*

By careful history taking, clinical examination, laboratory investigation [complete blood count and coagulation profile], and evaluation of dyspnea according to modified Medical Research Council (mMRC) scoring scale [12].

2. *Transthoracic ultrasonography (Aloka SSD 3500 (Aloka Echo Camera SSD-3500; Aloka Prosound, Yokohama, Japan)*

To evaluate the sliding sign, measure the pleural thickness, detect the presence of loculations, assess the amount of the pleural fluid, and estimate the pleural adherence score after pleurodesis [13]. The examination was done by linear probe (5 MHZ) and curvilinear probe (3.5 MHz).

The scanned hemithorax was subdivided into eight areas; infraclavicular, mammary, and inframammary areas on the front; upper and lower axillary areas laterally; and suprascapular, infrascapular, and interscapular areas on the back [7, 14, 15].

The anterior chest wall extended from the para sternal to the anterior axillary line and was subdivided into three areas [from clavicle to second intercostal space; infraclavicular, between fifth and sixth intercostal spaces; infra mammary, and between third and fourth intercostal spaces; mammary]. The lateral zone extended between the anterior and the posterior axillary line and was furtherly subdivided into upper and basal halves by the oblique fissure, which can be estimated with a line from the sixth costochondral junction to the tip of the scapular spine at the mid axillary line [16]. While the back "between the spine and medial border of the scapula" was divided into three zones; supra scapular: at second intercostal space; interscapular: at the level of fifth to seventh intercostal space; and infrascapular: at ninth intercostal space [17]. Usually, the lateral and dorsal images were obtained in the sitting position, while the ventral side was visualized in the supine position.

Lung sliding sign

It is the breath related to and fro movement of the pleura [18].

Each of the above mentioned areas was scanned for detecting the presence or abscence of lung sliding sign:

- If sliding sign present → the area was given a value of (1).
- If no sliding → the area was given a value of (0).

If the total lung sliding score for the hemithorax was ≥ 5→ pleurodesis is needed.

If the total lung sliding score for the hemithorax was ˂ 5→ adherence of two pleurae together and successful pleurodesis

The total score was recorded before and 1 month after pleurodesis [7, 15].

Pleural Adherence Score (PAS)

It was estimated in eight zones (upper, lower, and middle zones in the anterior and posterior chest wall; lower and upper zones in the lateral chest wall) throughout the scanned hemithorax by TUS. It was recorded 24 h after pleurodesis [6, 14].

Medical thoracoscopy procedure

Equipment: A rigid thoracoscope with a cold light source was used (Karl-Storz GmbH, Tuttlingen, Germany).

Technique: Preoperative fasting for 6 h, vital signs were monitored during the procedure (blood pressure, heart rate, respiratory rate, and oxygen saturation by pulse oximetry) [19].

Premedication: Intramuscular injection of 50 mg Pethidine for analgesia and good pain control.

Local anesthesia: infiltration of Lidocaine (xylocaine) 2% to skin and subcutaneous tissue down to the intercostal muscles, periosteum, and parietal pleura.

Procedure: The patient lied on the healthy side, an incision was made in mid-axillary area between the 3rd and 6th intercostal spaces [20] followed by Careful aspiration of the pleural fluid and inspection of the pleural cavity by the direct-viewing telescope.

Patients were allocated to one of four groups

Group 1 (spontaneous pleurodesis by the intercostal chest tube)

After thoracoscopy a large-bore intercostal tube (26–28 F) was inserted and placed underwater seal drainage to drain the residual fluid and air from the pleural cavity and allow the lung to expand [21, 22], and this was considered T_0 from which follow-up intervals were calculated.

Group 2 (pleurodesis with tetracycline solution)

Pleurodesis was done by tetracycline solution under thoracoscopic visualization. The pleurodesis fluid consisted of 12.5ml of 2% lidocaine and 37.5 ml of normal saline (NaCl 0.9%). Tetracycline capsules (35mg/kg) were added to the previously prepared fluid. The mixture was instilled to pleural cavity via the thoracoscope, and then, the intercostal tube was inserted. A tube clamp was applied for 2 h during which, the patient was asked to rotate to right and left lateral positions every 15 min and then the clamp was released [15, 23–25].

Group 3 (pleurodesis with tetracycline poudrage)

Tetracycline (35mg/kg) poudrage was used for pleurodesis. The powder evacuated from the oral capsules was insufflated via a powder blower fixed to the end of the medical thoracoscope after complete aspiration of the pleural fluid then an underwater seal intercostal tube was inserted.

Group 4 (pleurodesis with iodopovidone)

Pleurodesis was done by iodopovidone 10% (mixture of 2 mg/kg of 2% xylocaine, 20 ml of 10% betadine mixed with 80 ml of 0.9% NaCl) which was injected at the end of the medical thoracoscope after aspiration of the pleural fluid followed by intercostal tube insertion, tube clamping for 2 h, asking the patient to change his position in bed every 15 min, and finally clamp release [26].

When the amount of pleural fluid was less than 100ml/24h and chest radiography revealed complete lung re-expansion, removal of the chest tube was done. TUS was done 24 h following intervention and one month later.

Outcomes of pleurodesis (after 1 month)

**Success*: no or < 100 ml/day re-accumulation on chest radiographs [27].

**Partial response*: reduction of dyspnea and asymptomatic fluid build-up (˂50% of the initial radiographic evidence of fluid) that does not require further therapy.

**Pleurodesis failure*: if the patient came back with an amount of pleural effusion that needed intervention with absence of the above mentioned success criteria [27–29].

Ethical considerations

Research Ethical Committee, Faculty of Medicine, Assiut University, provided an ethical approval (IRB: IRB.no 17100919). All patients or their relatives gave a signed written informed consent. The study process maintained full confidentiality and privacy. Patients or their relatives were notified about the results of the interventions.

Statistical analysis

SPSS (version 20, IBM, and Armonk, New York) was used for data analysis. Mean ± SD or median (range) and frequency (percentage) were used for data presentation as appropriate. Chi-square test, Fisher's exact test, Student's

t test, and ANOVA test were applied to compare data of the study groups as appropriate. Diagnostic performance of pleural adherence score in predicting the successful pleurodesis was estimated by receiver operating characteristic curve (ROC) with 95% level of confidence. *P* value was considered significant when < 0.05.

Results

This study included 100 patients with MPE admitted to the Department of Chest Diseases and Tuberculosis, Assuit University Hospital, for palliative management of dyspnea by pleurodesis. The mean age of enrolled patients was 56.8 ± 22.87 years, 57 (57%) patients were males, and 60% of patients were smokers. Majority of patients (75%) had pleural thickening, and the mean thickness was 11.3±5.5mm. Sixty patients had right pleural effusion while 40 patients had left pleural effusion (Table 1). Fourteen patients had mesothelioma while majority (86%) of patients had metastasis from primary malignancy away from the pleura. The most common primary malignancies were lung cancer (34%), breast cancer (12%), and prostatic cancer (10%) (Table 2).

By thoracoscopy, normal looking pleura was found in three patients only while multiple small nodules, adhesions, and a pleural mass were detected in 88 (88%), 41 (41%), and 2 (2%) patients, respectively (Table 3).

Baseline assessment of sliding sign score by TUS showed that the majority of patients (91%) had high scores (6-8) with a significant reduction in the patients' scores 1 month after pleurodesis (Table 4). One month post-pleurodesis (*N*=88), the mean lung sliding score reduced significantly ($p<0.001$) in all pleurodesis groups (7.04±1.02 vs. 4.85±1.6;7.28±0.98 vs. 4.48±1.75;7.20±0.96 vs. 4.44±1.45;7.04±0.93 vs. 3.35±1.8 for spontaneous, tetracycline solution, tetracycline powder, and iodopovidine groups, respectively) and the iodopovidone group showed the lowest mean score. Majority (70%) of cases in the iodopovidine pleurodesis group recorded low lung sliding scores (1-4) while the spontaneous, tetracycline solution, and tetracycline powder pleurodesis groups showed low lung sliding scores in 40%, 47.8%, and 52% of patients, respectively (Tables 5 and 6).

The iodopovidone group showed a significantly higher (12.64 ± 2.98, $p=0.008$) pleural adherence score by TUS 24 h after pleurodesis in comparison to the other groups (Table 7). Pleural Adherence Score at a cut off ≥ 12 showed 92.75% sensitivity and 89.47% specificity for the prediction of successful pleurodesis with 0.91 AUC (Table 8, Figs. 1 and 2).

Iodopovidine and tetracycline powder had higher success rates (70% and 52%, respectively) in comparison to the other groups. Total lung re-expansion was higher with iodopovidine and tetracycline powder (65% and 48%, respectively) in comparison to other groups (Fig. 3).

The current results found that 81 (81%) patients did not report any complications following the procedure while 5 (5%) patients suffered from fever, and 13 (13%) patients complained of pain. One patient developed anaphylaxis and was controlled at once by medications. Overall,

Table 1 Baseline data of studied patients

	***N*= 100**
Age (mean± SD, years)	56.87 ± 22.87
Age groups	
˃18–24 years	11 (11.0%)
25–64 years	59 (59.0%)
≥ 65 years	30 (30.0%)
Sex	
Male	57 (57.0%)
Female	43 (43.0%)
Smoking status	
Smoker	60 (60.0%)
Non-smoker	9 (9.0%)
Ex-smoker	31 (31.0%)
Comorbidities[≠]	
None	53 (53.0%)
Hypertension	24 (24.0%)
Cardiac diseases	13 (13.0%)
Diabetes mellitus	10 (10.0%)
Occupation	
Housewife	31 (31.0%)
Employee	35 (35.0%)
Farmer	27 (27.0%)
Unemployee	7 (7.0%)
Complaints	
Dyspnea	100 (100.0%)
Chest pain	31 (31.0%)
Cough	37 (37.0%)
Chest pain and cough	24 (24.0%)
mMRC dyspnea scale	
II	5 (5.0%)
III	59 (59.0%)
IV	36 (36.0%)
Baseline ultrasound findings	
Effusion	100(100%)
Pleural nodules	50 (50%)
Pleural thickening (mm) (%, mean ± SD, range)	75 (75%), 11.35 ± 5.54 (1.0–22.0)
Right pleural effusion	60 (60%)
Left pleural effusion	40 (40%)

mMRC modified medical research council

Table 2 Type of malignancy among the studied patients

	N= 100
Primary (mesothelioma)	14 (14%)
Metastatic	86 (86%)
Lung cancer	34 (34%)
Breast cancer	12 (12%)
Prostatic cancer	10 (10%)
Colon cancer	2 (2%)
Hepatocellular carcinoma	3 (3%)
Uterine cancer	6 (6%)
Ovarian cancer	8 (8%)
Lymphoma	4 (4%)
Leukemia	2 (2%)
Bladder cancer	5 (5%)

Table 3 Thoracoscopic findings among studied patients

Thoracoscopic findings	**(No, %)**
Normally appearing pleura	**3 (3%)**
Multiple small nodules	**88 (88%)**
Adhesions	**41 (41%)**
Mass	**2 (2%)**

Table 4 Baseline and follow-up lung sliding score by chest ultrasound in studied patients

Lung sliding score	**Baseline (*n*= 100)**		**1 month after pleurodesis (*n*= 88)**		***P* value**
	No.	**%**	**No.**	**%**	
Score 0	0	0.0%	0	0.0%	--
Score 1	0	0.0%	4	4.5%	0.046*
Score 2	0	0.0%	12	13.6%	<0.001*
Score 3	0	0.0%	14	15.9%	<0.001*
Score 4	0	0.0%	16	18.2%	<0.001*
Score 5	9	9.0%	18	20.5%	0.025*
Score 6	13	13.0%	14	15.9%	0.470
Score 7	33	33.0%	10	11.4%	<0.001*
Score 8	45	45.0%	0	0.0%	<0.001*

46 (52.3%) patients had successful pleurodesis, while recurrent effusion was detected in 42 (47.7%) patients (Table 9).

Discussion

Malignant pleural effusion is a frequent complication observed in patients with advanced stages of malignancies that usually requires drainage to relieve patients' symptoms [30, 31]. Pleurodesis aims to prevent re-accumulation of fluid to improve patients' quality of life [23]. TUS is a sensitive method capable of detecting an amount of pleural fluid ≤50 ml and can assure adherence of the parietal and visceral pleurae [13]. Pleurodesis with sclerosing agents offers palliative treatment in most cases of MPE [7].

The current study included 100 patients diagnosed to have malignant pleural effusion, 57% were males, 43% were females, and 60% were smokers with 56.87 years mean age. These results agreed with Farouk et al. [32] who found that 60% of patients with MPE were males and 57% patients were smokers. To the contrary, Magdy and Hieba [14] reported that 75% were females, and this discrepancy as regards gender in comparison to our study may be attributed to their small sample size.

The majority (86%) of patients had metastasis from a primary malignancy away from the pleura and only 14% of patients had mesothelioma. Similarly, Manu et al. [33] found that mesothelioma accounted for 15.6% while 61.9% of MPE cases were due to metastasis. Arafa et al. [34] were also in line with these results. To the contrary, El Hadidy et al. [7] reported that 66.7% of their patients had mesothelioma.

The mean pleural thickness was 11.35±5.5 mm in 75% of patients. This agreed with Bugalho et al. [35] who reported pleural thickness ˃10 mm in 74.2% of their patients. Based on thoracoscopic findings, the current study stated that normally appearing pleura was found in only three patients while multiple small nodules, adhesions, and mass were detected in 88%, 41%, and 2% of patients, respectively. In agreement, Wu et al. [36] reported that pleural nodules were detected in 71% while pleural mass was detected in 3.3% of patients. Also AbouZaid et al. [15] mentioned the presence of pleural nodules/mass in 34.4% of cases.

The current results found that 100% of patients had sliding score ≥ 5 at baseline, while 1 month after pleurodesis, the detection rate of sliding score ≥ 5 was significantly (p˂0.001) reduced (47.8% of cases) by TUS. Lung sliding score ˂ 5 was detected in 40%, 47.8%, and 70% of spontaneous, tetracycline solution, and iodopovidine pleurodesis groups, respectively.

In line with these results, AbouZaid et al. [15] detected lung sliding score ≥ 5 in only 34.4% of patients after pleurodesis. Lung sliding score ˂ 5 was detected in 50%, 12.5%, and 75% of spontaneous, tetracycline solution, and iodopovidine pleurodesis groups, respectively. Also, in concordance, Farouk et al. [32] found a significant reduction (p˂0.001) in lung sliding among all scanned areas by TUS after povidone iodine pleurodesis.

Table 5 Comparison between the four groups as regards lung sliding score 1 month after pleurodesis

Lung sliding score	Groups (*N*=88)							
	Spontaneous (*n*=20)		Tetracycline solution (*n*=23)		Tetracycline powder (*n*=25)		Iodopovidone (*n*=20)	
	No.	%	No.	%	No.	%	No.	%
Score 0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Score 1	0	0.0%	1	4.35%	0	0.0%	3	15.0%
Score 2	2	10.0%	2	8.69%	3	12.0%	5	25.0%
Score 3	2	10.0%	5	21.74%	3	12.0%	4	20.0%
Score 4	4	20.0%	3	13.04%	7	28.0%	2	10.0%
Score 5	5	25.0%	4	17.4%	6	24.0%	3	15.0%
Score 6	3	15.0%	5	21.74%	4	16.0%	2	10.0%
Score 7	4	20.0%	3	13.04%	2	8.0%	1	5.0%
Score 8	0	0.0%	0	0.0%	0	0.0%	0	0.0%

Table 6 Baseline and post-pleurodesis lung sliding score by chest ultrasound

Lung sliding score	Spontaneous	Tetracycline solution	Tetracycline powder	Iodopovidone	*P* value[1]
Before pleurodesis					0.768
Mean ± SD	7.04 ± 1.02	7.28 ± 0.98	7.20 ± 0.96	7.04 ± 0.93	
Range	5.0–8.0	5.0–8.0	5.0–8.0	5.0–8.0	
Post pleurodesis					0.031*
Mean ± SD	4.85 ± 1.60	4.48 ± 1.75	4.44 ± 1.45	3.35 ± 1.81	
Range	2.0–7.0	1.0–7.0	2.0–7.0	1.0–7.0	
***P* value[2]**	<0.001*	<0.001*	<0.001*	<0.001*	

Table 7 Pleural Adherence Score by chest ultrasound 24 h after pleurodesis in the four study groups

Pleural Adherence Score	Spontaneous (*n*= 25)	Tetracycline solution (*n*= 25)	Tetracycline powder (*n*= 25)	Iodopovidone (*n*= 25)	*P* value
Mean ± SD	9.40 ± 3.66	10.56 ± 3.70	9.72 ± 3.85	12.64 ± 2.98	0.008*
Range	3.0–15.0	3.0–15.0	3.0–15.0	7.0–16.0	

Table 8 Diagnostic performance of Pleural Adherence Score and absent lung sliding for predicting successful pleurodesis

Cut off	Sensitivity	Specificity	+PV	-PV	Accuracy	AUC
≥12 Pleural Adherence Score	92.75%	89.47%	97.0%	77.3%	92.1%	0.911
Absent lung sliding	100%	86.2%	95%	100%	96%	0.93

PV predicted value, *AUC* area under the curve

One month after pleurodesis, the iodopovidone group showed the lowest mean lung sliding score in comparison to the spontaneous, tetracycline solution, and tetracycline powder groups (3.35±1.8, p=0.031)

Magdy and Hieba [14] illustrated that 2 weeks after doxycycline pleurodesis, absent lung sliding in more than 6 areas was found in 58.8% of cases and mentioned 14.27 ± 2.02 mean Pleural Adherence Score in cases of successful pleurodesis and Pleural Adherence Score of ≥11 after 24h from pleurodesis had sensitivity 93% and 50% specificity. Chaddha et al. [37] agreed to the current results and illustrated a Pleural Adherence Score

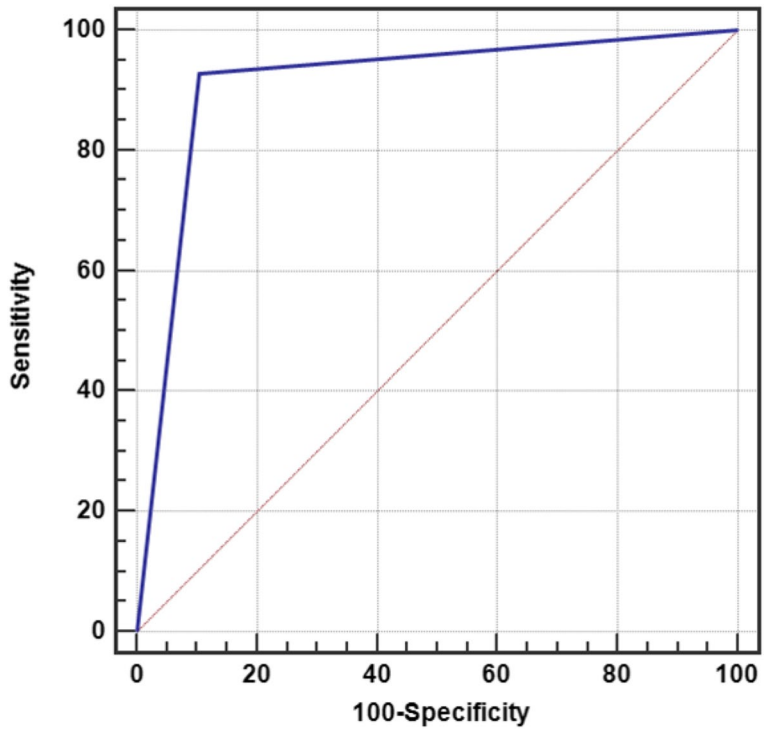

Fig. 1 Receiver operating characteristic (ROC) curve for Pleural Adherence Score for predicting successful pleurodesis

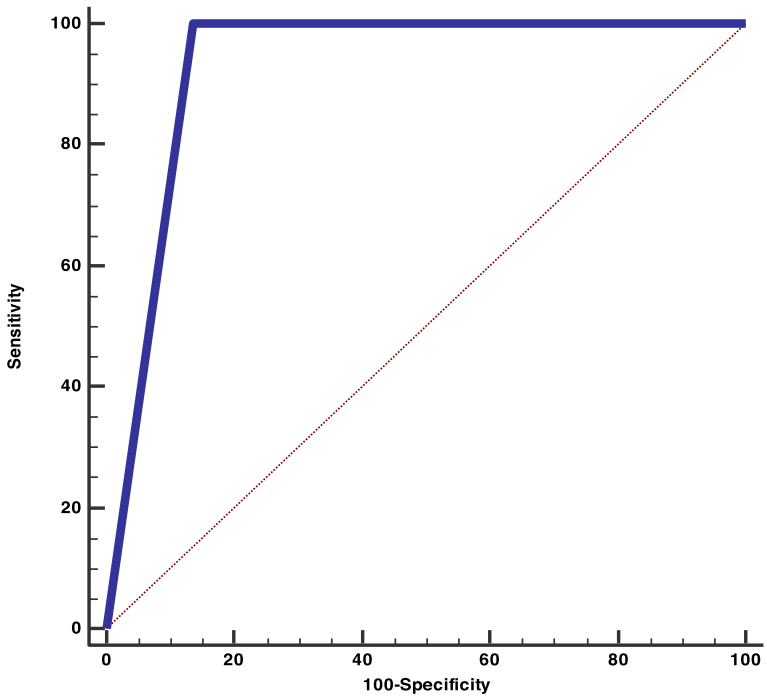

Fig. 2 Receiver operating characteristic (ROC) curve for absent lung sliding for predicting successful pleurodesis

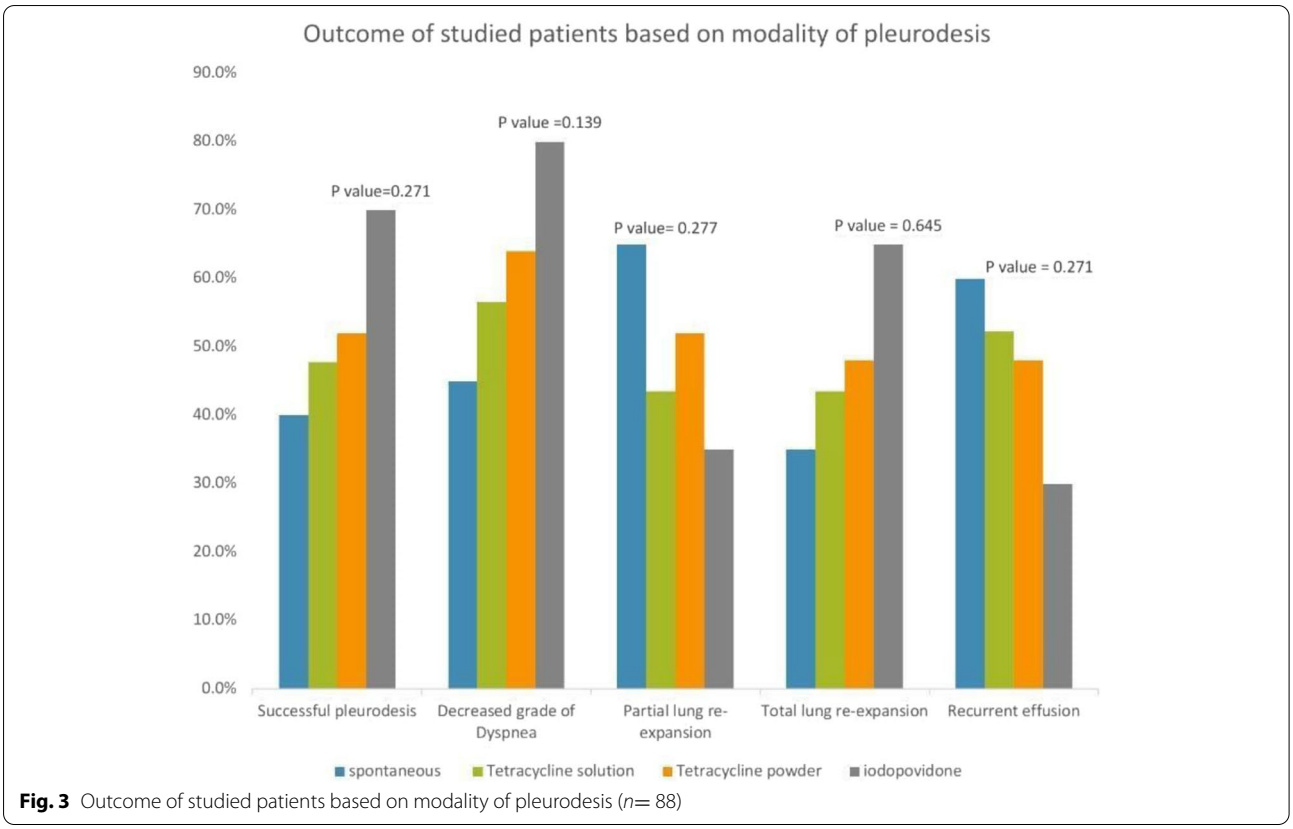

Fig. 3 Outcome of studied patients based on modality of pleurodesis (*n*= 88)

Table 9 Outcome among studied patients

	***N*= 100 (no., %)**
Complications	
None	81 (81.0%)
Fever	5 (5.0%)
Pain	13 (13.0%)
Anaphylaxis	1 (1.0%)
Outcome	**(*N*= 88)**
Successful pleurodesis	46 (52.3%)
Recurrent effusion	42 (47.7%)

[≠] Some patients had more than one complication

[>] 10 showed a sensitivity of 100% and specificity of 86% for the prediction of pleurodesis success. These results agreed with the current study. Moreover, Homma et al. [38] mentioned that absent sliding lung sign showed 0.94 AUC for the prediction of successful pleurodesis.

A recent systematic review and meta-analysis by Muthu et al. [39] reported that results of iodopovidine pleurodesis were comparable to other agents especially bleomycin and talc with nearly 90% pooled success rate. Also, El Hadidy et al. [7] illustrated that iodopovidine pleurodesis was more effective than bleomycin and doxycycline in 30-day follow-up by chest ultrasonography with loss of lung sliding sign (85.7%, 71.4%, and 62.5%, respectively, success rates).

Omoregbee and Okugbo [40] found that iodopovidine was effective as tetracycline for pleurodesis in patients with MPE with an overall success rate of 93.4% and 93.3%, respectively.

The study by El-Kolaly et al. [23] concluded that povidone–iodine resulted in complete pleurodesis in 73.3% of cases. Godazandeh et al. [41] were in line with the present results and found that povidone–iodine resulted in complete pleurodesis in 72.2% of patients and partial pleurodesis in 19.4% of patients with 91.6% overall success rate.

Kahrom et al. [42] reported 82.2% success rate for povidone–iodine. On the contrary, Bakr et al. [43] mentioned that tetracycline and iodopovidine were equally effective (80% of patients) for successful pleurodesis.

El Hadidy et al. [7] illustrated that intercostal chest tube induced successful pleurodesis in 87.5% of cases while 12.5% of cases showed positive sliding sign with increase in the amount of effusion. Meanwhile, AbouZaid et al.

[15] found 50 % success rate in the spontaneous pleurodesis group

The authors found that 81% of patients did not report any complications following pleurodesis while 5% of patients suffered from fever and 13% of patients complained of chest pain. Kahrom et al. [42] mentioned pain in 26.9% of their cases. Only one patient developed anaphylaxis with a 52.3% overall success rate. Chen et al. [44] found that majority of the patients reported no complication following pleurodesis. The most frequent adverse event was fever in 37.31% of patients. They also, found that the majority (88.03%) of the patients had successful pleurodesis.

Previous reports by Reddy et al., Terra et al., and Dipper et al. [45–47] have shown that the success rate of pleurodesis ranged between 65% and 96% in cases of MPE. This discrepancy of response in the studies reflects the use of different selection criteria and outcome definitions.

The study has some limitations. First, a relative small sample size. Second, extended follow-up for these patients was not feasible because usually patients with MPE are end-stage with only few months expected survival.

Conclusion

Most patients with MPE require palliative treatment, drainage, and chemical pleurodesis are usually needed for symptoms relief and prevention of fluid reaccumulation. Iodopovidone was more effective than spontaneous, tetracycline solution, and powder for induction of pleurodesis. TUS scores can play a role in predicting outcome of pleurodesis in MPE patients.

Abbreviations

MPE: Malignant pleural effusion; TUS: Transthoracic ultrasound; mMRC: Modified Medical Research Council; CT: Computed tomography.

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Authors' contributions

GR: conceptualization of the work, data analysis, substantively revised the work, and approved the final version. SS: data collection and analysis and approved the final version. MF: conceptualization of the work, data collection, and approved the final version. MM: conceptualization of the work, data analysis, work drafting and revision, and approved the final version. The authors read and approved the final manuscript.

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Availability of data and materials

Used and/or analyzed data in the current study are available upon request.

Declarations

Ethics approval and consent to participate

The ethics committee of the Faculty of Medicine, Assiut University, approved the study, IRB:17100919. Informed written consent was obtained from all participants or those responsible for them.

Consent for publication

All participants gave a consent to publish.

Competing interests

No

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