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Respiratory Muscle Strength and Lung Function in Patients Undergoing Medical Thoracoscopy

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Key Words
Thoracoscopy · Respiratory muscles · Maximal inspiratory pressure · Maximal expiratory pressure · Pleura · Lung function · Pleurodesis · Talc

Abstract
Background: Medical thoracoscopy (MT) is a procedure considered as minimally invasive. The safety of the procedure has been questioned recently in fragile patients, but no explanation of the pathophysiologic mechanism has been given. Although MT is applied by respiratory physicians who are also dealing with patients with impairment of lung function, it is surprising that there are no data concerning lung mechanics and function in this patient population. ***Objectives:*** To assess respiratory muscle strength and lung function in patients undergoing MT, with or without talc pleurodesis. ***Methods:*** We measured prospectively the maximal inspiratory (MIP) and expiratory pressures (MEP) and lung function of 29 patients who underwent MT before (baseline) and on consecutive days following MT. ***Results:*** 29 patients participated with a mean age of 63.6 ± 13.8 (range 20–79) years. 15 of them underwent talc pleurodesis and 14 diagnostic thoracoscopy. Mean MIP and MEP values were significantly decreased on day (d) 1 after MT compared to baseline ($p = 0.03$ and $p = 0.007$, respectively) and recovered on d2. FEV_1 and FVC mean values were also found significantly decreased on d1 after MT compared to baseline ($p < 0.0001$ and $p = 0.0003$, respectively) and recovered on d2. Patients with pleurodesis presented with lower mean values of the studied parameters than those with diagnostic thoracoscopy. No significant complication was associated with the procedure. ***Conclusion:*** Respiratory muscles and lung function can be temporarily affected from MT. Physicians should be alert, especially in patients with already impaired lung function, where any further impairment could be detrimental.

Introduction

Medical thoracoscopy (MT) is a method applied by respiratory physicians for diagnosis and treatment of pleural diseases [1]. The diagnostic accuracy of MT in patients with malignant pleural disease is approximately 95% [1, 2], while the rate of success in pleurodesis is approximately 90% for malignant pleural effusion [2] and 95% for pneumothorax [3]. MT is a simple procedure. It is usually performed under local anesthesia, in the endoscopy suite under cardiovascular monitoring, in an awake

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patient with spontaneous breathing [2]. The proper application of MT to the patients suffering from pleural disease is likely to have minor complications. However, it is less invasive than other interventional diagnostic thoracic procedures necessitating general anesthesia and an operating theater, such as video-assisted thoracic surgery (VATS) and lateral thoracotomy [4, 5].

Nevertheless, MT is still an invasive method. A previous study reported that with the application of MT to specific groups of patients, such as COPD and unstable cardiac status patients, a significantly increased morbidity might be observed [6]. This might be expected since thoracic surgery procedures induce respiratory muscle dysfunction due to inflammation or trauma next to the diaphragm, leading to local mechanical failure and reflex inhibition [4, 5]. So in some patients, complications with a concomitant increase in morbidity and mortality are not unlikely. Previous investigations studied respiratory muscle dysfunction in patients undergoing more invasive procedures than MT, such as lateral thoracotomy or VATS, by assessing changes in maximum inspiratory pressure (MIP) and maximum expiratory pressure (MEP) [4, 5, 7].

Although MT has been applied for one century for the diagnosis of pleural effusion, its impact on respiratory muscle function has never been studied. This is surprising since MT is applied by respiratory physicians who deal with COPD and obese subjects suffering from impaired respiratory muscles and function. We therefore conducted a prospective study which aimed to evaluate the changes of respiratory muscle strength and lung function in patients undergoing MT, with or without talc pleurodesis, and to answer the question whether this minimally invasive technique affects respiratory muscles and function.

Patients and Methods

Patients and Data Collection

This prospective study included 29 patients admitted to the Department of Pneumonology, University Hospital of Alexandroupolis, with pleural effusion between March 2006 and December 2007. All patients agreed and signed an informed consent to participate in the study before undergoing MT. The protocol was approved by the local internal review board.

The primary endpoint of this study was the post-thoracoscopy recovery of respiratory muscle strength, assessed by MIP and MEP before (baseline) and 24 h (day 1 – d1), 48 h (d2), 7 days (d7) and 14 days (d14) following thoracoscopy. The secondary endpoints included changes in lung spirometry tests; forced expiratory volume in 1 s (FEV_1) and forced vital capacity (FVC) were measured at baseline and d1, d2, d7, and d14 after thoracoscopy. Furthermore, we investigated whether talc pleurodesis affected the recovery of respiratory muscle strength, comparing to diagnostic thoracoscopy (DT) without pleurodesis. MIP, MEP, FEV_1 and FVC are expressed as a percentage of the predicted values.

Respiratory Muscle Assessment

MIP and MEP were measured according to the method described by Black and Hyatt [8]. Mouth pressure during MIP at the functional residual capacity was measured to give an index of inspiratory muscle strength. Expiratory muscle strength was assessed by mouth pressure during MEP at the functional residual capacity. Subjects exerted MIP or MEP against an obstructive mouthpiece with a small air leak. The mouthpiece was connected to a pressure transducer (plethysmograph Masterlab; E. Jaeger GmbH, Würzburg, Germany) and measurements were made with subjects seated and wearing a nose clip. Subjects were instructed to avoid collapsing or distending cheeks during inspiratory or expiratory effort to prevent the generation of excessive pressure by upper airway muscles with glottis closure. After a demonstration of the technique, each subject performed serial maximal maneuvers, repeated until at least three readings with a variation of <10% had been recorded. The highest value achieved was used in the analysis.

Lung Function Assessment

Spirometry (Masterlab, E. Jaeger GmbH) was performed according to the American Thoracic Society specifications [9]. Arterial blood gases on room air were analyzed for partial pressures (expressed in mm Hg) of oxygen (PaO_2), carbon dioxide ($PaCO_2$), and oxygen saturation (SaO_2 in %) at baseline, at the 1st and 2nd day only (for ethical and cost reasons) following thoracoscopy, using the GEM Premier 3000 Model 5700 device from Instrumentation Laboratory (Lexington, Mass., USA).

Medical Thoracoscopy

All patients underwent thoracoscopy according to published guidelines as already described also in our previous publications [2, 10, 11]. During the procedure, blood pressure, oxygen saturation and electrocardiogram were monitored. Oxygen supplementation was provided if needed. No general anesthesia was used in any of the cases. Thoracoscopy was performed in the lateral decubitus position using a single port of entry, under local anesthesia with 1% lignocaine. A 7-mm trocar was inserted into the fifth or sixth intercostal space along the midaxillary line. After evacuation of the pleural fluid, a 0° optical telescope was inserted and connected to a light source. The entire pleural cavity was then inspected, at times requiring supplemental air insufflation. Pleural biopsies were performed with an optical forceps through the single port of entry. The thoracic drain was removed in patients with DT, after the complete re-expansion of the lung to the thoracic wall.

Pleurodesis was performed by insufflating 4 g of sterile asbestos-free talc (Steritalc®, Novatech France) into the patients' pleural space. At the end of the procedure, a chest tube (20- to 24-Fr gauge) was inserted and connected to an underwater seal with a negative suction of 20 cm H_2O. The chest tube was removed when <100 ml of pleural fluid was drained over a 24-hour period in patients who underwent pleurodesis. After thoracoscopy, all patients received a continuous transdermal delivery system (patch) of low-dose analgesia (pethidine 1 mg/kg) in order to avoid pain affecting the respiratory muscle function [12, 13].

Table 1. Patients' characteristics and interventional data

	Total (n=29)	Thoracoscopic talc poudrage (n = 15)	Diagnostic thoracoscopy (n = 14)	p
Age, years (range)	63.6 ± 13.8 (20–79)	67.6 ± 8.5 (53–77)	59.3 ± 172 (20–79)	0.1
Sex				
Male	16 (55%)	5 (33.4%)	11 (78.5%)	0.01
Female	13 (45%)	10 (66.6%)	3 (21.5%)	
Diagnosis				
Malignant	21 (72.5%)	14 (93.3%)	7 (50%)	0.009
Benign	8 (27.5%)	1 (6.7%)	7 (50%)	
Karnofsky index, % (range)	95.1 ± 10.9 (70–100)	96.6 ± 9 (70–100)	93.5 ± 12.7 (70–100)	0.45
Side of thoracoscopy				
Right	15 (51.7%)	8 (53.3%)	7 (50%)	0.8
Left	14 (48.3%)	7 (46.7%)	7 (50%)	
Days of pleural drainage (range)	2.6 ± 1 (1–5)	3.2 ± 1.1 (1–5)	2.2 ± 0.8 (1–4)	0.05
Pleural fluid during thoracoscopy, l	2.3 ± 1.2 (0.4–5)	2.6 ± 1 (1.2–4.5)	1.9 ± 1.3 (0.4–5)	0.1
Pleural fluid LDH, IU/l	689 ± 801 (98–4,062)	613 ± 460 (98–1,810)	785 ± 1,117 (150–4,062)	0.6
Pleural protein, g/dl	4.6 ± 1 (3.2–7.5)	4.4 ± 0.6 (3.3–5.9)	4.8 ± 1.3 (3.2–7.5)	0.3
MIP, % predicted	45 ± 18.2 (18–100)	42.3 ± 13.4 (20–76)	47.8 ± 22.4 (18–100)	0.4
MEP, % predicted	47.3 ± 17.9 (17–95)	41.6 ± 18.4 (17–95)	53.3 ± 15.7 (33–77)	0.08
FEV_1, % predicted	60.2 ± 21.7 (27–98)	54.6 ± 22.3 (27–98)	66.1 ± 20 (28–96)	0.1
FVC, % predicted	58.6 ± 22.5 (21–107)	54.3 ± 25 (24–107)	63.1 ± 19.3 (21–96)	0.3
PaO_2, mm Hg	69.7 ± 9.3 (54–92)	66.9 ± 6.4 (54–78)	72.6 ± 11.2 (56–92)	0.1
$PaCO_2$, mm Hg	37.9 ± 2.8 (31–44)	37.3 ± 2.8 (31–42)	38.6 ± 2.8 (33–44)	0.2
SaO_2, %	93.8 ± 2.5 (86–97)	93.5 ± 2.2 (88–96)	94.2 ± 2.8 (86–97)	0.5

Table 2. Patients' diagnosis in our study (n = 29, 100%)

Malignant (n = 21, 72.4%)	
Lung cancer	10 (34.5%)
Breast cancer	5 (17.2%)
Mesothelioma	3 (10.3%)
Lymphoma	2 (6.9%)
Ovary carcinoma	1 (3.5%)
Benign (n = 8, 27.6%)	
Tuberculosis	2 (6.9%)
Other infections	4 (13.8%)
Non-specific	2 (6.9%)

A chest X-ray was performed on admission, immediately after thoracoscopy, 24 h later, upon discharge, and as needed based on the patient's clinical status. A clinical evaluation, with chest X-ray, was also performed by the respiratory physician at 1 week when the stitches were removed and 1 and 3 months after the procedure. All patients had a 3-month follow-up after the procedure [2].

Statistical Analysis

All values are expressed as mean ± SD. Comparison of means between groups was performed with Student's t test. The χ^2 test was used to determine whether a difference existed between the demographic parameters such as diagnosis and gender. Fisher's exact test was used to compare significant differences in proportions. $p < 0.05$ was considered significant. We used a statistical software package (StatView™, Version 4.5; Abacus Concepts Inc., Berkeley, Calif., USA) for the evaluation of our data.

Results

Baseline characteristics are shown in table 1. 14 patients underwent DT and 15 thoracoscopy with talc poudrage (TTP). Among the two groups of patients, there were no significant differences in age, Karnofsky index, preoperative MIP, MEP, spirometry, or blood gases (table 1). The diagnosis of all 29 patients is shown in table 2. Complications observed in our study are shown in table 3.

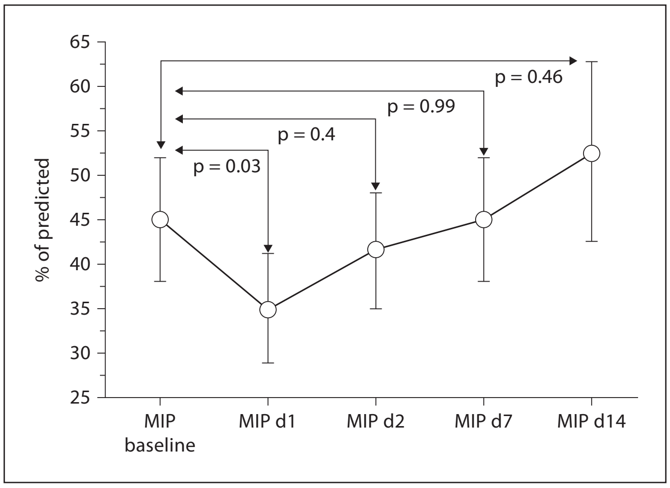

Fig. 1. Evolution of MIP in all patients at baseline, d1, d2, d7 and d14 after thoracoscopy. Values are expressed as mean (% of the predicted values) and error bars indicate standard deviations.

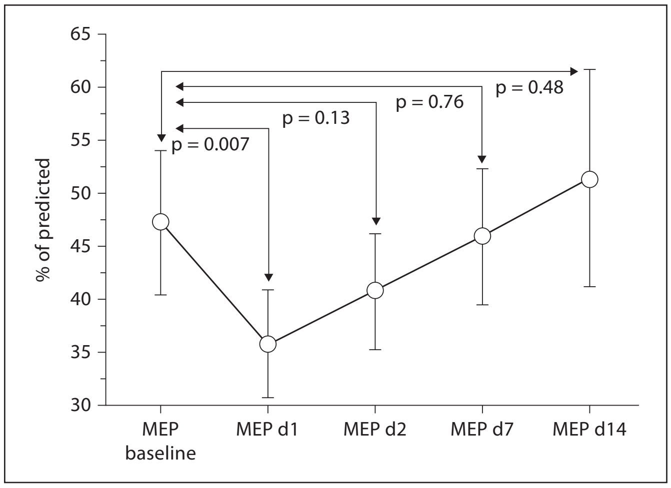

Fig. 2. Evolution of MEP in all patients at baseline, d1, d2, d7 and d14 after thoracoscopy. Values are expressed as mean (% of the predicted values) and error bars indicate standard deviations.

Table 3. Complications noted in our study

	All patients (n = 29)	Thoracoscopic talc poudrage (n = 15)	Diagnostic thoracoscopy (n = 14)	p
Fever >37.5°C not requiring treatment	17 (58.6%)	11 (73.3%)	6 (42.8%)	0.01
Pain requiring minor analgesics	5 (17.2%)	3 (20%)	2 (14.3%)	ns
Subcutaneous emphysema	4 (13.4%)	2 (13.3%)	2 (14.3%)	ns
Nausea/vomiting	1 (3.4%)	1 (6.6%)	0	ns
Bradyarrhythmia	1 (3.4%)	0	1 (7.6%)	ns

Respiratory Muscle Assessment

The mean (±SD) MIP values (% predicted) in all patients at baseline, d1, d2, d7 and d14 following MT were, respectively, 45 ± 18.2, 35 ± 16, 41.5 ± 17, 45 ± 17.3, and 52.5 ± 19. MIP was also found significantly decreased 24 h after the procedure compared to baseline (p = 0.03) and returned to baseline (p = 0.4) 48 h following MT (fig. 1).

The mean (±SD) MEP values (% predicted) in all patients at baseline, d1, d2, d7, and d14 following MT were, respectively, 47.3 ± 17.8, 35.8 ± 13.4, 40.8 ± 14, 46 ± 16, and 51.3 ± 19.1. Also, MEP was found significantly decreased 24 h after the procedure compared to baseline (p = 0.007), and returned to baseline 48 h following MT (p = 0.13) (fig. 2).

MIP and MEP values according to the procedure (TTP vs. DT) are shown in table 4.

Lung Function

The mean values (±SD) of FEV_1 and FVC (% predicted) were found significantly decreased 24 h following MT compared to baseline ($p < 0.0001$ and p = 0.0003, respectively) (fig. 3, 4). Both parameters returned to baseline 48 h following MT.

The mean value (±SD) of arterial PaO_2 (mm Hg) was found significantly decreased 24 h ($p < 0.0001$) and 48 h (p = 0.005) following MT compared to baseline, yet PaO_2 on d2 was significantly improved compared to d1 (p = 0.023) (fig. 5a). Oxygen saturation (SaO_2) measured in blood gases followed the same pattern as PaO_2 (fig. 5b). The mean value (±SD) of arterial $PaCO_2$ (mm Hg), was found significantly decreased 24 h (p = 0.003) following MT, but recovered on d2 (fig. 5a).

The mean values (±SD) in lung function parameters according to the procedure (TTP vs. DT) are shown in table 4.

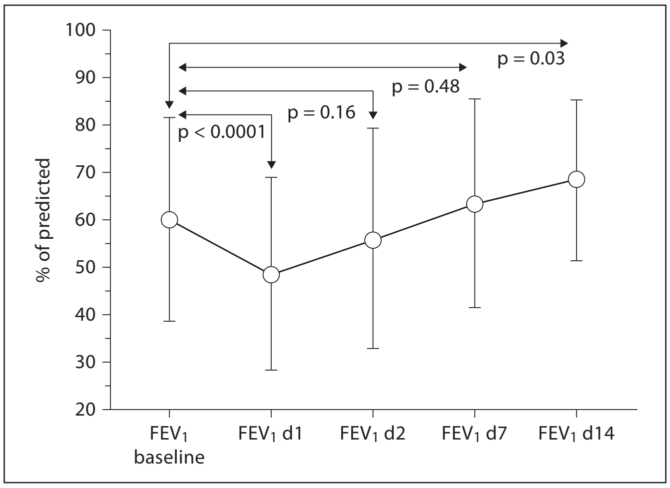

Fig. 3. Evolution of FEV_1 in all patients at baseline, d1, d2, d7 and d14 after thoracoscopy. Values are expressed as mean (% of the predicted values) and error bars indicate standard deviations.

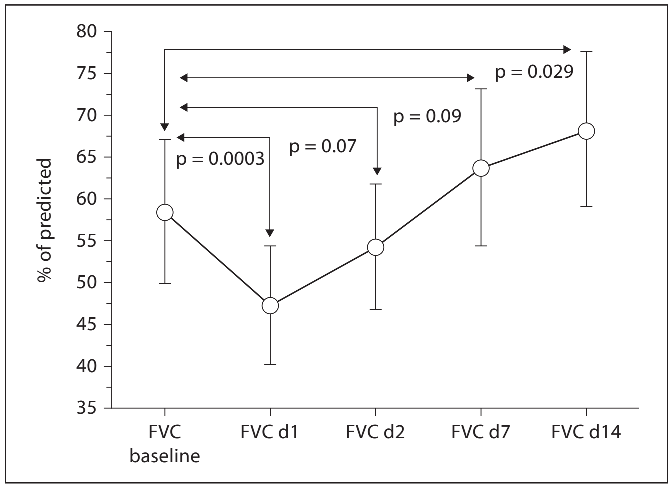

Fig. 4. Evolution of FVC in all patients at baseline, d1, d2, d7 and d14 after thoracoscopy. Values are expressed as mean (% of the predicted values) and error bars indicate standard deviations.

Table 4. Differences in the mean values of the studied parameters according to the interventional procedure

Parameter	Thoracoscopic talc poudrage (n = 15)	Diagnostic thoracoscopy (n = 14)	p
MIP d1	31.6 ± 13.2	38.7 ± 18	0.24
MIP d2	38.3 ± 14.1	44.7 ± 19.7	0.33
MIP d7	39.8 ± 16.6	50.2 ± 17	0.12
MIP d14	45.5 ± 16.3	61.5 ± 19.4	0.09
MEP d1	31.8 ± 13.9	40 ± 11.9	0.09
MEP d2	34.6 ± 13.2	47.1 ± 12.5	0.01
MEP d7	39.1 ± 14.1	52.7 ± 15.5	0.02
MEP d14	46.4 ± 18.7	57.7 ± 19.2	0.25
FEV_1 d1	39.8 ± 14.8	58.1 ± 21.5	0.01
FEV_1 d2	46.2 ± 15.6	66.1 ± 25.5	0.02
FEV_1 d7	58.7 ± 23.9	68.3 ± 19.6	0.28
FEV_1 d14	61.6 ± 16	77.2 ± 15.3	0.070
FVC d1	39.4 ± 12.9	55.9 ± 20	0.01
FVC d2	46 ± 15.4	62.6 ± 19.9	0.02
FVC d7	57.9 ± 25.2	69.6 ± 19.9	0.20
FVC d14	62.1 ± 16.9	76.4 ± 15.6	0.10
PaO_2 d1	59.9 ± 9	69 ± 12.3	0.029
PaO_2 d2	62 ± 8.2	71 ± 12.5	0.032
$PaCO_2$ d1	35.7 ± 2	37.7 ± 3.5	0.070
$PaCO_2$ d2	36.8 ± 1.7	38.7 ± 3	0.045
SaO_2 d1	90.7 ± 3.7	93 ± 3.6	0.028
SaO_2 d2	91.6 ± 3.1	93.3 ± 3.5	0.033

MIP, MEP, FEV_1 and FVC are expressed as mean values of the % predicted ± SD. PaO_2 and $PaCO_2$ are expressed as mean values of mm Hg ± SD. SaO_2 is expressed as mean values of % ± SD.

Discussion

The present prospective study aimed to answer whether respiratory muscle strength and lung function were affected in patients undergoing MT. The major findings of the study were that: (a) MIP, MEP and spirometric values were found significantly decreased 24 h following MT; (b) both respiratory muscle parameters and spirometric values returned to baseline 48 h following MT, and (c) patients who underwent TTP had lower MIP, MEP, FEV_1 and FVC values following TTP compared to those with DT. Diagnosis and occurrence of complications in all patients were in agreement with other studies performed in Western countries [2, 3]. Moreover, the present study provided evidence suggesting that MT is associated with temporary respiratory muscle and lung dysfunction.

So far, respiratory muscle dysfunction has been documented only in patients undergoing major procedures such as VATS, thoracotomy [4, 5, 7], or abdominal surgery [14, 15]. VATS has an advantage over transaxillary thoracotomy or posterolateral thoracotomy as diaphragmatic function is improved from the 3rd postoperative day [5]. Respiratory muscles in patients who underwent transaxillary thoracotomy recovered later, after the 4th postoperative day, reaching the values of VATS, as differences between those procedures become non-significant [5]. It takes longer for muscles to recover in patients who underwent posterolateral thoracotomy [5]. The results of our study are difficult to compare with those of Bernard et al. [5] because of the different patients, since we includ-

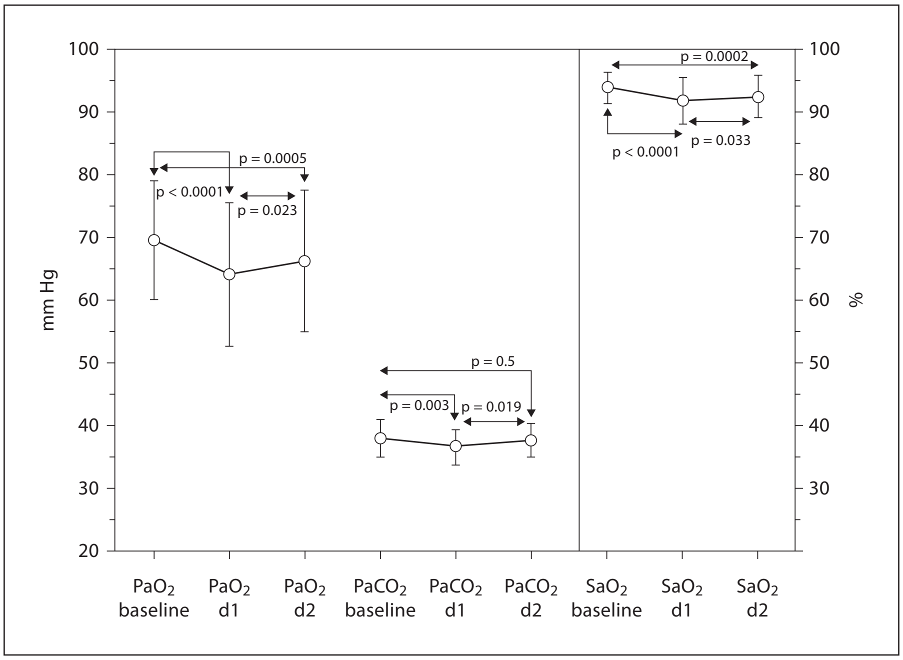

Fig. 5. Evolution of A/PaO_2, $PaCO_2$ (mm Hg) and B/SaO_2 (%) in all patients at baseline and after thoracoscopy. Values are expressed as mean and error bars indicate standard deviations.

ed patients with pleural effusion while in Bernard's study no patient presented with pleural effusion. In order to compare MT to VATS, it is necessary to randomize patients with pleural effusion in either group. Yet, as MT is performed with only one port of entry (instead of 3 in VATS) and under local anesthesia (instead of general anesthesia in VATS), the recovery of respiratory muscles and function might be quicker than in VATS [16, 17].

The present study evaluated prospectively the impact of MT on respiratory muscle function in a population of patients who underwent MT under local anesthesia and a low dose of pethidine transcutaneously. Both MIP and MEP were found significantly decreased 24 h following the procedure compared to baseline. It is likely that MT affected respiratory muscle strength, either by directly affecting the respiratory muscles and/or the neural structures locally (case of surgical incision) or by resulting in atelectasis, which may not allow the inspiratory muscles to operate on the best portion of their length-tension curve [16–18]. It is known that despite the removal of the fluid following MT, atelectasis might not resolve immediately and lung re-expansion may take as long as several weeks [19, 20]. In addition, atelectasis may occur due to the pain on the site of operation even with less invasive surgical procedures such as VATS [17]. However, pain requiring additional analgesia with opioids or radiologic evidence of atelectasis following MT were not observed in the present study.

In surgery, pain is also a factor limiting respiratory muscle strength from both the procedure and the chest tube drainage [16]. In patients who undergo thoracic surgery procedures, epidural anesthesia has a beneficial effect in respiratory muscles, increasing FRC and VC by controlling pain [12]. At the same time, it has an adverse effect on pulmonary function by reducing the tonic activity of both the intercostal muscles and the diaphragm. However, a continuous administration of low-dose morphine, as in our study, does not reduce the tonic activity of respiratory muscles, while it still has the beneficial effect on pain control [12, 13]. In a controlled study it has been shown that respiratory muscle strength and pulmonary function recover when pain has been treated in a systematic way by a low-dose opioid, as in our study [13].

In our study, MIP and MEP values were found lower in patients who underwent TTP compared to those who underwent DT only (table 4). Despite the fact that MIP and MEP values returned to baseline in both groups, the difference in MIP and MEP values between them might indicate that talc pleurodesis potentially affects respiratory muscle strength to a greater extent. Unfortunately, in the literature, there is lack of studies in this setting, although two studies, one in patients with pneumothorax [21] and the other in patients with malignant pleural effusions [22], noted a mild restrictive impairment of lung function after pleurodesis in the studied population. Similar findings have been observed in patients with diffused [23] and asbestos-related pleural thickening [24]. Interestingly, in patients with asbestos-related pleural thickening [24], respiratory muscle strength measured by MIP and MEP was slightly impaired compared to controls and to patients with non-thickened pleura but with pleural plaques. A plausible mechanism explaining the reduction of MIP and MEP values following TTP could be the changes in regional pleural pressure caused by pleural symphysis, resulting in the early impairment of respiratory compliance and of lung recoil that potentially affect respiratory muscle strength [25]. Yet, those changes tend to improve with time [21, 22, 25].

Similar to MIP and MEP, a significantly decreased FEV_1 and FVC was observed 24 h following MT in all patients of the present study. These values improved considerably after the second post-thoracoscopy day and continued to improve 2 weeks later. We believe that the improvement of lung function was primarily due to the resolution of pleural effusion leading to lung expansion and thus improvement of lung compliance [26] and to a reduction in the size of the thoracic cage, allowing the inspiratory muscles to operate on a more advantageous portion of their length-tension curve [19]. Indeed, pleural drainage of large pleural effusions, associated with inversion of the hemidiaphragm, may relieve the pressure on the muscle, resulting in the improvement of pulmonary function [27].

In the present study, our patients presented a significant decrease in PaO_2 and SaO_2 immediately after thoracoscopy. Both values were significantly improved on the second post-thoracoscopy day in parallel with MIP and MEP improvements. This phenomenon might be associated with the dysfunction of respiratory muscles observed after the procedure that possibly affected the lung volumes, resulting in an increased V/Q mismatch and subsequent desaturation [16]. This finding was more pronounced in patients who underwent thoracoscopic talc pleurodesis compared to those with DT.

One might say that the decrease in PaO_2 in patients undergoing TTP could be due to the systemic [10] and lung inflammation [28] caused by talc, as has already been suggested [28]. However, hypoxemia in this case is much more pronounced and is clearly associated with the use of mixed, non-calibrated talc. The latter has the potential to induce significant systemic and lung inflammation and in some cases, acute respiratory distress [28]. In our study, we used the French calibrated talc for pleurodesis that is not associated with ARDS [3, 29]. The secondary improvement of gas exchange in our patients could presumably be due to an increase in ventilation in the parts of the lung previously poorly ventilated, yet perfused following thoracoscopy [30], corroborating that no significant V/Q imbalance nor diffusion limitations were present in our patients [22].

MT is a less invasive procedure compared to other thoracic diagnostic modalities such as VATS and thoracotomy, since it does not require an extended surgical incision and general anesthesia. However, most patients requiring diagnostic or therapeutic thoracoscopy have pleural effusion associated to atelectasis which may adversely affect the functional residual capacity of patients [20]. Moreover, patients who require diagnostic or therapeutic thoracoscopy may present significant comorbidities such as COPD. A study reported significant mortality/morbidity among COPD patients who underwent thoracoscopy [6]. In this respect, it is questionable whether patients with compromised lung function can undergo MT without experiencing serious adverse events due to respiratory muscle dysfunction or oxygen desaturation. In the present study, although patients who underwent MT had compromised lung function before MT (baseline FEV_1 = 60.2% predicted, resting PaO_2 = 69.7 mm Hg), we did not observe any serious adverse event. Yet, Lee's study [6] included patients with severe COPD (mean FEV_1 = 0.88 l, 41% of predicted). In patients already known with serious respiratory impairment, a further small decrease of lung volumes, as observed in our study, might be clinically significant [16].

In our study we aimed to assess whether MT affects patients' respiratory muscles and function. Our findings provided novel and clear evidence that respiratory muscles and lung function can be temporarily affected due to MT but serious adverse events were not observed. In addition, we found that MIP, MEP, spirometric values and PaO_2/SaO_2 were improved 48 h following MT, which is certainly shorter than in thoracic surgical procedures where respiratory muscles take several days to recover [5, 7]. Nevertheless, physicians who perform thoracoscopy should be alert for respiratory muscle dysfunction, FEV_1 decline and oxygen desaturation that may follow MT – although temporarily – especially in patients with already impaired respiratory parameters like obese and COPD patients where any further decrease in respiratory muscle strength and lung function could be detrimental.

References

1 Froudarakis ME: Diagnostic work-up of pleural effusions. Respiration 2008;75:4–13.
2 Rodriguez-Panadero F, Janssen JP, Astoul P: Thoracoscopy: general overview and place in the diagnosis and management of pleural effusion. Eur Respir J 2006;28:409–422.
3 Janssen JP, Collier G, Astoul P, et al: Safety of pleurodesis with talc poudrage in malignant pleural effusion: a prospective cohort study. Lancet 2007;369:1535–1539.
4 Giudicelli R, Thomas P, Lonjon T, et al: Video-assisted minithoracotomy versus muscle-sparing thoracotomy for performing lobectomy. Ann Thorac Surg 1994;58:712–717.
5 Bernard A, Brondel L, Arnal E, et al: Evaluation of respiratory muscle strength by randomized controlled trial comparing thoracoscopy, transaxillary thoracotomy, and posterolateral thoracotomy for lung biopsy. Eur J Cardiothorac Surg 2006;29:596–600.
6 Lee P, Yap WS, Pek WY, et al: An audit of medical thoracoscopy and talc poudrage for pneumothorax prevention in advanced COPD. Chest 2004;125:1315–1320.
7 Nomori H, Horio H, Fuyuno G, et al: Respiratory muscle strength after lung resection with special reference to age and procedures of thoracotomy. Eur J Cardiothorac Surg 1996;10:352–358.
8 Black LF, Hyatt RE: Maximal respiratory pressures: normal values and relationship to age and sex. Am Rev Respir Dis 1969;99:696–702.
9 American Thoracic Society: Standardization of spirometry, 1994 update. Am J Respir Crit Care Med 1995;152:1107–1136.
10 Froudarakis ME, Klimathianaki M, Pougounias M: Systemic inflammatory reaction after thoracoscopic talc poudrage. Chest 2006;129:356–361.
11 Froudarakis ME, Papadaki HA, Klimathianaki M, et al: Thoracoscopic talc poudrage decreases T lymphocytes in the peripheral blood. Respir Med 2007;101:1212–1217.
12 Nomori H, Horio H, Suemasu K: Comparison of short-term versus long-term epidural analgesia after limited thoracotomy with special reference to pain score, pulmonary function, and respiratory muscle strength. Surg Today 2001;31:191–195.
13 Vassilakopoulos T, Mastora Z, Katsaounou P, et al: Contribution of pain to inspiratory muscle dysfunction after upper abdominal surgery: a randomized controlled trial. Am J Respir Crit Care Med 2000;161:1372–1375.
14 Ford GT, Whitelaw WA, Rosenal TW, et al: Diaphragm function after upper abdominal surgery in humans. Am Rev Respir Dis 1983;127:431–436.
15 Rovina N, Bouros D, Tzanakis N, et al: Effects of laparoscopic cholecystectomy on global respiratory muscle strength. Am J Respir Crit Care Med 1996;153:458–461.
16 Siafakas NM, Mitrouska I, Bouros D, et al: Surgery and the respiratory muscles. Thorax 1999;54:458–465.
17 Furrer M, Rechsteiner R, Eigenmann V, et al: Thoracotomy and thoracoscopy: postoperative pulmonary function, pain and chest wall complaints. Eur J Cardiothorac Surg 1997;12:82–87.
18 Hallfeldt KK, Siebeck M, Thetter O, et al: The effect of thoracic surgery on pulmonary function. Am J Crit Care 1995;4:352–354.
19 Estenne M, Yernault JC, De Troyer A: Mechanism of relief of dyspnea after thoracocentesis in patients with large pleural effusions. Am J Med 1983;74:813–819.
20 Altschule MD: Some neglected aspects of respiratory function in pleural effusions. The diaphragmatic arch. Chest 1986;89:602.
21 Lange P, Mortensen J, Groth S: Lung function 22–35 years after treatment of idiopathic spontaneous pneumothorax with talc poudrage or simple drainage. Thorax 1988;43:559–561.
22 Ukale V, Bone D, Hillerdal G, et al: The impact of pleurodesis in malignant effusion on respiratory function. Respir Med 1999;93:898–902.
23 Corris PA, Best JJ, Gibson GJ: Effects of diffuse pleural thickening on respiratory mechanics. Eur Respir J 1988;1:248–252.
24 Singh B, Eastwood PR, Finucane KE, et al: Effect of asbestos-related pleural fibrosis on excursion of the lower chest wall and diaphragm. Am J Respir Crit Care Med 1999;160:1507–1515.
25 McGahren ED, Teague WG Jr, Flanagan T, et al: The effects of talc pleurodesis on growing swine. J Pediatr Surg 1990;25:1147–1151.
26 Light RW, Stansbury DW, Brown SE: The relationship between pleural pressures and changes in pulmonary function after therapeutic thoracentesis. Am Rev Respir Dis 1986;133:658–661.
27 Wang JS, Tseng CH: Changes in pulmonary mechanics and gas exchange after thoracentesis on patients with inversion of a hemidiaphragm secondary to large pleural effusion. Chest 1995;107:1610–1614.
28 Maskell NA, Lee YC, Gleeson FV, et al: Randomized trials describing lung inflammation after pleurodesis with talc of varying particle size. Am J Respir Crit Care Med 2004;170:377–382.
29 Bouros D, Froudarakis M, Siafakas NM: Pleurodesis: everything flows. Chest 2000;118:577–579.
30 Perpina M, Benlloch E, Marco V, et al: Effect of thoracentesis on pulmonary gas exchange. Thorax 1983;38:747–750.