Interventional Pulmonology

Respiration

Respiration 2012;84:219–224
DOI: 10.1159/000339414

Received: February 6, 2012
Accepted after revision: May 3, 2012
Published online: July 24, 2012

Is Medical Thoracoscopy Efficient in the Management of Multiloculated and Organized Thoracic Empyema?

Claudia Ravaglia[a] Carlo Gurioli[a] Sara Tomassetti[a] Gian Luca Casoni[a]
Micaela Romagnoli[a] Christian Gurioli[a] Vanni Agnoletti[b] Venerino Poletti[a]

[a]Department of Disease of the Thorax, Pulmonology Unit, and [b]Emergency Department, Anesthesia Intensive Care Unit, Morgagni Hospital, Forlì, Italy

Key Words
Thoracoscopy · Pleuroscopy · Empyema · Efficacy

Abstract
Background: Pleural empyema can be subdivided into 3 stages: exudative, multiloculated, and organizing. In the absence of clear septation, antibiotics plus simple drainage of pleural fluid is often sufficient treatment, whereas clear septation often requires more invasive treatment. ***Objectives:*** The aim of this study was to report our experience and analyze the safety and efficacy of medical thoracoscopy in patients with multiloculated and organizing empyema. ***Methods:*** We performed a retrospective study reviewing the files of patients referred for empyema and treated by medical thoracoscopy at our department from July 2005 to February 2011. ***Results:*** A total of 41 patients with empyema were treated by medical thoracoscopy; empyema was free flowing in 9 patients (22%), multiloculated in 24 patients (58.5%), and organized in 8 patients (19.5%). Medical thoracoscopy was considered successful without further intervention in 35 of 41 patients (85.4%): all of the 9 patients with free-flowing fluid, 22 of the 24 patients with multiloculated empyema (91.7%), and only 4 of the 8 patients with organizing effusion (50%). ***Conclusions:*** Our study confirms that multiloculated pleural empyema could safely and successfully be treated with medical thoracoscopy while organizing empyema can be resistant to drainage with medical thoracoscopy, requiring video-assisted thoracic surgery or open surgical decortications; among this population, the presence of separate 'pockets' not in apparent communication with each other often leads to a surgical approach.

Introduction

Pleural empyema is defined by a collection of pus in the pleural space and it is associated with a significant morbidity and mortality of 2–30% [1]. It can be subdivided into 3 stages: exudative or acute (characterized by an effusion that is free moving in the pleural cavity), fibro-purulent (in which a reduced endocavitary fibrinolysis causes fibrin deposition on the pleural surfaces with a cloudy and viscous fluid and a tendency toward loculation and the formation of limiting membranes), and organizing or chronic (characterized by fibrous thickening of the visceral pleura, a sort of 'peel' which traps the lung). According to Light [2], empyema could be classified as simple, when there is the presence of frank pus, single locule or free-flowing effusion, and complex, when there is frank pus with multiple loculation.

KARGER

Fax +41 61 306 12 34
E-Mail karger@karger.ch
www.karger.com

0025–7931/12/0843–0219$38.00/0

Accessible online at:
www.karger.com/res

Venerino Poletti, MD
Department of Disease of the Thorax, Pulmonology Unit
Pierantoni-Morgagni Hospital, Via C. Forlanini 34
IT–47100 Forlì (Italy)
Tel. +39 0543 735 042, E-Mail venerino.poletti@gmail.com

Ultrasound is particularly helpful in determining the nature of localized or diffuse pleural opacities, and is more sensitive than X-ray in identifying small or loculated pleural effusions [3], to identify and quantify the pleural septation at an early stage and the reduction of mobility of the diaphragm, which can correlate with the prognosis [4–6]. Septations within the effusion are less readily seen on CT as compared to ultrasonography [3, 7]. These differentiations are useful in practice because the therapeutic approach is very different in each stage even if clinical trials to guide treatment are still lacking [8]. In the absence of clear septation on ultrasonography, simple pleural drainage could be the standard treatment, whereas patients with clear septation are felt by many to require a form of thoracoscopy as a first-line treatment [9]. The aim of the current study was to report our experience and analyze the efficacy and safety of medical thoracoscopy in patients with multiloculated and organized empyema stratified early by chest ultrasonography.

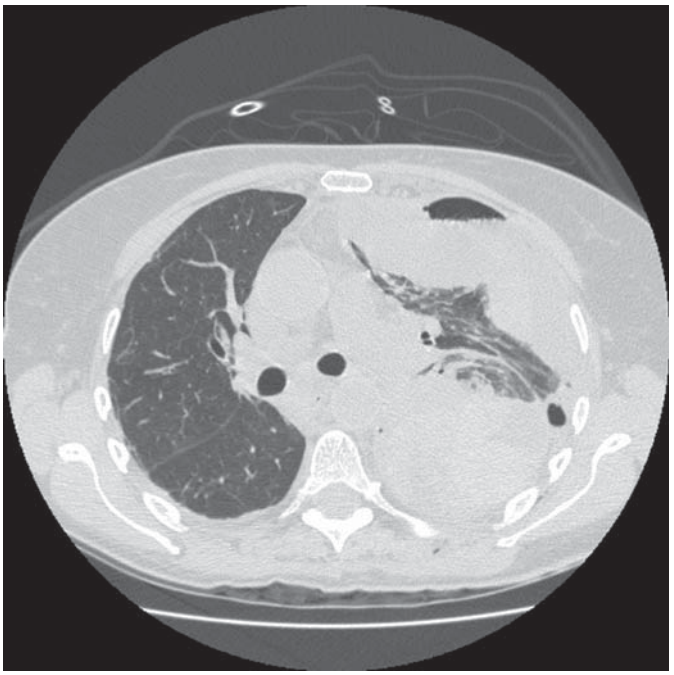


Fig. 1. A CT scan of the chest showing organized empyema, with fibrous thickening of the pleura and a 'multichambered' appearance (two separate 'pockets' not in communication with each other).

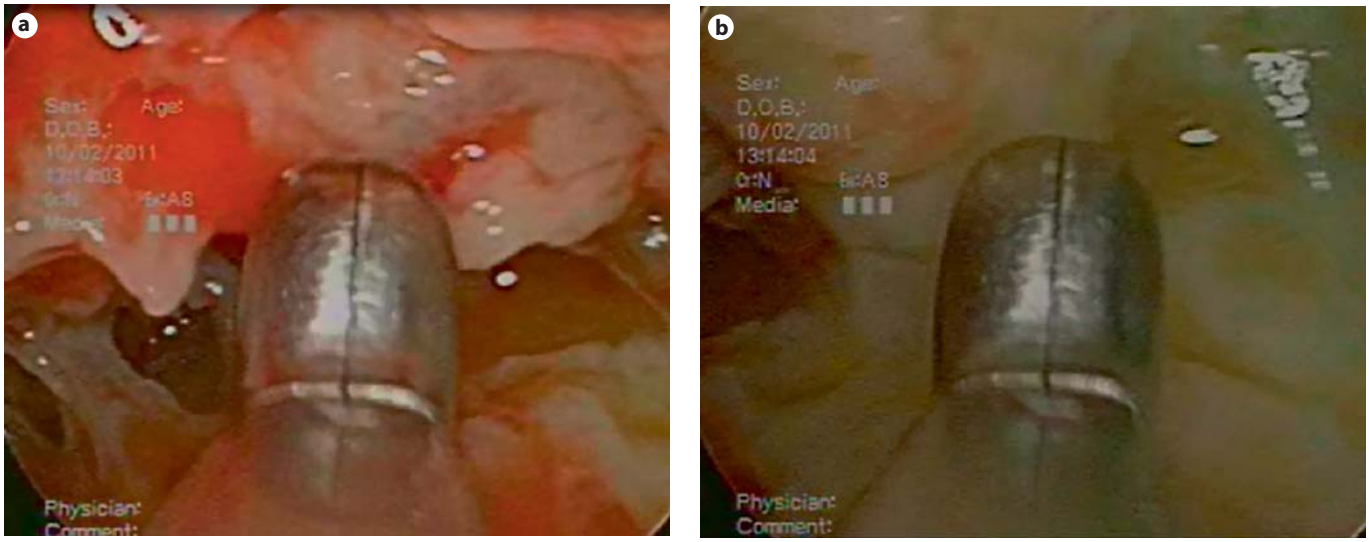
Material and Methods

This study was approved by the IRB (Area Vasta Romagna Review Board, project approval No. 3386/2011). We performed a retrospective study reviewing all files of 41 patients referred for empyema and treated with medical thoracoscopy at the Pulmonology Department of a referral hospital for respiratory diseases (Forlì, Italy) from July 2005 to February 2011; we did not consider cases with pleural effusion but no signs of empyema as these were not treated by thoracoscopy (medical thoracoscopy was performed on all empyema patients by agreement). All patients underwent chest radiography and also chest CT scan and ultrasonography to localize pleural fluid collection and to assess the echogenicity of the effusion and diaphragmatic motility; for ultrasonographic chest examination, a high-frequency linear transducer (5–7.5 MHz) and a convex transducer of intermediate frequency (3–4 MHz) were used in order to better evaluate the lung-pleura interface, effusions, parietal pleura, and lung parenchyma [3, 10, 11]. Ultrasonographic exploration was performed by a small group of pulmonologists from our department who had received specific training and performed the procedure regularly. The training included physician-performed pleural ultrasound, which allowed precise localization and characterization of pleural fluid, together with organ visualization. The training had two components: theoretical didactic training and a subsequent formal supervised practice; both phases were conducted by expert radiologists.

Thoracentesis was performed at our department in all patients and empyema was defined as frank pus on thoracocentesis (turbid malodorous liquid) with or without positive Gram stain smear and bacteriologic culture findings or pH <7.2 with signs of infection. Multiloculated empyema was defined as ultrasonographic presence of multiple empyema loculations with presence of intrapleural septae, and organized empyema was characterized by fibrous thickening of the pleura [5, 12]; fibrous thickening of the pleura was recognized with radiologic techniques (ultrasound and CT examination) before the thoracoscopic procedures, but during pleuroscopy we could find correspondence between radiologic images and thoracoscopic pictures (fig. 1, 2).

Among the 41 patients referred with empyema, 9 had been treated before in a different hospital and were referred for thoracoscopy after a failure of medical treatment; when they arrived at our department, 1 had free-flowing effusion, 3 had multiloculated empyema, and 5 had organized empyema.

Medical thoracoscopy was carried out in the lateral decubitus position under local anesthesia with 2% lidocaine and moderate sedation. A 7.5- and/or 10-mm trocar was inserted under ultrasonographic guidance in the appropriate intercostal space (in one 6-year-old patient a 5.5-mm trocar was used). A video-thoracoscope (Storz, Wolf, Germany) provided with a 0° optical telescope was inserted and the pleura was carefully inspected. With the closed biopsy forceps, step by step, fibrinous septae were perforated, the pleural space was irrigated with saline, and fluid and fibrinopurulent material were aspirated and removed from the pleural cavity. At the end of the procedure, a drain (20–32 F) was inserted and connected to underwater seal suction with a negative pressure suction of 20 cm H_2O. All patients received IV antibiotics for at least 1 week after the procedure; in 23 patients, 100,000 U of urokinase diluted in 100 ml of normal saline solution was administered into the pleural space once daily for 3–5 days and, after rinsing with the saline solution, the drain was clamped for 2 h [13, 14]; in two 6-year-old patients, 25,000 U of urokinase diluted in 30 ml of saline solution was administered.



Color version available online

Fig. 2. a Pleural cavity completely subverted by the presence of synechiae and fibrinous septae. **b** Pleural cavity after perforation of fibrinous septae and aspiration of fluid and fibrinopurulent material; it is possible now to see a second pocket on the right side.

Treatment success was defined as radiologic confirmation of successful pleural drainage (i.e. reduction of the size of the pleural fluid on the chest X-ray and a thoracic ultrasound of less than one third of the hemithorax in complete resolution or greater than one third in partial resolution), with no need for further treatment (subsequent chest tube insertions or surgical interventions) and objective evidence of sepsis resolution (improvement in temperature and clinical condition and decreasing inflammatory laboratory markers) [15].

Results

A total of 41 patients with empyema were treated by medical thoracoscopy. Patients were examined with radiologic techniques (ultrasound, X-ray, and CT scan); empyema was considered multiloculated in 24 patients (58.5%), organizing in 8 patients (19.5%), and free-flowing in 9 patients (22%). The mean age was 54 years [range 6 (2 cases) to 87 years] and 34 patients (83 %) were male. In 24 patients (58.5%) a microbiological diagnosis could be made (6 Gram-positive, 4 Gram-negative, 2 anaerobes, 1 fungi, and 11 *Mycobacterium tuberculosis*). All patients received antibiotic treatment and all underwent medical thoracoscopy; all patients received the same broad spectrum antibiotic after the thoracoscopy which was then targeted based on the culture results if necessary; patients with tuberculous empyema were treated with anti-tuberculosis medications.

Complications as a consequence of medical thoracoscopy occurred in 3 patients (7%): 1 cutaneous fistula, 1 residual pneumothorax, and 1 hemothorax caused by an intercostal vessel injury which required urgent thoracotomy. No deaths or chronic morbidity related to empyema were observed and no complications occurred in the 2 young patients (aged 6). Twenty-three of the 41 patients with empyema (56.1%) received adjuvant postthoracoscopy intrapleural fibrinolysis (urokinase) for 3–5 days; urokinase was administered in patients with multiloculated and organized empyema. Patients with free-flowing effusion were excluded. However, only 23 patients received intrapleural fibrinolysis as we considered as contraindications the presence of liver disease, renal failure, remarkable pleural bleeding during pleuroscopy, thoracic trauma as the cause of empyema or blood clotting disorder. Among the patients receiving urokinase, only 1 patient (with organized empyema) underwent subsequent surgical intervention.

Chest tube drainage after medical thoracoscopy was maintained for 7.9 days (range 2–17); we did not have a standard criterion for discontinuation of chest tube drainage and the duration of chest tubes was longer in those with multiloculated effusion.

Medical thoracoscopy was considered successful without subsequent intervention in 35 of 41 patients (85.4 %), with 6 patients (14.6%) receiving eventual surgical intervention through VATS in 3 cases (50%) or thoracotomy

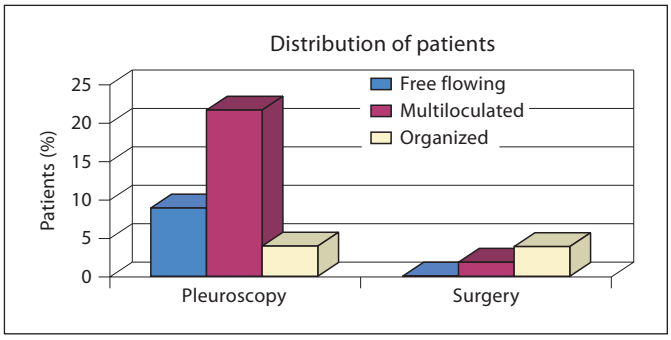


Fig. 3. Medical thoracoscopy was successful in all patients with free-flowing fluid, in 91.7% of patients with multiloculated empyema, and in 50% of patients with organized effusion.

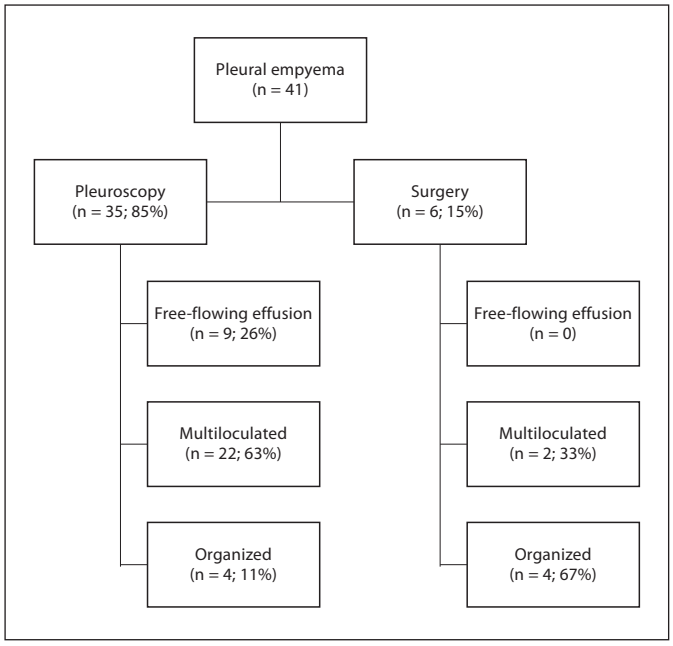


Fig. 4. Medical thoracoscopy was successful in 35 of 41 patients (85.4%), with 6 patients (14.6%) receiving surgical intervention; patients receiving surgical approach had multiloculated empyema (n = 2) and organized empyema (n = 4).

in 3 cases (the remaining 50%); patients receiving the surgical approach had multiloculated empyema (2 cases) and organized empyema (4 cases) (fig. 3; table 1). Among the 8 patients with third stage pleural effusion (organized), 3 (37.5%) had a 'multichambered' appearance with evidence of at least two separate 'pockets' not in apparent communication with each other; all of these 3 patients failed to resolve their empyema over 2–5 days after

Color version available online

Table 1. Distribution of patients

Pleural empyema (n = 41)	Successful thoracoscopy	Surgical procedures
Multiloculated (n = 24)	22 patients (91.7%)	2 patients (8.3%)
Organized (n = 8)	4 patients (50%)	4 patients (50%)
Free-flowing effusion (n = 9)	9 patients (100%)	0 patients (0%)

medical thoracoscopy, leading to a decision for surgical intervention, whereas among the remaining 5 patients with organized effusion without this peculiar morphology only 1 required thoracotomy (fig. 3, 4). According to the long-term follow-up data, 3 patients died (one with mesothelioma diagnosed 14 months after the pleuroscopy, one with lung cancer, and one with breast cancer, both already known at the time of pleuroscopy); 1 patient who developed residual pneumothorax was treated via surgical intervention 4 months later, and we have no long-term follow-up data for 4 cases.

Discussion

Our study confirms that free-flowing and multiloculated pleural empyema stratified by chest ultrasonography could be treated safely and successfully by medical thoracoscopy, while organizing empyema can be resistant to drainage with medical thoracoscopy, requiring video-assisted thoracic surgery or open surgical decortication. Indeed medical thoracoscopy was successful in all patients with free-flowing fluid, in 91.7% of patients with multiloculated empyema, and in 50% of patients with organized effusion. These results are in accordance with the current literature which demonstrates that nonloculated anechoic effusion without septae is associated with successful treatment with catheter drainage [16, 17] while multiloculated empyema needs to be treated by medical thoracoscopy as well as VATS; in particular, some investigators reported that multiloculated pleural empyema stratified by chest ultrasonography can safely and successfully be treated with medical thoracoscopy, with a small proportion of patients (7%) needing conversion to VATS or open surgery [15].

Other studies, however, do not consider medical thoracoscopy as an alternative to surgical intervention in the presence of loculations [5, 4, 18]. Medical thoracoscopy is a much less invasive video-assisted thoracoscopy, it is

performed under local anesthesia and moderate sedation, and it has been used throughout Europe since 1910 to diagnose and treat pleural disease including thoracic empyema [15, 19, 20]. Medical thoracoscopy can achieve opening of multiple loculations and aspiration of the purulent liquid and removal of the fibrinous adhesions, and it can provide local treatment with fibrinolytics [21, 22].

The advantages of medical thoracoscopy compared with VATS include a lower cost and better tolerance by frail patients who may not tolerate general anesthesia with tracheal intubation [20]; some limitations to this technique can be related to the fact that, in contrast to surgical VATS, it is usually performed via a single port so the lung is not fully collapsed during the intervention and it can be more time consuming.

Our series of patients with multiloculated thoracic empyema stratified by ultrasonography and treated early by medical thoracoscopy shows that this approach is safe, minimally invasive, and efficient in these patients with a disease having relevant mortality. In our 41 patients, no deaths and no chronic morbidity related to empyema were observed. However, while free-flowing and multiloculated pleural empyema could be successfully treated by medical thoracoscopy, organizing empyema can be resistant to drainage with medical thoracoscopy, requiring video-assisted thoracic surgery or open surgical decortication. In particular, among patients with organizing empyema the 'multichambered' appearance (with separate 'pockets' not in apparent communication with each other) could represent a peculiar morphology more difficult to treat with medical thoracoscopy, requiring thoracic surgery for recovery.

Regarding the use of intrapleural fibrinolytics, in our study only one patient (among the group who had been treated with intrapleural urokinase) underwent a subsequent surgical intervention. This result confirms that intrapleural urokinase could confer a significant benefit in reducing the requirement for surgical intervention in empyema; however, we know that in a recent meta-analysis intrapleural fibrinolytic therapy conferred a significant benefit in some studies but not in others [23]; the safety profile of intrapleural fibrinolytics remains uncertain.

Tuberculous empyema is a rare disease; in our case series we found 11 patients with tuberculosis (26.8%) and we think that this predominance could be related to the fact that our hospital is a referral center for tuberculosis patients as well.

One important limit to the study is that it is not prospective, but we are confident that, though retrospective, our assessment of treatment efficacy is reliable because all original hospital charts were reviewed, but retrospective data collection could not give a complete image of intervention-related complications as minor events are less likely to be recorded in case charts [15, 24]. We also recognize that our findings may be limited by the relatively small sample size of the subgroups which could decrease the reliability of the results.

Multicenter trials are needed to recruit the required number of patients and to improve the therapeutic approach by studying different outcomes such as the duration or type of chest tube drainage, length of hospital stay, type of intervention, and timing and combination of procedures [15]. One remarkable aspect of the approach to pleural diseases (mostly empyema) is the relationship between pulmonologists and thoracic surgeons; these two specialties should share patients with clinical quandaries such as pleural diseases as pulmonologists need the surgical back-up of the thoracic surgeon and similarly thoracic surgeons benefit from the availability of a dedicated clinician with appropriate referrals for surgical resection at adequate times.

Financial Disclosure and Conflicts of Interest

The authors report no conflict of interest.

References

1 Ferguson AD, Prescott RJ, Selkon JB, Watson D, Swinburn CR: The clinical course and management of thoracic empyema. QJM 1996;89:285–289.

2 Light RW: Parapneumonic effusions and empyema. Proc Am Thorac Soc 2006;3:75–80.

3 Heffner JE, Klein S, Hampson C: Diagnostic utility and clinical application of imaging for pleural space infections. Chest 2010;137:467–479.

4 Tassi GF, Davies RJ, Noppen M: Advanced techniques in medical thoracoscopy. Eur Respir J 2006;28:1051–1059.

5 Chen KY, Liaw YS, Wang HC, Luh KT, Yang PC: Sonographic septation: a useful prognostic indicator of acute thoracic empyema. J Ultrasound Med 2000;19:837–843.

6 Chiu CY, Wong KS, Huang YH, Lai SH, Lin TY: Echo-guided management of complicated parapneumonic effusion in children. Pediatr Pulmonol 2006;41:1226–1232.

7 Evans L, Gleeson FV: Radiology in pleural disease: state of the art. Respirology 2004;9:300–312.

8 Tassi GF, Marchetti GP, Pinelli V, Chiari S: Practical management of pleural empyema. Monaldi Arch Chest Dis 2010;73:124–129.

9 Davies HE, Davies RJ, Davies CW: Management of pleural infection in adults: British Thoracic Society Pleural Disease Guideline 2010. Thorax 2010;65:ii41–ii53.

10 Beckh S, Bolcskei PL, Lessnau KD: Real-time chest ultrasonography: a comprehensive review for the pulmonologist. Chest 2002;122:1759–1773.
11 Wernecke K: Sonographic features of pleural disease. Am J Roentgenol 1997;168:1061–1066.
12 Kearney SE, Davies CW, Davies RJ, Gleeson FV: Computed tomography and ultrasound in parapneumonic effusions and empyema. Clin Radiol 2000;55:542–547.
13 Misthos P, Sepsas E, Konstantinou M, Athanassiadi K, Skottis I, Lioulias A: Early use of intrapleural fibrinolytics in the management of postpneumonic empyema: a prospective study. Eur J Cardiothorac Surg 2005;28:599–603.
14 Cameron R, Davies HR: Intra-pleural fibrinolytic therapy versus conservative management in the treatment of adult parapneumonic effusions and empyema. Cochrane Database Syst Rev 2008;2:CD002312.
15 Brutsche MH, Tassi GF, Györik S, Gökcimen M, Renard C, Marchetti GP, Tschopp JM: Treatment of sonographically statified multiloculated thoracic empiema by medical thoracoscopy. Chest 2005;128:3303–3309.
16 Akhan O, Ozkan O, Akinci D, Hassan A, Ozmen M: Image-guided catheter drainage of infected pleural effusions. Diagn Interv Radiol 2007;13:204–209.
17 Shankar S, Gulati M, Kang M, Gupta S, Suri S: Image-guided percutaneous drainage of thoracic empyema: can sonography predict the outcome? Eur Radiol 2000;10:495–499.
18 Lim TK: Management of pleural empyema. Chest 1999;116:845–846.
19 Cafiero F: Jacobaeus operation during parapneumothoracic empyema. Minerva Med 1954;45:553–557.
20 Kern L, Robert J, Brutsche M: Management of parapneumonic effusion and empyema: medical thoracoscopy and surgical approach. Respiration 2011;82:193–196.
21 Waller DA: Thoracoscopy in management of postpneumonic pleural infections. Curr Opin Pulm Med 2008;4:323–326.
22 Kern L, Robert J, Brutsche M: Management of parapneumonic effusion and empyema: medical thoracoscopy and surgical approach. Respiration 2011;82:193–196.
23 Cameron R, Davies HR: Intra-pleural fibrinolytic therapy versus conservative management in the treatment of adult parapneumonic effusions and empyema. Cochrane Database Syst Rev 2008;16:CD002312, review.
24 Bouros D, Schiza S, Tzanakis N, Chalkiadakis G, Drositis J, Siafakas N: Intrapleural urokinase versus normal saline in the treatment of complicated parapneumonic effusions and empyema: a randomized, double-blind study. Am J Respir Crit Care Med 1999;159:37–42.