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Early Video-Assisted Thoracic Surgery for Primary Spontaneous Hemopneumothorax

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Abstract
Introduction: Primary spontaneous hemopneumothorax (PSHP) is a rare surgical emergency. The aim of this study was to compare the previous strategy of tube thoracostomy followed by thoracotomy when complications developed with early video-assisted thoracic surgery (VATS) for PSHP.
Methods: Between November 1989 and May 2005, a total of 24 consecutive patients with PSHP were retrospectively reviewed. Before January 2000, there were 13 patients who were subjected to the treatment strategy of initial tube thoracostomy and underwent operation if the condition deteriorated or later complications occurred (group T). Under this strategy, all of these patients later required operations. After January 2000, another 11 patients were treated with VATS as soon as their condition stabilized after tube thoracostomy and resuscitation (group V). The data for the two groups were compared: sex, age, involved side, initial heart rate (HR) and mean blood pressure (BP), initial hemoglobin (Hb), preoperative blood loss, operating time, amount of blood transfusion, period of chest tube drainage (POD), length of hospital stay (LOS), complications, and length of follow-up.
Results: The sex, age, involved side, and the initial HR, BP, and Hb of the two groups were similar. The patients of group V had a significantly longer operating time [group V, 111 minutes (mean); group T, 85 minutes, $P = 0.002$]; less preoperative blood loss (group V, 946 ml; group T, 1687 ml, $P = 0.003$); less blood transfusion (group V, 465 ml; group T, 1044 ml, $P = 0.002$); shorter POD (group V, 4 days; group T, 7 days, $P = 0.011$); and shorter LOS (group V, 5 days; group T, 10 days, $P = 0.002$). No mortality or recurrence was noted in the entire series.
Conclusions: Our study suggests that surgery should be undertaken for PSHP as soon as possible after the clinical condition has stabilized. Under this strategy, VATS is an acceptable approach. It allows a shorter hospital stay and is exempt from unnecessary blood transfusion. Later complications, such as empyema and impaired lung reexpansion, can also be avoided.

The reported incidence of primary spontaneous hemopneumothorax (PSHP) is 1% to 12% of all cases of spontaneous pneumothorax.[1] Although the mortality of this rare disorder may not be high, nonoperative complications and the appropriate delay until surgical intervention are of great concern for clinicians.

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The guidelines for treating PSHP have not yet been established, and there are still some issues about the ideal timing of surgical intervention. As per most reports in the literature, patients with PSHP have been managed with tube thoracostomy initially; however, most of them ultimately underwent surgery for one of the following conditions: initial profuse blood loss, reappearance of an unstable condition after resuscitation, or later complications such as a persistent air leak, reactive pleural effusion, or clot empyema.[1–4] Under emergent or complicated circumstances, standard thoracotomy was still a safe procedure.[5]

Before January 2000, patients with PSHP in our hospital were managed by the above strategy and had similar experiences. Because video-assisted thoracic surgery (VATS) had become well developed and accepted universally, its use was initiated at our institution in 1992. Up to January 2000, more than 2000 VATS procedures had been performed in our hospital, and it has become a familiar technique for our surgical team. With the reports of VATS being used for PSHP,[1–4] an earlier and more aggressive approach (i.e., early VATS in patients in stable condition after tube thoracostomy and resuscitation) has been employed in our institution since January 2000. In this study, we compared the previous strategy with our 6-year experience of early VATS for PSHP to determine if the later approach is a better alternative.

MATERIALS AND METHODS

The time between November 1989 and May 2005 was divided into two periods because of the use of different surgical strategies. Before January 2000, the patients in our hospital were managed with initial tube thoracostomy or subsequent thoracotomy, or both (group T). Since January 2000, as a consequence of three factors—our experience with VATS of more than 250 procedures per year for 8 years, inspiration from the reports in other centers,[1–4] and a review of the previous strategy (group T)—we performed VATS in patients with PSHP within 24 hours of admission, as soon as the condition of the patients was stabilized after resuscitation (group V).

Altogether, 24 consecutive patients (1 female patient, 23 male patients) with a mean age of 23 years (95% CI 20–26 years) were reviewed retrospectively. None of them had had an operation, a history of trauma, or a systemic or congenital disease. Four patients had a history of smoking. Two patients had a history of ipsilateral spontaneous pneumothorax and underwent tube thoracostomy alone. The diagnosis of PSHP was based on the clinical presentation, chest radiography, and subsequent tube thoracostomy. Tube thoracostomy was initiated in all patients to relieve dyspnea and evacuate blood. Most of the patients had symptoms of chest pain initially, dyspnea, and dizziness. The immediate chest roentgenogram usually showed mild scoliosis because of chest pain, pneumothorax, and an air-fluid level in the pleural space with or without mediastinal shift. These patients were resuscitated with intravenous fluid at first or blood transfusion if necessary. Supplemental oxygen was applied in all patients.

There was no use of computed tomography in these patients except in two patients with later complications in group T and one with a postoperative complication in group V.

Initial Tube Thoracostomy and Subsequent Thoracotomy (Group T) (November 1989 to January 2000)

Data for 13 patients in group T were collected. On arrival at the emergency department, the mean HR was 98 beats per minute (bpm) (95% CI 84–113 bpm), and the mean BP was 84 mmHg (95% CI 77–92 mmHg). After tube thoracostomy, fluid resuscitation or blood transfusions (or both) were instituted, operations were performed if one or more of the following criteria were met: (1) hemodynamic instability after disease onset; (2) persistent chest tube blood drainage > 100 ml/hr for 6 hours; and (3) persistent air leakage beyond 7 days or failure of lung reexpansion.[6] Two patients had initial profuse blood loss with worsening hemodynamics at all times (1600 and 1400 ml, respectively) despite fluid and blood transfusion in the emergency department. Emergency thoracotomy was performed 3 and 4 hours after admission, respectively. The other 11 patients returned to a more stable condition after medical resuscitation. However, 9 of the 11 experienced stable condition of short duration (25 hours, 95% CI 15–36 hours) after medical resuscitation but relapsed because of later persistent blood drainage; they required an emergency operation. The remaining two stable patients eventually underwent thoracotomy owing to a persistent air leak for more than 7 days in one and failure of lung reexpansion due to a clotted hemithorax in the other. In brief, all patients in this group ultimately underwent surgery, in 11 cases due to unstable hemodynamics and in 2 cases due to later complications.

Early VATS after Tube Thoracostomy (Group V) (January 2000 to May 2005)

The data for 11 patients in group V were collected. On arrival at the emergency department, the mean HR was 99 bpm (95% CI 92–106 bpm), and the mean BP was 79 mmHg (95% CI 72–85 mmHg). Two patients experienced significant hypovolemia before operation (episodes of systolic BP < 90 mmHg during resuscitation), but both of the patients were resuscitated to a stable condition after intravenous fluid and blood transfusion. VATS was performed as soon as the patients became stable. Unlike the patients in group T, all patients in group V were hemodynamically stable before the VATS.

Surgical Techniques

Open Thoracotomy

Under general anesthesia with univent tracheal intubation (Fuji Systems, Tokyo, Japan), in decubitus position the patients underwent exploratory thoracotomy with a lateral incision through the fifth intercostal space. Any blood clots and fresh blood were aspirated, and the visible bleeding point was ligated or cauterized. The bleb formation in the upper lobe was excised with conventional TA-type staplers (AutoSuture Company Division, United States Surgical Corporation, Norwalk, CT, USA). Mechanical pleurodesis was performed. For the patients with persistent air leak, the sites of leakage were identified and resected with staplers. For patients with clotted hemothorax, decortication of necrotic or fibrotic tissue and mechanical pleurodesis were performed. The lung was routinely inflated after the procedure to make sure that it was well expanded, and a chest tube was inserted.

Video-Assisted Thoracic Surgery

Under general anesthesia with univent tracheal intubation for one-lung ventilation, the patient was prepared as for thoracotomy. The procedure was performed using three ports, with the initial trocar positioned at the chest tube wound. A 30-degree camera was inserted to allow visualization and placement of two 10-mm working ports on both sides of the trocar. The blood was first aspirated. Active oozing from torn adhesions of pleura or a ruptured vascularized bulla was coagulated directly by an endoprobe. The ruptured visceral bulla was grasped with an endograsper and excised with an endoscopic articulating linear stapler (Endopath; Johnson & Johnson, Cincinnati, OH, USA). Mechanical pleurodesis was then performed. Warm saline was instilled to check for air leak. One chest tube was placed under endoscopic vision.

After operation, all patients were transferred to the intensive care unit (ICU) for overnight observation. The chest tube was removed when drainage was minimal and the lungs were fully reexpanded.

Data Collection, Abbreviations, and Acronyms

The interval between the beginning of symptoms and arrival at the emergency department (I_{SER}) was recorded in days. The interval between arrival at the emergency department to the surgical intervention (I_{ERSx}) was recorded in hours. The mean heart rate (HR) measured on arrival at the emergency department (initial HR) was recorded in beats per minute (bpm). The mean blood pressure (BP) measured on arrival at the emergency department was regarded as the initial BP. The hemoglobin (Hb) level of blood drawn in the emergency department was regarded as the initial Hb. Before operation, the amount of blood drained from the chest tube was recorded to the preoperative blood loss. The data of two groups, including sex, involved side, I_{SER}, initial HR and BP, initial Hb, initial amount of blood drained, I_{ERSx}, operating time, amount of blood transfusion, period of chest tube drainage (POD), length of hospital stay (LOS), complications, and follow-up period were reviewed.

Statistical Analysis

Results are expressed as the mean with 95% confidence interval (CI). Statistical analysis was performed using the Mann-Whitney nonparametric U-test. The χ^2 test was used to compare proportions. All P values reported are two-sided, and $P < 0.05$ denotes statistical significance. SPSS for Windows version 12.0 was used for all statistics.

RESULTS

Group T

The T group included 13 males with a mean age of 25 years (95% CI 21–30 years). There were eight left lungs and five right lungs. The I_{SER} was 2 days (95% CI 1–3 days). Initial Hb was 13 g/dl (95% CI 13–14 g/dl). All chest tubes were inserted in the emergency department, and these patients underwent resuscitation with intravenous fluid and blood transfusion if necessary. However, a second tube thoracostomy was performed in three patients because of poor drainage of the chest tube. Operations were performed, on average, 46 hours (95%

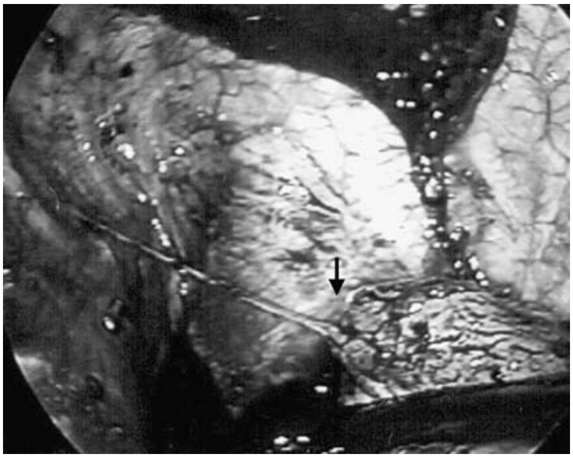

Figure 1. Thoracoscopic view of an active bleeder from a torn adhesive band (arrow).

CI 11–81 hours) after admission, with an average time of 85 minutes (95% CI 71–99 minutes). The bullae were at the apex or confined to the upper lobe in nine patients, and multiple lobes were involved in one patient. Three patients had only fibrotic scarring at the apex of the upper lobe without significant bullae. The cause of bleeding was torn adhesion of the pleura (n = 5), a ruptured vascularized bulla (n = 1) and a torn apical aberrant vessel (n = 1). However, no obvious bleeder was found in six patients. The mean blood transfusion was 1044 ml (95% CI 862–1228 ml). The total POD was 7 days (95% CI 4–11 days), and LOS was 10 days (95% CI 7–13 days).

Group V

There were 10 males and one female in group V, with a mean age of 22 years (95% CI 18–26 years). The left lung was involved in seven patients and the right lung in four patients. The I_{SER} was 2 days (95% CI 1–3 days). The initial Hb was 13 g/dl (95% CI 12–14 g/dl). The amount of preoperative blood drained was 946 ml (95% CI 715–1175 ml). The I_{ERSx} was 9 hours (95% CI 5–12 hours). The mean operating time was 111 minutes (95% CI 102–120 minutes), and none was converted to an open procedure. The bullae were at the apex or confined to the upper lobe in nine patients; multiple lobes were involved in one patient. Only one patient had fibrotic scarring at the apex of the upper lobe without significant bullae. The cause of bleeding was torn adhesion of the pleura (n = 4) (Fig. 1) a ruptured vascularized bulla (n = 2), and a torn apical aberrant vessel (n = 1). However, no obvious bleeder was found in four patients.

Postoperatively, only one patient of group V had a prolonged air leak for more than 7 days. He required a second VATS. No obvious air leak was found, and a more extensive pleurodesis was performed on the patient. He was finally discharged with full recovery 3 days later. The postoperative course of the remaining 10 patients of group V was uneventful. The mean blood transfusion was 465 ml (95% CI 249–682 ml).Total POD was 4 days (95% CI 2–5 days), and LOS was 5 days (95% CI 3–7 days).

Comparison of Groups T and V and Follow-up

All patients were followed up with chest radiography in the outpatient clinic (Table 1). Neither mortality nor recurrence was found (group T: 150 months, 95% CI 131–168 months; group V: 36 months, 95% CI 24–47 months). The sex, age, involved side, I_{SER}, and the initial HR, BP, and Hb were not significantly different ($P = 0.268$, 0.207, 0.625, 0.649, 0.820, 0.324, and 0.369, respectively). Furthermore, preoperative blood loss, I_{ERSx}, amount of blood transfusion, postoperative POD, postoperative LOS, total POD, and LOS were significantly less in group V ($P = 0.003$, 0.001, 0.002, 0.030, 0.035, 0.011, and 0.002, respectively). The VATS was more time-consuming than open thoracotomy ($P = 0.002$).

DISCUSSION

The incidence of PSHP is rare, and most reports are of Asian origin.[1,2,4,6–11] The diagnosis of PSHP should be based on the clinical presentation, radiography, and tube thoracostomy. More than 400 ml of initial blood drained was regarded as PSHP according to the criteria described by Ohmori and associates.[7] Unlike other spontaneous hemopneumothorax caused by malignancy, congenital cystic adenomatoid malformation, or hemophilia,[12–14] the mechanisms of bleeding in PSHP are well described. PSHP most commonly results from torn adhesions of the pleura,[1,3] rupture of vascularized bullae,[6] and torn congenital aberrant vessels between the parietal pleura and bulla.[2,8] In the present series, the source of bleeding was identified in 61% of patients during operation. Although nearly half had no obvious focus of bleeding, the bleeding problems were unrelated to chest tube insertion. Some authors have stated that the peculiarity of PSHP is a sustained hemorrhage resulting from negative intrapleural pressure and an abnormal structure of the ruptured vessel.[1]

We believe that the basic principles of PSHP management are pleural air evacuation, hemostasis, complete drainage of blood, and reexpansion of the lung. In the past, most of the reported studies managed PSHP

Table 1.
Comparison of management of PSHP

Parameter	Group T (n = 13) (95% CI)	Group V (n = 11) (95% CI)	*P* Value
Left: right (no.)	8:5	7:4	0.625
Average age (years)	25 (21–30)	22 (18–26)	0.207
I_{SER} (days)	2 (1–3)	2 (1–3)	0.649
Initial HR (bpm)	98 (84–113)	99 (92–106)	0.820
Initial BP (mmHg)	84 (77–92)	79 (72–85)	0.324
Initial Hb (g/dl)	13 (13–14)	13 (12–14)	0.369
I_{ERSx} (hours)	46 (11–81)	9 (5–12)	0.001
Preoperative blood loss (ml)	1687 (1348–2026)	946 (715–1175)	0.003
Operating time (minute)	85 (71–99)	111 (102–120)	0.002
Blood transfusion (ml)	1044 (862–1228)	465 (249–682)	0.002
Postoperative POD (day)	5 (3–7)	3 (2–5)	0.030
Postoperative LOS (day)	7 (5–9)	5 (3–7)	0.035
Total POD (days)	7 (4–11)	4 (2–5)	0.011
LOS (days)	10 (7–13)	5 (3–7)	0.002
Follow-up (months)	150 (131–168)	36 (24–47)	0.001

I_{ESRx}: time interval between the arrival at the emergency department to surgical intervention; HR: heart rate; BP: blood pressure; Hb: hemoglobin; POD: period of drainage; LOS: length of stay in hospital.

with conservative methods (i.e., tube thoracostomy) to release tension, resuscitation, and operation if the condition deteriorates or complications occur, which were similar to the guidelines for traumatic hemothorax.[5,6] Generally, fewer than 5% of patients with traumatic hemothorax require operative management.[15,16] In contrast, most patients with PSHP require surgical intervention eventually.[1,5,6,9] Some studies have concluded that conservative treatment is adequate if bleeding persists less than 24 hours after chest tube insertion.[17,18] All of our patients encountered before January 2000 ultimately required surgery. The previous strategy for PSHP seems inadequate, and a more aggressive approach should be considered.

In the past, there were three general presentations of patients with PSHP requiring operations. In the first scenario,[3,10] the most accepted treatment for uncontrolled bleeding or a refractory deteriorating condition is prompt, immediate surgery (2 of 13 patients in group T). In the second and most common presentation,[1,5,9,19,20] the hemodynamics become stable temporarily after medical resuscitation (7 of 13 patients in group T). The surgeons often postpone surgical intervention at that moment and consider the disease to be under control; however, once the stable condition deteriorates, emergency thoracotomy is usually performed in a patient with an unstable medical condition and the doctors are operating under pressure. Thus, we should consider the question: "Why do we put these patients in a potential hazardous condition?" This is a difficult issue for thoracic surgeons to confront. No one knows when the intrathoracic bleeding will stop. Moreover, the chest tube might be functioning poorly; and if it should malfunction, repeat tube thoracostomy is often necessary. In the third and final clinical presentation, even if hemostasis is achieved with medical therapy alone, a reactive fluid collection, clot empyema, or persistent air leak (which occurs in 20% to 30% of patients[1,5,9]) impairs lung reexpansion and may lead to further decortication or pneumorrhaphy during the hospitalization (2 of 13 patients in group T).

In the literature, the incidence of patients with significant hypovolemia (systolic BP < 90 mmHg) varies between 30% and 46%.[1,4–6] In this study, 38% of these patients experienced significant hypovolemia before operation (seven patients in group T and two in group V). However, the high incidence of significant hypovolemia in patients with PSHP might be reduced if these patients undergo surgical intervention earlier. Although there was no significant difference in the initial Hb between the two groups ($P = 0.369$), the higher Hb level in group T may be attributed to hemoconcentration because of more depletion of the intravascular volume. Recent studies have been concerned with the importance of early operation and aggressive treatment of PSHP as soon as the patients can be resuscitated to a stable condition.[4,5,9] Early operation avoids unnecessary excessive bleeding and transfusion and facilitates the removal of blood clots. Operations can also be performed more safely before the condition deteriorates or complications occur.

Traditional surgical intervention is axillary or lateral thoracotomy. Kakaris *et al.*[5] suggested that thoracotomy is safer and more appropriate in cases of shock or in chronic cases where fibrin has been organized. However, thoracotomy causes significant postoperative pain and a large, noticeable scar. With the advances in endoscopic techniques and equipment, VATS has been used for PSHP and has been reported.[4,6,9–11] We started performing VATS in 1992, with more than 2000 VATS procedures having been undertaken up to January 2000. Because of the excellent cosmetic appearance and minimal invasiveness of VATS, it may be considered as an aggressive therapy for patients with PSHP. In this study VATS was performed in patients with stable status and in whom the strategy might prevent a relapse to an unstable clinical condition or later complications. Early VATS was more time-consuming because we spent some time removing blood clots. However, the procedure could be performed in a leisurely and attentive manner because these patients were more likely to be stable after resuscitation.

One patient of group V had an early postoperative complication of persistent air leak. This complication was solved by a second VATS. Although the number of patients in this series is small, none had a recurrence of spontaneous pneumothorax or PSHP in either group. Also the mean follow-up period of group V was not short (36 months; 95% CI 24–47 months). To our knowledge, recurrence of PSHP has never been reported, no matter what procedure was chosen.[1,5,6,9] However, according to a review study, the recurrence rates for patients with primary spontaneous pneumothorax treated by drainage only, conventional thoracotomy, or VATS was 30.0%, 1.5%, or 4.0%, respectively.[21] The rare recurrence of PSHP might be due to good pleurodesis and dense adhesions of inflamed pleura caused by temporary oozing in the pleural cavity.

In general, the patients treated by VATS are mobilized faster and have a shorter postoperative POD and LOS.[9,22] In the current study, the same results of shorter postoperative POD and LOS were observed in group V ($P = 0.030$ and 0.035, respectively). We also found there was an approximately 5-day increase of LOS in group T ($P = 0.002$). Prolonged I_{ERSx} ($P = 0.001$) and postoperative POD ($P = 0.030$) accounted for the preponderance of prolonged LOS in group T.

A number of drawbacks in this study have been identified. First, we regarded the blood drained from the chest tube as the total blood loss before operation, but actual blood loss was sometimes disproportionate to drainage from the chest tube. Second, the time to remove the tube was somewhat subjective, and the decision may be different in various institutions. Third, the current study of a small number of patients examined the practice at only a single facility and may not be reflective of all institutions. A multicenter randomized trial comparing the two treatment modalities is necessary.

We know that a comparison of two treatment strategies is not easy, as the disease severities and parameters of the two populations were not fully comparable. However, with the trend toward minimally invasive surgery nowadays, we were able to evaluate the possible application and the advantages of early VATS for PSHP. Some doctors would be concerned about possible overtreatment of early stage disease, which can occasionally be resolved by simple tube thoracostomy. However, we think they are overworried. Even when bleeding has subsided, we can evacuate the residual blood clot and repair the bulla directly through a less invasive technique. Later complications, such as clot empyema and restrictive lung disease, can be prevented. Moreover, as the present series revealed, early surgical intervention has better results.

CONCLUSIONS

We affirmed that early operation is a feasible strategy for PSHP because conservative treatment often leads to the need for an operation in a patient in risky condition or a surgical intervention due to later complications. VATS is an acceptable surgical approach under this strategy. If PSHP is diagnosed, early aggressive VATS should be performed as soon as the patient attains a stable condition after resuscitation. Compared with traditional strategies, early operation by VATS can avoid the evolution of possible life-threatening conditions, resulting in less blood loss, a shorter hospital stay, and a shorter period of chest tube drainage.

REFERENCES

1. Tatebe S, Kanazawa H, Yamazaki Y, *et al.* Spontaneous hemopneumothorax. Ann Thorac Surg 1996;62:1011–1015.
2. Muraguchi T, Tsukioka K, Hirata S, *et al.* Spontaneous hemopneumothorax with aberrant vessels found to be the source of bleeding: report of two cases. Surg Today 1993;23:1119–1123.
3. Sharpe DA, Dixon K, Moghissi K. Spontaneous haemopneumothorax: a surgical emergency. Eur Respir J 1995;8:1611–1612.
4. Hsu NY, Hsieh MJ, Liu HP, *et al.* Video-assisted thoracoscopic surgery for spontaneous hemopneumothorax. World J Surg 1998;22:23–27.

5. Kakaris S, Athanassiadi K, Vassilikos K, *et al.* Spontaneous hemopneumothorax: a rare but life-threatening entity. Eur J Cardiothorac Surg 2004;25:856–858.
6. Wu YC, Lu MS, Yeh CH, *et al.* Justifying video-assisted thoracoscopic surgery for spontaneous hemopneumothorax. Chest 2002;122:1844–1847.
7. Ohmori K, Ohata M, Narata M, *et al.* 28 Cases of spontaneous hemopneumothorax. J Jpn Assoc Thorac Surg 1988;36:1059–1064.
8. Kurimoto Y, Hatamoto K, Hase M, *et al.* Aberrant artery as a source of bleeding in spontaneous hemopneumothorax. Am J Emerg Med 2001;19:326–327.
9. Hwong TM, Ng CS, Lee TW, *et al.* Video-assisted thoracoscopic surgery for primary spontaneous hemopneumothorax. Eur J Cardiothorac Surg 2004;26:893–896.
10. Chiang WC, Chen WJ, Chang KJ, *et al.* Spontaneous hemopneumothorax: an overlooked life-threatening condition. Am J Emerg Med 2003;21:343–345.
11. Tatebe S, Yoshiya K, Yamaguchi A. Video-assisted thoracoscopic surgery for spontaneous hemopneumothorax. Surg Laparosc Endosc 1997;7:113–115.
12. Chou SH, Cheng YJ, Kao EL, *et al.* Spontaneous haemothorax: an unusual presentation of primary lung cancer. Thorax 1993;48:1185–1186.
13. Lee SC, Cheng YL, Yu CP. Haemopneumothorax from congenital cystic adenomatoid malformation in a cryptorchidism patient. Eur Respir J 2000;15:430–432.
14. Martinez FJ, Villanueva AG, Pickering R, *et al.* Spontaneous hemothorax: report of 6 cases and review of the literature. Medicine 1992;71:354–368.
15. Liman ST, Kuzucu A, Tastepe AI, *et al.* Chest injury due to blunt trauma. Eur J Cardiothorac Surg 2003;23:374–378.
16. Galan G, Penalver JC, Paris F, *et al.* Blunt chest injuries in 1696 patients. Eur J Cardiothorac Surg 1992;6:284–287.
17. De Perrot M, Deleaval J, Robert J, *et al.* Spontaneous hemopneumothorax—results of conservative treatment. Swiss Surg 2000;6:62–64.
18. Haciibrahimoglu G, Cansever L, Kocaturk CI, *et al.* Spontaneous hemopneumothorax: is conservative treatment enough? Thorac Cardiovasc Surg 2005;53:240–242.
19. Hentel K, Brill PW, Winchester P. Spontaneous hemopneumothorax. Pediatr Radiol 2002;32:457–459.
20. Hart SR, Willis C, Thorn A, *et al.* Spontaneous haemopneumothorax: are guidelines overdue? Emerg Med J 2002;19:273–274.
21. Schramel FM, Postmus PE, Vanderschueren RG. Current aspects of spontaneous pneumothorax. Eur Respir J 1997;10:1372–1379.
22. Waller DA, Forty J, Morritt GN. Video-assisted thoracoscopic surgery versus thoracotomy for spontaneous pneumothorax. Ann Thorac Surg 1994;58:372–377.