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Video-assisted thoracoscopic surgery (VATS) for the treatment of hepatic hydrothorax: report of twelve cases

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Abstract: Background: Hepatic hydrothorax is defined as a significant pleural effusion in patients with liver cirrhosis and without underlying cardiopulmonary diseases. Treatment of hepatic hydrothorax remains a challenge at present. Methods: Herein we share our experiences in the treatment of 12 patients with hepatic hydrothorax by video-assisted thoracoscopic surgery (VATS). Repair of the diaphragmatic defects, or pleurodesis by focal pleurectomy, talc spray, mechanical abrasion, electro-cauterization or injection was administered intraoperatively, and tetracycline intrapleural injection was used postoperatively for patients with prolonged (>7 d) high-output (>300 ml/d) pleural effusion. Results: Out of the 12 patients, 8 (67%) had uneventful postoperative course and did not require tube for drainage more than 3 months after discharge. In 4 (33%) patients the pleural effusion still recurred after discharge due to end-stage cirrhosis with massive ascites. Conclusion: We conclude that the repair of the diaphragmatic defect and pleurodesis through VATS could be an alternative of transjugular intrahepatic portal systemic shunt (TIPS) or a bridge to liver transplantation for patients with refractory hepatic hydrothorax. Pleurodesis with electrocauterization can be an alternative therapy if talc is unavailable.

Key words: Hepatic hydrothorax, Video-assisted thoracoscopic surgery (VATS), Pleurodesis
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INTRODUCTION

Patients with portal hypertension from liver cirrhosis develop accumulation of fluid, which usually manifests as ascites or edema. Fluid could also be accumulated in the pleural space, resulting in hepatic hydrothorax, which usually occurs on the right side in approximately 5%~10% of cirrhotic patients with ascites (Cárdenas *et al*., 2004; Bozkurt *et al*., 2005). Treatments of hepatic hydrothorax include sodium restriction, diuretics, and thoracocentesis (Lazaridis *et al*., 1999). More aggressive procedures, such as intravascular or surgical porto-systemic shunts, pleurodesis or repair of the diaphragmatic defects, and liver transplantation, are usually reserved for patients refractory to conservative treatments (Mouroux *et al*., 1996). Herein we report the treatments of patients with refractory hepatic hydrothorax through video-assisted thoracoscopic surgery (VATS).

PATIENTS AND METHODS

From June, 1995 to May, 2008, over 2000 patients with various intrathoracic diseases had undergone VATS procedures, including 12 hepatic hydrothorax patients who were refractory to medical control or had repeated thoracentesis. The Child-Pugh class and etiology of cirrhosis were documented in all the 12 patients. All the patients had coexisting ascites, which failed to respond to fluid restriction, diuretics, at least one time of thoracentesis, or other modes of medical therapy. Clinical presentations of these patients were similar to those with refractory ascites, but

shortness of breath, chest tightness and other related respiratory symptoms were additional problems. Pleural effusions from other causes, such as parapneumonic empyemas, chylothorax, tuberculosis, or malignancy, were excluded by analysis of plural fluid from diagnostic thoracentesis. Chest X-ray and computed tomography (CT) revealed right side, but without or only little left side, pleural effusion in all the 12 patients. Fig.3 displays the demographic information and previous strategies of the patients. Infection in the pleural fluid was detected in three patients, which was regarded as spontaneous bacterial empyema (SBEM) and should be differentiated from parapneumonic empyema.

VATS was performed in these patients with refractory hepatic hydrothorax and willing to undergo this procedure. Under general anesthesia and double lumen endotracheal intubation, patients were placed in a standard lateral decubitus position. Two ports (one for scope insertion and the other for working) were designed for VATS procedures (Fig.1). A 10-mm rigid thoracoscope with a 30-degree lens was used. Firstly the pleural effusion was drained and the diaphragmatic surface was carefully inspected. Visible defects were found in only two of our patients (Fig.1), and these defects were repaired by endoscopic suturing directly or with Teflon pledget buttressing. Talc spray was used as the method of intraoperative pleurodesis in three patients. Since it became illegal to use talc in human body in Taiwan since 2000 due to its potential harmful and carcinogenic effects, we used electrocauterization in combination with mechanical abrasion for intraoperative pleurodesis. About 50~60 MHz spray mode was used for electrocauterization. The cauterization was applied most densely on the diaphragmatic surface and the lower parietal pleura (Fig.2). The upper parietal pleura was also applied but with less dense electrocauterization spots than the lower parts. We used only small mechanical abrasion, instead of electrocauterization, over some areas of mediastinal pleura to avoid the risk of massive bleeding from great vessel ruptures. Once the above procedures were completed, a right angle chest tube was placed on the diaphragmatic surface. Tetracycline 4 amps intrapleural injection would be administered for additional pleurodesis if large amount (>300 ml/d) of pleural fluid drainage persisted over 7 d postoperatively.

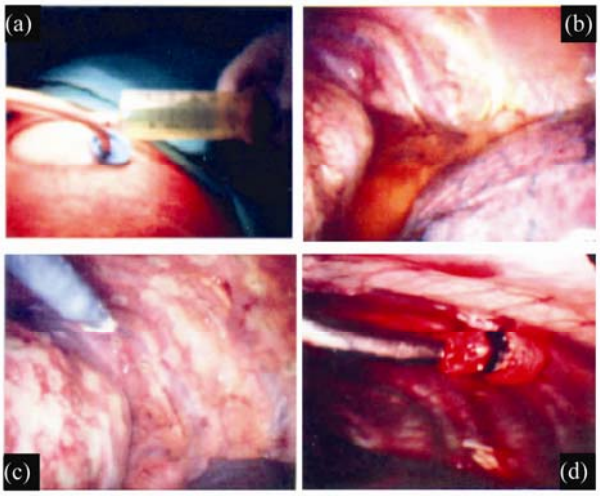

Fig.1 VATS for hepatic hydrothorax. (a) Sampling the fluid; (b) Fluid re-appeared from the costo-phrenic angle; (c) Electrocauterization for pleurodesis especially on the lower chest wall and diaphragmatic surface; (d) Pleurodesis by mechanical abrasion for the other pleural surfaces

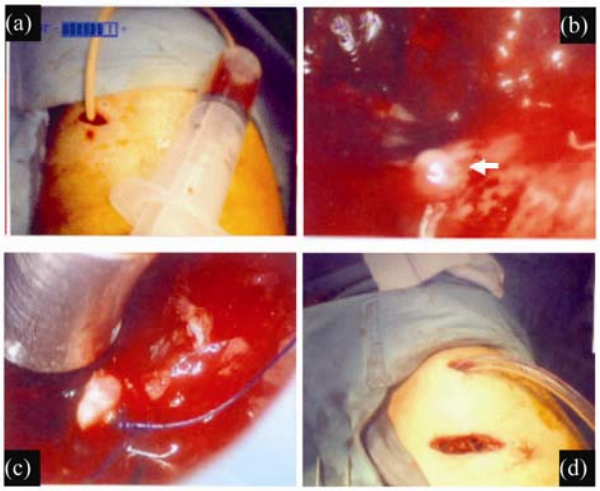

Fig.2 VATS for hepatic hydrothorax. Fluid was sampled (a) and a perforating hole with active fluid leakage (arrow) was noted over the diaphragmatic surface (b). This hole was repaired (c) through small port or incision (d)

The outcomes of these patients during the follow-up period were confirmed by chart review or telephone interview. If patients passed away, information was obtained from families or caregivers. Successful pleurodesis was defined, as reported in previous literature (Cerfolio and Bryant, 2006), by significant symptomatic improvement and being without fluid reaccumulation on the chest X-ray for at least 3 months of follow-up.

RESULTS

The VATS procedures, postoperative treatments, and patient outcomes are displayed in Fig.3. The mean number of days that the chest tube remained after initial VATS was 14.6 (from 5 to 29) days. Out of the 12 patients, 8 (67%) responded favorably to VATS procedures within the first 3 months of follow-up, and still maintained on fluid restriction and diuretics treatment, but thoracentesis was not required. Additional chemical pleurodesis with tetracycline 4 amps injection from the chest tube was done on 4 of the 8 patients because of prolonged (>7 d) and large amount (>300 ml/d) of fluid drainage postoperatively. Three of these 8 early successful patients developed fluid re-accumulation on 92, 103, and 132 d, and these symptoms were controlled by pleurodesis through re-do VATS (n=1) or tube thoracostomy (n=2). Four of these eight patients with early favorable outcomes eventually died of progressive liver disease during the follow-up period (from 9 to 23 months). The remaining 4 of them were still alive during the follow-up period from 3 to 36 months. Four out of the 12 patients with unfavorable early outcomes manifested as recurrent hydrothorax, accompanied by massive ascites within first 3 months. Two of these 4 patients underwent repeated pleurodesis through tube thoracostomy and the remaining 2 took VATS. However, 2 of the 4 still died of progressive liver disease and the remaining 2 also suffered from end-stage hepatic dysfunction. None of the 4 patients underwent liver transplantation due to limited live or cadaver donor resources.

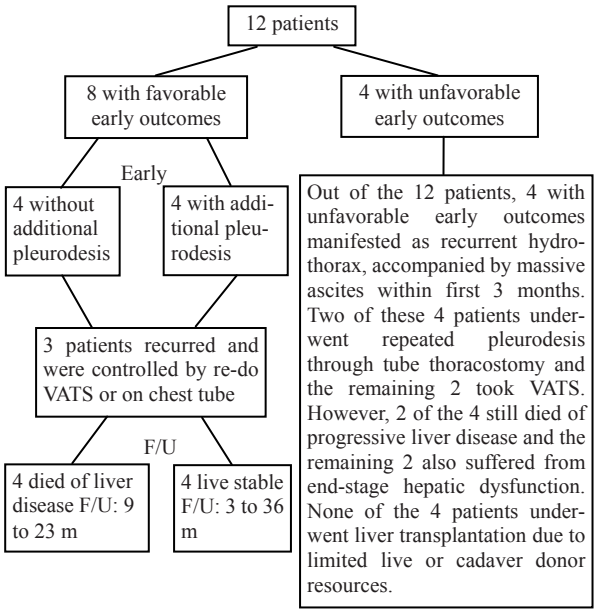

Fig.3 Demographic information and previous strategies of the 12 patients

DISCUSSION

Hepatic hydrothorax is defined as a significant pleural effusion, usually more than 500 ml, resulting from cirrhosis of the liver. Pleural effusion from other causes, such as hemodynamic or inflammatory diseases, should be excluded before establishing this diagnosis (Cárdenas *et al*., 2004). Hepatic hydrothorax occurred in around 4%~10% of patients with liver cirrhosis, and around 85% of them were right-sided (Lazaridis *et al*., 1999; Strauss *et al*., 1994). The movement of fluid from the peritoneal space into the pleural space could be through congenital or acquired diaphragmatic defects, as well as the diaphragmatic lymphatics (Alberts *et al*., 1991), circulation of peritoneal fluid (Zocchi, 2002), or oncotic pressure differences between the right and left diaphragms (Kinasewitz and Keddissi, 2003). The diaphragmatic "openings" can be classified into four types (Huang *et al*., 2005). Type 1 is described as no openings, type 2 is small blebs, type 3 is small fenestrations, and type 4 is multiple gaps at the diaphragm. Type 3 is the most common type of the diaphragmatic openings in these 12 patients reviewed. However, in our series only 2 patients (16.7%) were found to have openings, similar to the findings of other larger case studies (Cerfolio and Bryant, 2006), Ferrante *et al*.(2002) used thoracoscope to check the defect on the diaphragmatic surface but failed to detect any visible holes in all 15 patients studied.

Hepatic hydrothorax can be suspected in a patient with advanced cirrhosis presenting with a unilateral, mostly on the right side, pleural effusion. Patients might present with various degrees of related respiratory symptoms, such as shortness of breath or hypoxemia. Diagnostic thoracentesis can confirm the diagnosis or exclude alternative diagnosis, such as chylothorax, empyema, tuberculosis, pancreatitis, or malignancy (Strauss and Boyer, 1997). Pleural fluid from patients with hepatic hydrothorax can be infected, which is known as SBEM, and its occurrence

stands for deteriorating prognosis (Xiol *et al*., 1996). SBEM should be suspected in patients who developed fever, pleuritic pain, encephalopathy or unexplained renal dysfunction. The pleural fluid of SBEM with neutrophils was predominant with positive culture results (Alberts *et al*., 1991). One of our patients developed SBEM postoperatively. No evidence shows the relationship between SBEM and VATS procedure. It was thought that terminal liver cirrhosis with massive ascites and compromised immune function might be the main reason to develop subsequent SBEM.

Initial treatments of patients with hepatic hydrothorax include restriction of sodium intake or diuretics. More invasive procedures such as repeated thoracentesis, continuous positive airway pressure (CPAP), transjugular or surgical porto-systemic shunts, pleurodesis or diaphragmatic repair through VATS or thoracotomy, can be considered for patients refractory to conservative treatments (about 10% of these patients) (Ibi *et al*., 2008). Therapeutic thoracentesis can relieve symptoms for patients with large amount of effusions safely and quickly. However, no more than 2 L of fluid could be removed at one time because it will increase the risk of re-expansion pulmonary edema or hypotension (Lazaridis *et al*., 1999). The other complications of thoracentesis include local pain, pneumothorax, empyema or soft tissue infection, and bleeding. If thoracentesis was required every 2~3 weeks, more aggressive treatment strategies should be considered. Surgical or non-surgical (such as transjugular intrahepatic portal systemic shunt (TIPS)) shunt, a procedure of portal decompression, can effectively decrease the ascites and pleural effusion in 70%~80% of patients with refractory hydrothorax. However, its estimated mortality rate up to 20%~25% on the first 45 d reflected the importance of case selection. Shunt procedure is relatively contraindicated in patients with severe liver dysfunction (Child C or encephalopathy) (Malinchoc *et al*., 2000).

Pleurodesis with talc through VATS or chest tube, or combination of both, can be effective, around 50% to 85% of successful rates in patients with hepatic hydrothorax (Milanez de Campos *et al*., 2000; Cerfolio and Bryant, 2006; Luh and Liu, 2006; Luh *et al*., 2007). Because talc is no longer permitted to be used at human body since 2000 in Taiwan, we used pleural electrocauterization for pleurodesis combined with postoperative minocin pleurodesis for some of our patients and can achieve equivalent results (Chen *et al*., 2008; Hsu *et al*., 2009). The cauterization was applied most densely on the diaphragmatic surface and lower parietal pleura, and also applied on upper parietal pleura, but with less dense electrocauterization spots. We only used little mechanical abrasion, instead of electrocauterization, over some areas of mediastinal pleura to avoid the risk of massive bleeding from great vessels rupture. We use the spray mode of cauterization to reduce injuries in the deeper layer, and thus can reduce the risk of diaphragm perforation.

The most important issue in the treatment of patients with hepatic hydrothorax is to determine whether they can undergo liver transplantation, which is so far the only choice of definitive therapy for severe cases (Roussos *et al*., 2007). The appearance of significant hepatic hydrothorax poses an increased risk for respiratory infections, renal failure, and mortality. It is estimated that nearly a half of patients who have a poor prognosis will die in approximately two years without transplantation (Cárdenas and Arroyo, 2007). From our experiences, treatment failure after VATS pleurodesis is related to the severity of liver dysfunction and the degree of portal hypertension, which will influence the rate of ascites accumulation. For some patients, although the fluid will not re-accumulate in the pleural cavity, the ascites accumulation and hepatic dysfunction still compromise their quality of life. Liver transplantation is usually required for these patients.

In summary, patients with medical refractory hepatic hydrothorax represent a therapeutic challenge. The repairing of the diaphragm and pleurodesis through VATS can be an effective alternative to TIPS and a bridge to liver transplantation. Pleurodesis with electrocauterization can be an alternative therapy if talc is unavailable.

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