Thoracoscopic resection of bulky thymoma assisted with artificial pneumothorax: A report of 19 consecutive cases

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Abstract. The aim of the present study was to examine the feasibility and efficacy of thoracoscopic radical resection of large retrosternal thymoma using artificial pneumothorax. A retrospective analysis was performed on 19 patients with bulky thymoma who underwent thoracoscopic resection using artificial pneumothorax by CO_2 insufflation. The operations were performed with unilateral or bilateral thoracic incisions via single lumen endotracheal intubation and two-lung ventilation. This approach provided excellent exposure of the thoracic cavity and reliable control of the neuro-vascular structures in the anterior mediastinum, which was of vital importance for the extended resection of malignant thymoma. The operation time was 140.0±51.4 min without conversion to thoracotomy or sternotomy. The pathological diagnosis was confirmed by immunohistochemistry, including 5 cases of thymus lipomyoma, 1 case of thymus hyperplasia, 1 case of thymus cyst, 2 cases of type AB thymoma, 4 cases of type B1 thymoma, 4 cases of type B3 thymoma, and 2 cases of thymic carcinoma. Furthermore, there were no complications such as recurrent laryngeal nerve injury, phrenic nerve injury, pulmonary infection or atelectasis, with a hospital stay of 5.0±3.0 days. In conclusion, the thoracoscopic resection of thymoma using artificial pneumothorax is a preferable approach, that may be considered for patients with bulky retrosternal tumors.

Introduction

Thymectomy was considered as the only curative treatment for patients with resectable thymoma (1). Landreneau *et al* introduced video-assisted thoracoscopic surgery (VATS) thymectomy in 1992 (2).

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Double-lumen endotracheal tube (DLET) anesthesia is the routine method for VATS thymectomy, which may frequently result in more complications (3). In rare circumstances, use of the single-lumen endotracheal tube (SLET) is mandatory, such as the translocation of the DLET, structural malformations, and tracheostenosis (4). Double-lung ventilation with SLET intubation potentially offers improved visualization for certain thoracoscopic procedures (5).

In the present study, we retrospectively examined SLET anaesthesia with CO_2 insufflation artificial pneumothorax in VATS thymectomy to determine whether patients benefit from this type of surgery.

Patients and methods

Patients. In total, 19 patients with bulky thymoma underwent thoracoscopic resection assisted with artificial pneumothorax via CO_2 insufflation at the Xuzhou Central Hospital (Jiangsu, China), between January 2014 and April 2015 by the same surgeon. The study was approved by the Institutional Review Board of Xuzhou Central Hospital. Informed consent regarding participation was received from the patients.

Methods. During the procedure, the patients were placed in a supine position with double-lung ventilation. Firstly, the thoracoscopy was placed into the thorax for exploration, and pleural adhesions were separated carefully using an ultrasonic scalpel (Johnson & Johnson, NY, USA). Artificial CO_2 pneumothorax (CO_2 pressure = 8 mmHg) was then established. Three to four ports were made with respect to the location and the size of the lesion determined by CT (Fig. 1). Generally, the thoracoscopic thymectomy was performed following the procedures detailed by other surgeons previously (6). The dissection was initiated with the inferior thymic poles carefully mobilized. Subsequently, the anterior mediastinal tissue was swept along the pericardium and the retrosternum. The innominate vein was located at the junction with the superior vena cava, and dissection continued until the thymic vein was located, which was then doubly clipped. The operation was completed by dissecting directly along the left pleura to avoid injury to the left phrenic nerve. One of the manipulating ports was enlarged appropriately for the extraction of thymus, and a drainage tube was placed unilaterally.

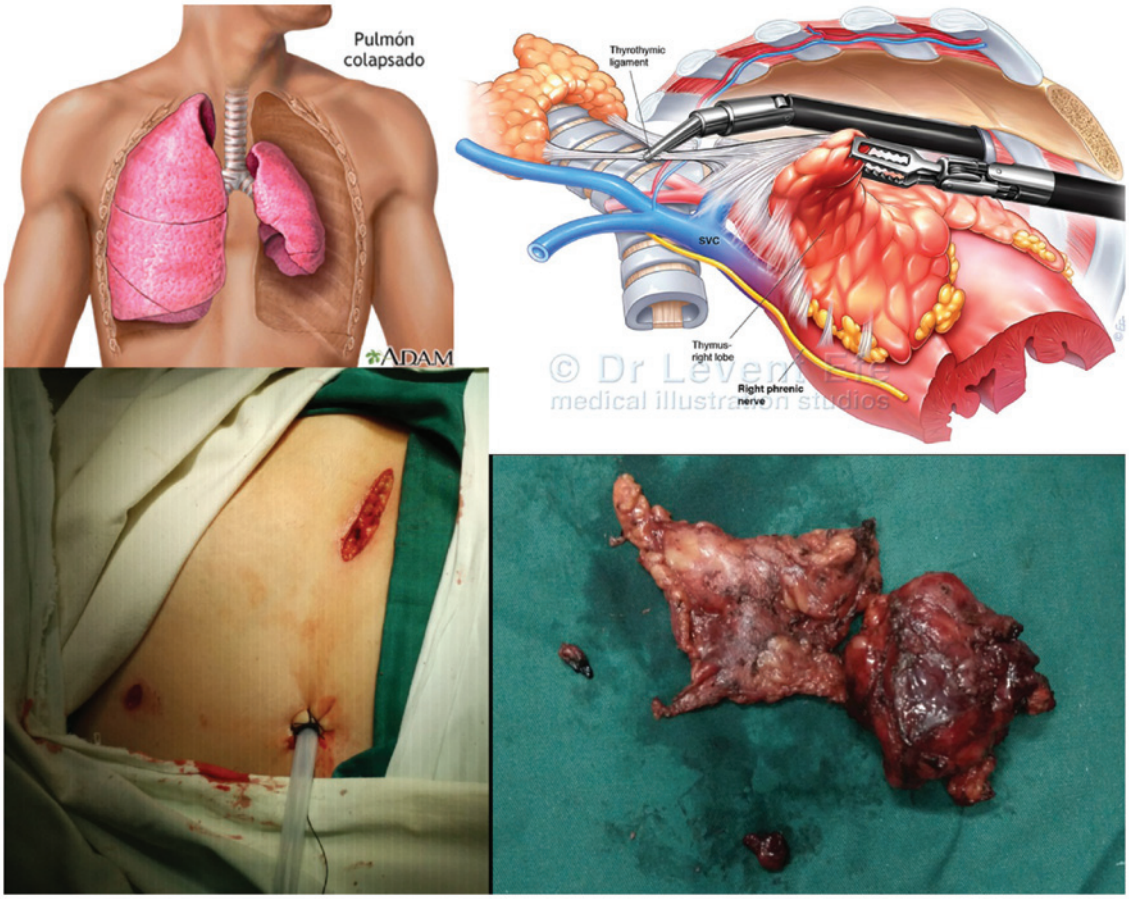

Figure 1. The graphs with CO_2 insufflations during the VATS thymectomy. VATS, video-assisted thoracoscopic surgery.

Results

The operations were performed with unilateral or bilateral thoracic incisions via single-lumen endotracheal intubation and double-lung ventilation. This approach provided excellent exposure of the thoracic cavity and reliable control of the neuro-vascular structures in the anterior mediastinum. This was crucial for the extended resection of malignant thymoma. The operation time was 140.0±51.4 min without conversion to thoracotomy or sternotomy. The pathological diagnosis was confirmed by immunohistochemistry resulting in, 5 cases of thymus lipomyoma, 1 case of thymus hyperplasia, 1 case of thymus cyst, 2 cases of type AB thymoma, 4 cases of type B1 thymoma, 4 cases of type B3 thymoma, and 2 cases of thymic carcinoma. Furthermore, there were no complications such as recurrent laryngeal nerve injury, phrenic nerve injury, pulmonary infection or atelectasis. The patients had a hospital stay of 5.0±3.0 days.

Discussion

The application of VATS thymectomy was extended with advances in techniques. VATS thymectomy is optimal compared with the open approach for early-stage thymoma patients (Masaoka staging I-II), which indicated shorter postoperative hospital length of stay (5.26 vs. 8.32 days), less blood loss (114.74 vs. 194.51 ml) and shorter duration of postoperative drainage (3.87 vs. 5.22 days), respectively (6). Similarly, it was reported that VATS thymectomy showed less postoperative complications with similar 5-year overall survival, 5-year disease-free survival and recurrence rates (7,8). The superior poles of the thymus may be exposed by CO_2 insufflation and neck flexion, without cervical incision (9). In addition, Suda *et al* reported that single-port trans-subxiphoid robotic thymectomy assisted with CO_2 gas injection at 8 mmHg provides a good operative view in the neck region and makes verification of the phrenic nerve easy (10). Furthermore, Wu *et al* reported that uniportal VATS for mediastinal tumour resection including extended thymectomy was a promising and safe technique (11).

Notably, the size of the thymoma was not an absolute contraindication for VATS, because the thymoma with maximal diameter of ~13 cm was completed through the VATS approach, as previously reported (6). Furthermore, DLET and one-lung ventilation may result in a variety of complications, including hoarseness, hypoxaemia, tracheobronchial injury, vocal cord injury and re-expansion or oxidative stress (12,13). Therefore, CO_2 infusion artificial pneumothorax with double-lung ventilation may be a better option for VATS (4). Of note the artificial pneumothorax is not suitable for all cases, and DLET should be prepared in case the need of single-lung ventilation during the surgery, such as severe pleural adhesion to avoid pleural tear and bleeding, is required. In addition, the artificial pneumothorax with CO_2 insufflation may result in deteriorative changes, such as circulatory failure, ventricular arrhythmias and contralateral pneumothorax. This should be

considered during the surgery assisted with artificial pneumothorax. However, a moderate-to-low intra-abdominal pressure >12 mmHg can assist to limit the extent of the pathophysiological changes (14). Brock *et al* reported that one-lung ventilation via a double-lumen endotracheal tube is safe and convenient for VATS surgery (15). In conclusion, our initial experience of 19 cases indicated that VATS thymectomy assisted with artificial pneumothorax via single-lumen endotracheal intubation and two-lung ventilation is safe and feasible, and constitutes a method that may be utilized for patients with other retrosternal tumors.

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