

Original Research Article

Surgery for Primary Anterior Mediastinal Tumors: a Report of 71 Cases from a Single Institute

Angui Li¹, Bangqing Liu¹, Tianci Qian¹, Fugui Ruan¹, Xiaolin Sun¹, Jiangbin Sun¹, Jianfei Song², Zhenzong Du², Haiyong Wang^{1*}

¹Department of Cardiovascular Surgery, Affiliated Hospital of Guilin Medical University, Guilin 541001, China;

²Department of Cardiothoracic Surgery, the Second Affiliated Hospital of Guilin Medical University, Guilin 541199, China

***Corresponding author**

Dr. Haiyong Wang

Email: docwanghy@gmail.com

Abstract: The aim of this study was to review the clinical presentations, diagnostic tools adopted, the histological features and the treatment of primary anterior mediastinal tumors. A retrospective analysis of 71 patients who underwent total or subtotal resection of primary anterior superior mediastinal tumors between 2010 and 2014 was performed. Clinical data were collected from the medical records. All 71 patients with anterior mediastinum tumors were surgically treated and were pathologically confirmed with anterior mediastinum tumors. Of the 71 cases, there were 60 cases of benign tumor and 11 cases of malignant tumor. All patients were partially and completely removed. The all operations were successful. 10 cases appeared postoperative complications, but no obvious serious complications. Symptoms of other patients with complications are relieved after the medical treatment, and the remaining patients recovered and discharged. Primary anterior mediastinal tumors can be partially and completely even if they have invaded other mediastinal structures. Surgical treatment for primary anterior mediastinal tumors is safe and efficacious regardless of approach.

Keywords: Primary mediastinal tumor, Surgical treatment, Anterior

INTRODUCTION

Mediastinal tumors are relatively uncommon, yet span a wide spectrum of diseases, and preoperative diagnosis plays a crucial role in guiding subsequent surgical and medical treatments. The three imaginary mediastinal compartments (anterior, middle, posterior) are useful for locating and providing diagnostic clues when a mediastinal mass is present. Some anterior mediastinal tumors can be diagnosed with confidence based on imaging tool alone. But in the other anterior mediastinal masses, a particular entity can be strongly suggested when a typical appearance is combined with the right clinical presentation [1]. Clinically anterior mediastinal tumors that appear resectable should usually undergo tumor removal. When an invasive anterior mediastinal tumor is present, the surgeon's decision to removal the mass along with involved neighboring structures must be considered against the morbidity of such a procedure [2]. Consequently, we reviewed our 5-year experience with resection of anterior mediastinal tumors to evaluate the factors

affecting surgically removal of anterior mediastinal tumors.

PATIENTS AND METHODS

From January 2010, through January 2014, all patients with primary anterior mediastinal tumors underwent tumor resection at Affiliated Hospital of Guilin Medical University were reviewed under a protocol approved by the Institutional Review Board. Patients who had metastatic disease of the mediastinum, direct extension of lung malignancy into the mediastinum, tracheal, esophageal, or cardiac malignancies, or extra thoracic metastases were excluded.

Medical records were reviewed for demographic data, clinical presentation, diagnostic investigations, operative procedure, location, tumor invasion as determined by the surgeon, histologic diagnosis, postoperative morbidity and mortality, and follow-up. Clinical data included history and physical examination, chest X-ray, chest and abdominal

computed tomography (CT), magnetic resonance imaging (MRI).

RESULTS

All 71 patients with anterior mediastinum tumors were surgically removed and were pathologically confirmed. The youngest patient was 9 months old and the oldest, 73 years old. Average age was 40 years. There were 42 male patients and 29 female. Of the 71 cases, there were 60 cases of benign tumor and 11 cases of malignant tumor. There were 4 malignant thymoma, 3 invasive neurogenic tumors, 3 yolk sac tumors, 1 sclero nodular Hodgkin's lymphoma. Twelve patients had pericardial cysts, 22 benign substernal Goiter or benign thyroid tumors arising in the mediastinum, 12 benign neurogenic tumors, 4 teratomas, 4 thymic hyperplasias, 3 thymic cysts and 2 bronchial cysts.

Nine cases were accidentally found via CT without any signs or symptoms. Nine patients showed chest tightness, cough and sputum in 13 cases, chest pain and/or back pain in 12 cases, three cases of dyspnea, myasthenia gravis in 19 cases, and one case of superior vena cava obstruction syndrome.

All patients were operated on under general anaesthesia with single or double-lumen endotracheal intubation. A median sternotomy was used in 13 patients (20%). A transverse neck incision was used in 7 patients. A left thoracotomy was added in 12 patients and a right thoracotomy, in 3 patients. The video-assisted thoracoscopic surgery (VATS) was used in 32 patients. In the majority of patients (79%), total removal of the tumor by radical excision was achieved.

Ten patients (11%) experienced complications. Two patients had postoperative pneumonia. Sternal wound infections developed in 2 patients. Two patients, both with myasthenia gravis, required intubation for longer than 3 days, and 2 patients sustained postoperative hemorrhage requiring reoperation. Two patients each had phrenic nerve injury. Symptoms of other patients with complications are relieved after the medical treatment, and the remaining patients recovered and discharged. No patients died in the immediate postoperative period. Follow-up was available for 52 patients and extended from 13 months to 5 years. Median follow-up was 20 months with an average of 28 months. The overall actuarial 2-year survival rate for all benign patients was 100%. The 2-year survival rate for patients with malignant tumor was 42%.

DISCUSSION

Mediastinal tumors, which include various types of neoplasms, are uncommon [3]. Anterior mediastinal tumors comprise a diverse group of neoplasms and account for 50% of all mediastinal

masses [4]. There is considerable overlap in the field of anterior and middle mediastinal tumors, because anterior masses often invade into the middle mediastinum. Differential diagnoses of anterior mediastinal tumors, such as mature teratoma, thymic epithelial, germ cell tumors and malignant lymphoma, should be screened. In the perioperative period, anterior mediastinal tumors can be very difficult to manage and the previous study provides many examples of cardiorespiratory disasters and even death [5, 6].

We found some masses with cyst (for example, pericardial cysts), were more likely to be asymptomatic than those with other histological variants. The clinical benefit would be obvious if it was possible to differentiate these masses, because pericardial cyst, thymic cysts, thymoma, thymic carcinoma, and mature teratoma would be resected if possible. On the other side, patients with malignant germ cell tumor and malignant lymphoma would be treated by chemotherapy and/or radiation therapy. Severe cardiorespiratory compression caused by anterior mediastinal masses in pediatric patients is very challenging for both diagnosis and treatment. Patients usually require urgent therapy; otherwise, sudden death may occur [7]. Anterior mediastinal masses in pediatric patients are also at high anesthesia risks. Patients are typically placed supine for procedures, and the weight of the mass may further compress the airway and major vessels [8].

Although some primary anterior mediastinal tumors are accidentally identified via CT without any signs or symptoms, many tumors can cause dyspnea as a result of tumor compression [9]. Symptomatic masses, infection, suspected malignancy, progressive growth, tracheal compression, presence in children and adults, and atypical location or characteristics have been proposed as criteria that signal the requirement of surgical removal. Although, it remains controversial whether asymptomatic cysts can be observed or resected, as malignancy cannot be ruled out by CT or MRI [10, 11]. Some authors advocate that pericardial cysts were never removed, since they are always asymptomatic. However, when the cysts were larger, a thoracoscopic removal is advocated and simple to perform [12].

The preoperative diagnosis of anterior mediastinal tumors depends on radiographic imaging because identification by biopsy is not easy. For these reasons, the preoperative diagnosis of anterior mediastinal tumors using imaging methods is essential. However, the diagnostic accuracy of CT and MRI has reliability [13]. CT could distinguish fatty, cystic, vascular and soft tissue masses. The soft tissue component of the tumor can be further defined in terms of the homogeneity of the mass, the presence or absence

of calcification, and whether there is enhancement with contrast. CT is equal or superior to MRI in the diagnosis of anterior mediastinal tumors except for thymic cyst [13]. The diagnostic accuracy using all diagnostic imaging methods is high. In the clinical setting, however, every imaging method is not always selected because some tumors can be diagnosed easily with only plain chest CT. Therefore, it is important to investigate factors affecting preoperative diagnosis. Image-guided percutaneous needle biopsy, ultrasound-guided endoscopic biopsy, VATS and open surgical procedures are all methods used for obtaining tissue from the anterior mediastinum [14]. CT-guided percutaneous biopsy is a safe diagnostic procedure with high diagnostic accuracy for anterior mediastinal masses, highest for thymic neoplasms (100%), and can potentially avoid more invasive procedures [15]. We didn't routinely used MRI to investigate anterior mediastinal tumors in all patients, but it could also be helpful.

Anesthetic management in both children and adult patients with an anterior mediastinal mass is fatal with the potential for cardiorespiratory collapse. Airway collapse upon induction is a rare finding in the adult population. Many cases have been reported of hemodynamic and airway collapse induced by general anesthesia in patients with an anterior mediastinal mass. There is no guidance on quantifying risk and planning the safe conduct of anesthesia.

Detailed preoperative cardiovascular evaluation is essential in predicting hemodynamic stability during anesthesia. Ventilation-perfusion mismatch caused by compression of a bronchus and the contralateral pulmonary artery has been also shown to be fatal, and treatments should be individualized by critically assessing structures that are affected to predict stability after induction [16]. Tracheomalacia is a condition of the large airways that is often caused by a large anterior mediastinal mass [17]. However, tracheal stenosis, wound infection, hemorrhage, decannulation, and other complications may be associated with surgery, thus indicating that less traumatic manipulation should be considered [18,19]. Caution must be taken to avoid distortion of the airway as a result of excessive tension on the sutures. Careful assessment must be made to ensure safe pathways for the suspension sutures. General anesthesia is a highest risk for these patients. It should be considered early and appropriate preparations should be made prior to the initiation of general anesthesia [20]. When general anesthesia is required, we would formulate a comprehensive plan preoperatively in our surgical team and anesthetists.

Although symptomatic anterior mediastinum benign tumors were always considered indication for surgical treatment, the management of asymptomatic

anterior mediastinum tumors is still controversial. Many surgeons prefer surgical removal for possibility of malignant transformation, cyst infection, invasive growth, or spontaneous rupture [21], whereas others assert that there is no need for universal resection due to the benign nature of these tumors [22]. Thymomas, lymphomas, and germ cell tumors are the most frequent lesions of the anterior mediastinum. Depending on mass location, mediastinoscopy and thoracoscopy are the preferred diagnostic tools. Generally, surgical resection of thymoma is the gold standard, and median sternotomy is the most frequently applied approach. Thoracoscopy could be performed in patients with myasthenia gravis and with very small tumors. In these cases complete resection is necessary due to the probability of recurrence. In our cases, neurogenic tumors in adults are benign and usually resected via VATS or thoracotomy, depending on location and size. Regarding surgical procedures, sternotomy was performed in 34 patients and VATS without sternotomy was performed in 37 patients. Optimal visualization of the whole operative field is greatly facilitated by appropriate instrumentation in VATS. We performed surgery in such patients when malignancy could not be ruled out based on the following imaging features on preoperative CT or MRI: invasion into the surrounding structures, progressive growth and thickened irregular cystic wall.

Thoracoscopic surgery for anterior mediastinal tumors has emerged as a less invasive to conventional approach. A thoracoscopic procedure was used in 37 (52%) patients without conversion to thoracotomy in this study. Although this technique offers significant benefits, we believe use an open procedure in a complicated case, to achieve complete resection. We should try to obtain pathological complete resection in most case, by using individualized procedure properly.

We detected a postoperative complication rate of 11% (n = 10). Postoperative mortality was not observed. Surgical treatment for anterior mediastinal tumors could be performed safely regardless of the approach used. Long-term follow up is indicated in case of incomplete resection.

LIMITATIONS

This study is summarized our experience of treating primary anterior mediastinal tumors over the past 5 years. However, there were a few limitations. In our study the sample size is too small. We need more cases and long-term follow-up to determine the outcomes in this study.

CONCLUSION

Surgical treatment for primary anterior mediastinal tumors is safe and effective regardless of approach. Surgical access depends on the location of

the mass. Primary anterior mediastinal tumors can be partially and completely removed.

CONFLICT OF INTERESTS

None declared.

AUTHOR'S CONTRIBUTION

Haiyong Wang and Angui Li wrote the paper. Bangqing Liu, Tianci Qian, Fugui Ruan, Jianbin Sun, Zhenzong Du, Jianfei Song and Xiaolin Sun supervised the composition of the paper. All authors read and approved the final paper.

ACKNOWLEDGEMENTS

This work was supported by Health Department of Guangxi Zhuang Autonomous Region Grant [Z2014313]. We thank Donghua Pan and for his contribution to this article.

REFERENCES

1. Carter BW, Okumura M, Detterbeck FC, Marom EM; Approaching the patient with an anterior mediastinal mass: a guide for radiologists. *J Thorac Oncol.* 2014; 9(Suppl 2):S110-8.
2. Bacha EA, Chapelier AR, Macchiarini P, Fadel E, Darteville PG; Surgery for invasive primary mediastinal tumors. *Ann Thorac Surg.* 1998; 66(1):234-9.
3. Yano M, Sasaki H, Moriyama S, Hikosaka Y, Okuda K, Shitara M, *et al.*; Clinicopathological analysis of small-sized anterior mediastinal tumors. *Surg Today.* 2014; 44(10):1817-22.
4. Strollo DC, Rosado de Christenson ML, Jett JR; Primary mediastinal tumors. Part 1: tumors of the anterior mediastinum. *Chest.* 1997; 112(5):1344-57.
5. Hammer GB; Anaesthetic management for the child with a mediastinal mass. *Paediatr Anaesth* 2004; 14 (1):95-7.
6. NgA, Bennett J, Bromley P, Davies P, Morland B; Anaesthetic outcome and predictive risk factors in children with mediastinal tumours. *Pediatr Blood Cancer* 2007; 48 (2):160-4.
7. Huang YL, Yang MC, Huang CH, Wang CC, Wu ET, Huang SC, *et al.*; Rescue of cardiopulmonary collapse in anterior mediastinal tumor: case presentation and review of literature. *Pediatr Emerg Care.* 2010; 26(4):296-8.
8. Prakash UB, Abel MD, Hubmayr RD; Mediastinal mass and tracheal obstruction during general anesthesia. *Mayo Clin Proc.* 1988; 63(10): 1004-1011.
9. Zambudio AR, Lanzas JT, Calvo MJ, Fernandez PJ, Paricio PP; Non-neoplastic mediastinal cysts. *Eur J Cardiothorac Surg.* 2002; 22(5):712-6
10. Kirmani B, Sogliani F; Should asymptomatic bronchogenic cysts in adults is treated conservatively or with surgery? *Interact Cardiovasc Thorac Surg.* 2010; 11(5):649-59.
11. Cohen AJ, Thompson L, Edwards FH, Bellamy RF; Primary cysts and tumors of the mediastinum. *Ann Thorac Surg.* 1991; 51(3):378-84 (discussion 85-6).
12. Gossot D, Izquierdo RR, Girard P, Stern JB, Magdeleinat P; Thoracoscopic resection of bulky intrathoracic benign lesions. *Eur J Cardiothorac Surg.* 2007; 32(6):848-51.
13. Tomiyama N, Honda O, Tsubamoto M, Inoue A, Sumikawa H, Kuriyama K, *et al.*; Anterior mediastinal tumors: diagnostic accuracy of CT and MRI. *Eur J Radiol.* 2009; 69(2):280-8.
14. Date H; Diagnostic strategies for mediastinal tumors and cysts. *Thorac Surg Clin.* 2009; 19(1):29-35.
15. Petranovic M, Gilman MD, Muniappan A, Hasserjian RP, Digumarthy SR, Muse VV *et al.*; Diagnostic Yield of CT-Guided Percutaneous Transthoracic Needle Biopsy for Diagnosis of Anterior Mediastinal Masses. *AJR Am J Roentgenol.* 2015; 205(4):774-9.
16. Kanellakos GW; Perioperative management of the pregnant patient with an anterior mediastinal mass. *Anesthesiol Clin.* 2012; 30(4):749-58.
17. Liu Z, Yang R, Shao F, Pan Y; Controlled Trachea Suspension for Tracheomalacia After Resection of Large Anterior Mediastinal Mass. *Ann Thorac Surg.* 2015; 99(6):2225-7.
18. Mitchell ME, Rumman N, Chun RH, Rao A, Martin T, Beste DJ, *et al.*; Anterior tracheal suspension for tracheobronchomalacia in infants and children. *Ann Thorac Surg* 2014; 98 (4):1246-53.
19. Carden KA, Boiselle PM, Waltz DA, Ernst A; Tracheo malacia and racheo broncho malacia in children and adults: an indepth review. *Chest* 2005; 127 (3):984-1005.
20. Blank RS, de Souza DG; Anesthetic management of patients with an anterior mediastinal mass: continuing professional development. *Can J Anaesth.* 2011; 58(9):853-9, 860-7.
21. Takeda S, Miyoshi S, Minami M, Ohta M, Masaoka A, Matsuda H; Clinical spectrum of mediastinal cysts. *Chest* 2003; 124(1):125-32.
22. Ponn RB; Simple mediastinal cysts: resect them all? *Chest* 2003; 124(1):4-6.