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Case Report

Video-assisted thoracoscopic surgery for a giant mediastinal teratoma in a pediatric patient

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ABSTRACT

Mediastinal teratomas are tumors originating from the primitive germ streak. The primary treatment for these tumors is surgery, traditionally performed through thoracotomy or sternotomy. Video-Assisted Thoracic Surgery (VATS) procedures have been increasingly employed in adult patients. However, the utilization of the VATS approach in pediatric patients remains limited worldwide. Furthermore, the presence of teratomas in the anterior mediastinum poses a challenge for VATS surgery in pediatric patients, as it involves delicate anatomical structures such as the heart, vena cava, and aorta. Here we present the case of a symptomatic pediatric patient weighing 35 kilograms who presented with respiratory distress. The patient had a mass measuring 7.5 cm in diameter with indistinct borders with the pericardium. The patient underwent a successful complete surgery using the VATS technique. VATS is a reliable surgical approach for mediastinal teratoma surgery in pediatric patients, provided the surgeon has adequate experience.

Keywords: mediastinal teratoma, mature teratoma, pediatric surgery, teratoma, video-assisted thoracic surgery

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Introduction

Teratomas are tumors that may arise from more than one primitive germ cell layer. They commonly occur in the sacrococcygeal region, as well as other locations such as the ovaries, head and neck, mediastinum, testes, and central nervous system. Mediastinal teratomas usually lack specific clinical signs and are often asymptomatic. However, when symptoms do arise, they typically include chest pain, fever, cough, and hemoptysis. The primary treatment for these tumors is surgery [1].

Video-Assisted Thoracic Surgery (VATS) has become a standard surgical approach for the diagnosis and treatment of various disease groups among adults. However, its utilization in pediatric patients remains limited worldwide. This limitation stems from factors such as the anatomical structure of the pediatric chest, limited space, challenges with intubation (single lumen/double lumen), and the lack of specialized closed surgical instruments for pediatric patients, and insufficient experience in this population [2].

Furthermore, the localization of teratomas in the anterior and superior mediastinum presents an additional challenge in pediatric patients due to their proximity to critical anatomical structures, including the heart, vena cava, aorta, innominate vein, and phrenic nerve [2-4].

Case Report

A 13-year-old male patient, who had been followed up for growth retardation, presented to another medical center with a persistent cough that had been ongoing for the past month without improvement despite treatment. During the physical examination, the patient's height was measured at 137 cm, and he weighed 35 kg, leaving him below the 3rd percentile and indicating growth and developmental retardation. As a result of visualizing a well-defined opacity in the right mediastinal area on the posteroanterior chest X-ray (Figure 1), a contrast-enhanced chest CT scan was conducted.

The CT scan revealed a mass measuring 75x36x47 mm in size, located in the prevascular area of the anterior mediastinum. This mass contained fluid, fat, soft tissue density, and calcification (Figure 1). To further assess the mass's relationship with the mediastinal structures, a contrast-enhanced chest MRI was performed. The borders of the mass with the pericardium were not clearly distinguishable, raising suspicions of a germ cell tumor.

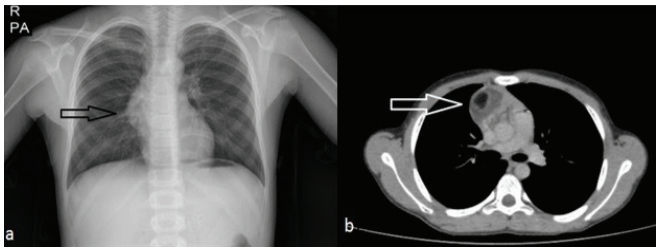

Figure 1. The view of mediastinal mass in lung x-ray (arrow) **(a),**mediastinal teratoma in Thorax CT scan (arrow) **(b)**.

Based on the initial findings, the patient was referred to our center for surgical treatment. The blood tests showed no abnormalities, and the AFP and beta-HCG levels were within the normal range. Considering the possibility of a gonadal primary tumor, scrotal and abdominal ultrasound examinations were conducted, which revealed no gonadal lesion.

Given the unclear borders of the lesion with the pericardium and its diameter of 7.5 cm, the family was informed about the high likelihood of requiring conversion to thoracotomy or sternotomy during the surgery.

The patient was placed in the supine position, and intubation was successfully achieved using a size 28 double-lumen left intubation tube. To access the thoracic cavity, a mini camera port was created through the right anterior axillary 7th intercostal space. A 5-mm-diameter optical camera system with a 30-degree view angle was employed. Within the anterior mediastinum, a well-defined encapsulated mass displaying adhesions with the thymus and mediastinal structures was observed (Figure 2). During the surgery, it was determined that the wing of the mass could be separated from the pericardium through blunt dissection. As a result, a second port entrance was created in the right mid-axillary line at the 4th intercostal space to facilitate the dissection process. The mass was dissected from the surrounding tissues using an ultrasonic energy device. Once the lesion was completely resected, the camera port was enlarged, and the mass was removed en-bloc in an endobag (Figure 2). During the procedure, no carbon dioxide (CO2) was used. The operative time was 93 minutes, and the estimated blood loss was 110 cc. Macroscopically, the mass was observed to contain sebum, fat, hair, and cartilage tissues (Figure 3). Following the removal of the mass, a 16F chest drain was inserted into the right hemithorax and the operation ended. No complications arose during the surgery.

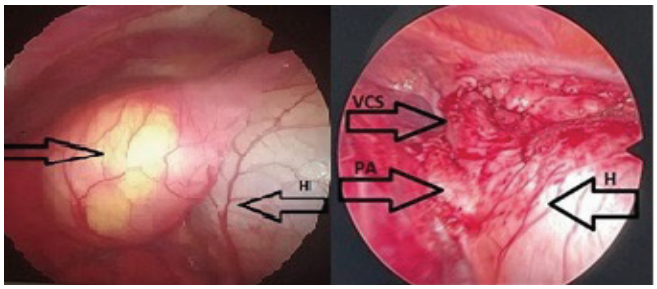

Figure 2. The location of teratoma during surgery; T; teratoma, H; Heart (arrow) **(a)**, mediastinal space after resection of the teratoma *(Abbrev.:VCS; vena cava superior, PA; pulmonary artery, H; heart) (arrow)* **(b).**

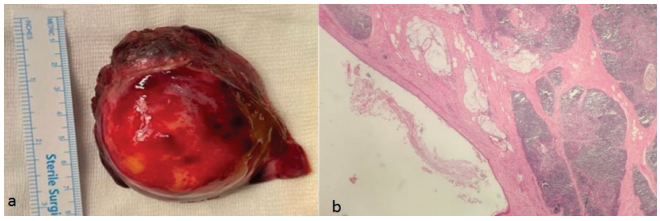

Figure 3. Macroscopic view of the tumor **(a)**, microscopic view of the tumor; Squamous epithelium, skin layers (ectoderm), muscular and fat tissue (mesoderm), salivary glands (endoderm) in hematoxylin eosin stain **(b).**

The patient, postoperatively extubated and transferred to the intensive care unit, demonstrated a good general condition with stable vital signs and consciousness. No air or fluid drainage was observed from the chest tube. Furthermore, the patient did not exhibit diaphragm elevation and was subsequently transferred to the ward where he was mobilized.

During the ward follow-up, the patient remained free of complications. On the third postoperative day, the patient was discharged after the removal of the chest drain. The chest X-ray taken on the 15th day after discharge was insignificant.

The results of the pathological examination indicated a mature teratoma with typical hyperplasia and multiple cysts (Figure 3). No additional treatment was deemed necessary, and the patient was placed under regular follow-up. Written informed consent was obtained from the parents for the publication of his data.

Discussion

Mediastinal teratomas account for 5-10% of all mediastinal tumors. They originate from vascular potential stem cells during the development of thymus tissue in embryonic life and consist of multiple germ layers. These tumors do not show a clear gender distribution. The highest incidence is observed in the age group of 20-40 [5,6].

Mediastinal teratomas often do not cause specific symptoms and are typically asymptomatic. However, symptomatic patients commonly present with chest pain, dyspnea, and hemoptysis.. The presence of symptoms is considered by some authors as a relative contraindication for minimally invasive surgery [7].

Chest X-ray is often the initial diagnostic modality, but the main diagnostic tool is a chest CT scan [7].

Surgery is the primary treatment for mediastinal teratomas. The conventional surgical approaches include sternotomy and thoracotomy. VATS is increasingly preferred due to its minimally invasive nature, better cosmetic outcomes, shorter length of hospital stay, and potential to reduce complications such as scoliosis and muscle development defects, which can occur in up to 10% of pediatric patients undergoing thoracotomy. However, VATS is not yet considered a standard surgical approach for pediatric mediastinal tumors [8].

Performing VATS surgery for mediastinal teratomas in pediatric patients presents two primary technical challenges. The first challenge relates to the patient's characteristics. Pediatric patients, due to their anatomically limited thoracic space, elliptical thorax shape, absence of specialized closed surgical instruments for their size, and lack of surgical experience, cannot be intubated with double-lumen tubes if they weigh less than 30 kg [3,4,7]. The second challenge is associated with the location of the teratomas in the anterior and superior mediastinum. These tumors are localized close to critical anatomical structures such as the heart, vena cava, innominate vein, and phrenic nerve, making the surgical procedure more complex and increasing the risk of major complications. Although there are limited studies available in the literature on this subject, both in pediatric and adult patients, it appears that the location of mediastinal teratomas poses significant challenges [4].

The literature contains various opinions regarding the eligibility of patients for the VATS approach. Suspected invasion or presenting symptoms are considered relative contraindications. Furthermore, there is a suggestion that patients with a tumor diameter exceeding 5 cm may not be suitable candidates for VATS. However, it is important to note that these recommendations are primarily based on studies conducted with adult patients, and there is a lack of specific recommendations for pediatric patients [4,7].

The largest study we found in the literature focusing on adult patients included 108 patients and accumulated data over 26 years. Remarkably, only 22 out of 108 adult patients with mediastinal teratoma underwent VATS surgery. Another study from China, spanning 10 years and involving a total of 28 adult patients, reported the largest series of patients who underwent teratoma surgery using minimally invasive techniques. These limited publications emphasize the rarity and complexity of such surgeries, even among adult patients [1,7].

There is a lack of serial studies specifically focusing on isolated mediastinal teratomas in pediatric patients. Sato et al. reported a pediatric VATS series involving 31 patients with tumors located in various mediastinal compartments, out of which only 6 patients underwent surgery for teratoma over a period of 23 years [4]. Similarly, in the study by Da et al., which included 137 patients with mediastinal tumors, the lowest rate of VATS utilization was observed in cases of anterior mediastinal masses upon careful evaluation of the article. Specifically, in that study, VATS surgery was performed on only 5 out of 18 children with teratoma [9].

Complete resection is recommended in teratoma surgery, although there are articles in the literature suggesting that incomplete surgeries have no impact on survival [7].

Although our patient exhibited dyspnea at admission and showed signs of pericardial invasion on MRI, along with a tumor diameter of 7.5 cm, we decided to proceed with VATS surgery based on our experience and interest with pediatric patients, despite these relative contraindications [10,11].

In conclusion, it is important to emphasize that there are no absolute contraindications for the removal of anterior mediastinal masses/teratomas using VATS. We believe that a practical approach is to begin the surgery with VATS and assess the situation intraoperatively before deciding whether to convert to open surgery. This allows for flexibility and ensures that the most appropriate surgical technique is chosen based on the patient's specific condition.

Declaration of conflicting interests

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Authors' contributions

OFD; organized the article, wrote the paper, FTB,YDKJ; contributed to the data collection MŞ,ÇG,HM; revised the the article. All authors revised the manuscript. The authors read and approved the final manuscript.

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