Mediastinoscopy, Mediastinotomy And Thoracoscopy For Mediastinal Lesions

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The mediastinum is a complex anatomic part of the thoracic cavity. Mediastinum is composed of many vital organs and anatomic structures like nerves, ductus thoracicus and lymph nodes. Histologically different neoplasms are located here and cysts that may be noticed at all ages. Mediastinum is also an harbor for numerous lymph node metastases secondary to the tumors of the other parts of the body. Both benign and malignant lesions are being recognized with increasing frequency due to more computerized tomographic evaluation and a differential diagnosis becomes an important issue which is under responsibility of the chest surgeon. The incidence and types of the mediastinal lesions vary with the age of the patient. This brings the different diagnostic and treatment modalities for each patient, each lesion and each location. In infants and children, neurogenic tumors are the most common lesions, followed by lymphomas, foregut cysts, and benign germ cell tumors. In adults, thymic tumors are the most common surgically treated mediastinal tumors. Diagnostic modalities and treatment strategies for mediastinal tumors and cysts are quite different, depending on the above mentioned criteria. Mediastinal tumors are also among the most difficult lesions examined by the surgical pathologists for several reasons. 1- Many different types of lesions occur in this location, 2- Biopsies are often small, crushed specimens which may change due to experience of the surgeons, 3- There are not so many pathologists who have significant experience with mediastinal pathology.
because specimens from this location are relatively uncommon, 4- Tumors of the mediastinum may be presented with undifferentiated and overlapping histologic features, thus, pathologist must consider a broad differential diagnosis and perform evaluation of each biopsy specimen. Tissue diagnosis is very important since appropriate therapy for various mediastinal tumors differs considerably and may significantly impact survival.

Masses in the anterior compartment are more likely to be malignant than those found in the other mediastinal compartments. As an example, one series of 400 patients with mediastinal tumors noted that 59, 29, and 16 percent of anterior, middle, and posterior mediastinal masses were malignant, respectively. Lesions most commonly found in the anterior mediastinum are thymomas, lymphomas, germ cell tumors, congenital cysts, intrathoracic thyroid tissue, and parathyroid lesions.

Surgical biopsies of the mediastinum are obtained via several techniques. Mainly; mediastinoscopy, mediastinotomy, and thoracoscopy. The aim of this article to discuss the potential role of each technique, advantages and disadvantages and description of the techniques.

**Possible histologic diagnostic modalities prior to a surgical biopsy**

*Percutaneous US-CT Guided Needle Biopsy:* Ultrasonography is an effective modality for guidance of percutaneous biopsy. Compared with CT, US-guided biopsy offers a number of advantages, including bedside approach, lower cost, lack of radiation exposure, and real-time monitoring. The most important advantage of US-guided biopsy is a possible approach the lesion from different directions. CT-guided biopsy of this region is usually hindered by surrounding bony structures at an axial plane. The greatest limitation of US guided biopsy is the need of anterior or posterior contact with the chest wall. Pneumothorax (8%–61%) is the most common complication, followed by hemoptysis (1.6%–3%).

*US-Guided Endoscopic Biopsy:* Bronchoscopists can perform real-time EBUS-guided transbronchial needle aspiration (EBUS-TBNA). Although EBUS-TBNA has been mainly considered for lymph node staging in lung cancer, there is a pos-
sible indication for middle mediastinal lesions. Esophageal US-guided fine-needle aspiration needle biopsy may be considered for the posterior and inferior mediastinal lesions. EBUS-TBNA is minimally invasive and can be performed quite safely under local anesthesia. The disadvantages are small tissue sample, time-consuming procedure, technical demanding, and expensive equipment.

**Surgical techniques for diagnostic purposes**

*Mediastinoscopy*

Conventional mediastinoscopy and videomediastinoscopy are generally in use for evaluating the mediastinal lymph nodes in patients with carcinoma of the lung. These techniques could also be used for the diagnostic purposes in mediastinal lesions located in the pretracheal, paratracheal, and subcarinal spaces. A few articles are present for their use in the anterior mediastinal tumors. The procedure is common to all chest surgeons but briefly, it is performed under general anesthesia, a small transverse incision is made 2 cm above the sternal notch. The pretracheal fascia is opened and a tunnel created by finger dissection along the anterior and lateral walls of the trachea. The mediastinoscope is then introduced by taking care to right innominate artery and advanced further by means of blunt instrument dissection to extend the mediastinal tunnel. Great care should be taken to avoid vascular injury and left-recurrent nerve palsy. An adequately sized tissue sample can be obtained using biopsy forceps. Intubation tube located on the left side of the mouth for right handed surgeons and vice versa for the left handed. An arterial monitorization to left arm is recommended (if necessary) for the anesthetists due to manipulation of the right innominate artery with mediastinoscope during the procedure. We have employed this procedure in children with paratracheal lesions and have recently published. Another important issue is close cooperation with pathologists during the procedure to understand if the obtained tissue is enough and from the correct location.
Parasternal Anterior Mediastinotomy (Chamberlain Procedure): The parasternal anterior mediastinotomy was first described in 1966 by Chamberlain and McNeil. This approach is mostly indicated for large masses located in the anterior mediastinum, with direct contact to the posterior aspect of the sternum and the adjacent chest wall. This technique has not only been proposed and employed for the histologic confirmation of lymphadenopathies in lung cancer but also reserved for masses located in the anterior mediastinum.

Surgeons generally prefer Chamberlain’s approach for anterior mediastinal masses which is an open biopsy technique using a parasternal anterior mediastinotomy. The patient is placed in a supine position under general anesthesia. Local anesthesia may be preferred in huge lesions due to difficult intubation, possible tracheal collapse and inability to extubation. The level of the preferred surgical access is between the second and the fourth intercostal space and should be chosen based on radiological findings. Pectoralis muscle fibers are separated and incision of the intercostal muscle is made close to the sternum by trying to preserve the internal mammarian vessels. Removal of the costal cartilage is generally not necessary. Under direct visualization between the ribs specimen can be obtained from an anterior mediastinal tumor. Para-aortic lesions and masses arising from the aortopulmonary window can be reached by inserting a mediastinoscope through the parasternal incision. An intraoperative histologic examination is usually required to assess whether the specimen is adequate for diagnosis. Pleural opening should be avoided whenever possible for the potential risk of tumor seeding. Some surgeons prefer to resect the cartilage part of the rib and divide internal mammarian artery and vein to gain a wider access.

Subxiphoid mediastinotomy: It is a diagnostic modality with limited indications. Author of this manuscript prefers to employ this procedure in pediatric patients and adults with an anterior mediastinal mass and pericardial effusion necessitating drainage. A subxiphoid incision is performed like performing a pericardial drainage and gentle finger dissection anterior to the pericardium is employed and mediastinoscope is introduced to obtain a biopsy from the anterior mediastinum.
The advantage is availability of pericardial drainage and biopsy from the same incision.

**Posterior mediastinotomy:** This diagnostic procedure is done to obtain biopsy from otherwise undiagnosed posterior mediastinal lesions located in the paravertebral region. With the technical developments of VATS procedure, this technique began to lose its popularity of the 70’s and 80’s. The most important disadvantage is the need of posterior rib resections. But it may still be reserved for some mediastinal lesions.

**Video-Assisted Thoracoscopic Surgery:** Video-assisted thoracoscopic surgery (VATS) has been widely used for various types of thoracic surgery. Under general anesthesia, the patient is intubated with a double-lumen endotracheal tube and placed in a lateral decubitus position. With the lung collapsed, the entire thoracic cavity is visible. (Exceptions are possible; I would prefer to biopsy an anterior mediastinal lesion with a single lumen tube under apnea and in supine position). VATS is a valuable procedure, especially in cases of lesions with difficult access that require direct vision, such as tumors close to great vessels or the heart. The disadvantage of VATS biopsy for mediastinal tumor is possible tumor seeding to the pleural cavity. Performing a VATS biopsy and draining concomitant pleural-pericardial effusions through a VATS access is great advantage. Management of pericardial effusion is important because this condition has been found to be predictive of life-threatening complications and even to significantly affect survival in patients with bulky mediastinal masses. Using a transpleural route may also avoid any potential delay for salvage radiotherapy because the skin incision would be far away. It has been reported by Pompeo that awake VATS is possible especially if the patient has pleural effusion and nodules. He claimed 100% diagnostic accuracy rate. In female patients, the anterior mediastinotomy incision through the breast is avoided with the use of the laterally oriented VATS intercostal access sites. In general, the VATS approach is superior to anterior mediastinotomy for biopsy of mediastinal lymphadenopathy inaccessible to standard
cervical mediastinoscopy. Accepted mediastinal indications for VATS are as follows:

- Biopsy of mediastinal lymph nodes
- Biopsy of mediastinal masses
- Resection of benign germ cell tumors
- Resection of ectopic parathyroid
- Resection of thymus for thymic cyst, myasthenia gravis, stage I thymoma
- Resection of bronchogenic or pericardial cysts
- Esophageal cystectomy
- Resection of posterior mediastinal (neurogenic) tumors

**Symptomatology, clinical and radiologic findings to choose appropriate approach**

Two-thirds of patients may have specific symptoms. Signs and symptoms may differ according to the benign or malignant lesion, size, location, the presence or absence of infection, the elaboration of specific endocrine or other biochemical products, and the presence of associated systemic diseases.

A clue for direct anatomic invasion or compression may be hoarseness, Horner’s syndrome, diaphragmatic paralysis, chylothorax, and superior vena cava syndrome. Systemic symptoms are rare, but typically are caused by the release of excess hormones and antibodies. Ectopic thyroid tumors may be associated with thyrotoxicosis. Parathyroid adenomas, occasionally found in the mediastinum, are associated with the clinical and laboratory findings of hyperparathyroidism. Thymic carcinoid tumors may be associated with Cushing’s syndrome. Gynecomastia is present in over half of the patients with mediastinal choriocarcinoma and is believed to result from b-human chorionic gonadotropin (hCG) production. Hypertension occurs in association with mediastinal pheochromocytomas and ganglioneurinomas, and diarrhea may also be associated with these lesions. Myasthenia gravis is known to occur more frequently in the presence of thymoma. Thymomas have also been reported in association with pure red blood cell aplasia, hypogammaglobulinemia, and other autoimmune diseases.

According to abovementioned criteria an appropriate technique could be chosen.
1- If the clues for direct anatomic invasion to major structures are present and elevated levels of alfa feto protein, beta HCG, LDH or suspect for a possible lenfoid malignancy is under consideration, appropriate surgical diagnostic modalities are mediastinoscopy and mediastinotomy depending on the location and experience of the surgeon.

2- If the symptomatology and radiologic signs confirms a cyst like pericardial, bronchogenic and enteric, the best strategy will be complete excision with VATS or Robotics.

3- If the patient was diagnosed to have a parathyroid adenoma, an ectopic goiter, a benign neurogenic tumor of the posterior mediastinum or thymoma with a considerable size and location with clinical and radiological findings, an appropriate treatment is surgical complete excision with VATS. Many surgeons including the author of this manuscript, would not hesitate to make a complete excision with VATS.

Conclusion

A chest surgeon could predict the preoperative diagnosis for each lesion by considering the age of the patient, location of the tumor, the presence or absence of symptoms and signs, the association of a specific systemic disease, radiographic findings, and biochemical markers.

The appropriate choice may be the observation, surgical resection, chemotherapy, radiotherapy, or multimodality therapy, depending on the nature of the disease and characteristics of the patient. After liberal use of VATS, the threshold for surgical resection is lowered. In patients with cystic lesions or probable benign solid tumors, such as neurogenic tumors in adults, VATS extirpation of the lesion is recommended without biopsy, being both diagnostic and therapeutic simultaneously. When radiographs show typical signs of benign germ cell tumors, mature teratomas, or early stage thymomas, the authors recommend open or VATS resection without biopsy.
Making a correct diagnosis for poorly demarcated tumors in the anterior or middle mediastinum is difficult. Large and invasive thymomas, thymic carcinomas, seminomas, nonseminomatous germ cell tumors, and lymphomas are quite similar in radiographic appearance. PET-CT may be a valuable option to differentiate the aggressivity of the primary lesion. These lesions show difference in treatment strategy. Therefore, pathologic diagnosis is necessary to choose the optimum treatment modality. The choice of surgical technique depends on the location of the lesion, clinical factors such as the age and the condition of the patient, and the surgeon’s ability and preferences.

Reading references


