Mediastinoscopy: Its anesthetic considerations
NANCY J. SWANSON, CRNA
Roswell, New Mexico

Mediastinoscopy is rapidly gaining widespread usage as a diagnostic tool and merits special anesthetic consideration. The author covers not only the anesthetic aspects, but gives a comprehensive introduction to the procedure itself— including preoperative considerations, complications, and a basic review of mediastinal anatomy.

Mediastinoscopy has become a recognized means of diagnosis and of determination of resectability of bronchogenic carcinoma, sarcoidosis, and other mediastinal masses.

The underlying rationale for the procedure is that intrathoracic lymphatic drainage is from the pulmonary periphery toward the centrally placed paratracheal lymph nodes. Therefore, the mediastinal nodes are one of the first stations for the spread of lung carcinoma, and their status is of prime importance in establishing possible unresectability of the neoplasm.

History
Daniels, in 1949, described scalene node biopsy—the first step in the search for the answer of resection without a thoracotomy. This technique makes possible the biopsy of the most superior mediastinal nodes—those at the junction of the subclavian and internal jugular veins.

Eric Carlens, a Swedish oto-laryngologist, in 1959, first described mediastinoscopy. It was a means of examining the paratracheal, subcarinal, and supra-hilar areas of the mediastinum.

Mediastinoscopy can be a misleading term. The examination is limited and restricted to the paratracheal, parabronchial, and subcarinal areas. By no means does it imply a total visualization of the mediastinum. Several extended techniques have been described, but acceptance has been limited.

The scopes used are modified laryngoscopes, resembling a child’s esophagoscope. A standard straight-bladed Jackon laryngoscope may be used.

Indications
Lymph nodes are of diagnostic and prognostic value.

The most common type tumor—squamous cell—can cause extensive intrathoracic changes before any more peripheral involvement occurs.

The significance of the spread of cancer to mediastinal lymph nodes is still a subject of debate; however, most authors agree that spread to ipsilateral superior mediastinal nodes is a relative contraindication to thoracotomy and that contralateral spread is an absolute contraindication.

The absence of mediastinal spread, as determined by the procedure, is of significance since the resectability has been reported to be in the range of 85-95%.
The procedure can be used in order to determine the extent to which a bronchoscopically demonstrated widening and fixation of the carina or radiographically visualized broadening of the superior mediastinum is caused by metastasis. It has been extremely valuable in the diagnosis of sarcoidosis. The diagnostic yield by this approach is close to 100%.

Certain infectious diseases that invade or involve the mediastinal lymph nodes are possible to diagnose with mediastinoscopy. These would include such things as: tuberculosis, evaluation of exudative pleural effusion to differentiate between tuberculosis or cancer, toxoplasmosis, histoplasma capsulatum, and silicosis. Also included would be malignant diseases other than bronchogenic cancer: metastatic cancer, Hodgkin’s disease, reticulum cell sarcoma, unspecified lymphomas, and depending on the area—esophageal cancer. Finally, benign tumors, such as mediastinal cysts, thymomas, substernal thyroid, and intra-thoracic goiters can be diagnosed by this method.

Anomalous tracheal bronchi have been identified with the scope, as have an occasional aortic aneurism. It is possible to divide the right vagus for treatment of osteomyopothy. As a precursor to radiation, radon seeds have been inserted through mediastinoscopy.

Carlens has described a technique for thymectomy via the scope.

One of the most exciting new uses of the scope is in the placement of an atrial electrode for atrial pacing of the heart. In this procedure, a transverse pacemaker is triggered by an electrode placed near the atrial appendage through mediastinoscopy.

There are three groups of upper mediastinal nodes that are not accessible through the scope: (1) anterior mediastinal, (2) subaortic, and (3) posterior subcarinal chains.

Contraindications

The one absolute contraindication is previous mediastinoscopy. The surgical planes are lost, making dissection impossible. However, patients with mediastinal fibrosis from irradiation, Hodgkin’s disease, or previous infection make dissection very difficult.

Superior vena cava syndrome seems to increase the risk of bleeding, apparently because of increased pressure in the vessel. This syndrome consists of headaches, swelling above the clavicles, and superficial collaterals.

Severe tracheal deviation and such vascular problems as thoracic aneurysm are considered relative contraindications. An open tracheostomy is considered by some to be a relative contraindication.

Preoperative considerations

There frequently seems to be an association of chronic obstructive lung disease (COLD) with cancer of the lung. This, plus the fact that many of these patients are in the older age group, presents special problems to us—that is, such patients become poor anesthetic risks.

These patients may have some type of systemic disease which may influence the preoperative preparation as well as the choice and technique of the anesthetic. Chronic type illnesses such as diabetes, cardiovascular disease of some type, arthritis with a possible long-term intake of cortisone, hypertension and its related drug problems, and of vital importance, a poor nutritional state, all must be considered carefully.

I am not going to elaborate on the routine check through the chart. We all know the meaning of normally encountered laboratory work, EKG’s, x-rays, and so on.

Preoperative assessment to determine whether pulmonary resection can cure or significantly add to the patient’s life is based on both anatomical and physiological considerations. Anatomy is the surgeon’s field. We become involved during the physiological review.

The patient must be able to tolerate both the diagnostic mediastinoscopy and
possible thoracotomy and resection. Needless to say, though this is most difficult to judge, it is of utmost importance. It is estimated that 40% of operative mortality of resections are due to surgically-induced pulmonary insufficiency.

It is difficult to set absolute values but the mortality rate is higher in patients who show less than 50% of predicted maximal ventilatory volume or a vital capacity less than 70% predicted.\(^6\)

Additionally, in chronic obstructive lung disease with a reduction in forced expiratory volume (FEV), the morbidity and mortality is higher. When it is below 60%, there is a significant added risk. An absolute FEV of 1-1.5 liters makes the patient a poor candidate.

Absolute blood gas values are not very helpful, since in many of the older patients a \(pO_2\) of 60-75 TORR would be perfectly acceptable.

Exercise response provides one of the best criteria. Probably easiest and most helpful are some of the old standby questions—that is, what is the individual's reaction to walking a flight or two of stairs, blowing out candles, ability to walk several blocks, and so on.

Lung scan results indicate altered distribution of pulmonary blood flow.\(^5\) An absence of perfusion on the side in question suggests pulmonary artery involvement. This may help in evaluating poor pulmonary function tests. The patient, in fact, may have a vascular "pneumonectomy" and is left with dead space ventilation. The scan also provides a reliable index of proportional \(O_2\) uptake by each lung, which may influence resection in a patient with chronic obstructive lung disease and borderline pulmonary function.

In order to assess selective lobar vessel involvement, an invasive pulmonary angiogram may be done. One thing that should be done more frequently is the measurement of pulmonary arterial pressure to indicate the degree of pulmonary vascular resistance in patients with chronic obstructive lung disease.\(^8\)

The patient with carotid artery disease must be carefully evaluated. These patients may have significant problems from partial occlusion of an already partially occluded vessel. A diminished blood flow to the carotid and vertebral arteries also is possible from compression of the innominate artery, making arteriosclerotic disease an important preoperative consideration.

Often, mediastinoscopy is scheduled with a thoracotomy to follow if indicated. Therefore, all preoperative decisions must include the possibility of more extensive work and complications. The procedure is diagnostic, but the possible results must be kept in mind.

Anatomy

Basic knowledge of mediastinal anatomy is necessary to understand the technique of this procedure.

The mediastinum is that area of the thoracic cavity bounded by the manubrium and the first rib above, the diaphragm below, and the parietal pleura laterally. It is divided into the superior, anterior, middle, and posterior spaces.

The great venous structures are situated anteriorly, ventral to the major arterial vessels—aortic arch, innominate and carotid arteries. The azygos vein is the only exception to this plan. It rises posteriorly in the mediastinum and runs anteriorly to join the superior vena cava just above the right main stem bronchus.

The principal landmark for the procedure is the trachea, which enters the chest in an oblique plane above the spine, crosses the superior mediastinum dorsal to the great vessels, and bifurcates in the posterior portion of the middle mediastinum.\(^8\)

As the esophagus lies posteriorly to the trachea, it is the most vulnerable in the subcarinal region.

Laceration of major vessels in the superior mediastinum is possible. The mediastinal pleura, especially on the right side, lies close to the trachea and the pleural space can be entered inadvertently.

Anesthesia

The choice of agents and techniques
must be that combination which is most familiar and works best for you. A smooth induction is necessary, while maintenance requires a depth of anesthesia that is just enough to enable the patient to tolerate the endotracheal tube. The presence of the tube in the trachea is important (one advantage of a general anesthetic) because it eliminates the risk of mediastinal emphysema by protecting the trachea from compression. Such compression could cause increased negative pressure in the thorax, possibly leading to the emphysema complication. Care should be taken to see that the patient does not cough or buck at the end of the procedure.

Strict sterile technique must be maintained. The endotracheal tube and all monitors must be secured well, so as not to cause problems during the procedure. The anesthetist should be positioned at the head of the table, off to the right side.

The patient's position is supine, with a pillow under the shoulders to extend the head. Frequently, a 15-degree head-up position is requested by the surgeon to help relieve venous congestion. The patient's head is often rotated to the left somewhat.

At times, the surgeon may use an operating microscope to give him better illumination and magnification. The draping procedure is like that of a thyroid procedure.

Emergency equipment must be readily available. Bleeding problems should be anticipated, with the inclusion of volume expanders in the room. Blood must be already prepared and be easily accessible. Pumps for the blood also should already be in the room. Atropine sulfate, drawn up in a syringe, should be on the anesthetist's table.

Monitoring equipment is an absolute necessity. An EKG must be in place to monitor for manipulation of the vagus and cardiac nerves. A precordial or esophageal stethoscope is vital for you to listen to breath sounds. The pulse monitor should be on the patient's right arm, along with the blood pressure cuff.

**Complications**

The incision is made in the suprasternal notch. The technique seems quite simple, as long as strict adherence is kept to the principles and goals necessary to achieve results and avoid complications.

The first arterial vessel palpated with the finger ventral to the trachea is the innominate. Compression of the innominate can cause simulation of cardiac arrest. This is the reason for monitoring the right arm. Through manipulation or compression, the brachiocephalic artery may become occluded, causing loss of pulse and pressure in the right arm. Vagal stimulation may cause severe bradycardia. There also may be diminished blood flow to the brain through the right common carotid and vertebral arteries. Transient left hemiparesis following the procedure has been reported.

The azygos vein is usually identified at the level of the right mainstem bronchus where it arches anteriorly to join the vena cava. The nodes in this area are commonly adherent to the vein, and pulling and tugging during dissection can cause tears in the vein.

When dissection is done in the area of the left mainstem bronchus, the recurrent laryngeal nerve may be injured. This is usually due to overly enthusiastic lateral dissection. If blunt dissection is used, the risk is very slight. However, one-half of those recurrent nerve injuries reported were permanent.

When biopsy is anterior to the left mainstem bronchus, the danger is injury to the pulmonary artery. Further down and to the left is the aortic arch which also may be injured.

Ordinarily, the dissection is easy. Prior to the biopsy, a needle aspiration (with a 6-inch 20-gauge spinal needle) should be done to rule out an adjacent or underlying vascular structure. If blood is freely aspirated, another site should be chosen. All solid tumors should also be aspirated prior to biopsy.

Minor oozing at site of biopsy is of no consequence. Hemorrhage of a
more brisk nature can usually be controlled by pressure with pledgets of oxidized cellulose. Silver clips can be used on the vessels.

Major hemorrhage occurs when a large vessel is inadvertently torn or biopsied. Such a situation can be avoided by careful dissection and aspiration of all structures before biopsy.

A pneumothorax is possible; and it most often occurs on the right. Treatment is not usually necessary, but if needed, chest tube drainage is effective.

Mediastinitis usually does not occur if a sterile technique is followed. Many (one-half) temperature elevations within 12 hours were reported, but these always subsided spontaneously without other evidence of sepsis. Prophylactic antibiotics are not usually used.

Complications can arise from mechanical stimulation of the vagus and its branches. It can be directly injured by sectioning or contusion. Indirectly, injury can come from a hematoma or edema in surrounding tissues.

Death can sometimes occur after biopsy of the pulmonary and innominate arteries, the superior vena cava, and the azygos vein. Other possible complications include an air embolism, subcutaneous emphysema, or cardiac arrhythmias due to accidental cardiac biopsy. Also possible are phrenic nerve injuries, esophageal injury, chylothorax, and finally, infection.

It is most important to make sure the wound is dry before the scope is withdrawn. Hemorrhage is the most common complication, so you must be continually prepared for immediate thoracotomy. The second most common complication is that of pneumothorax.

During the post-anesthesia period, the recovery room personnel should be instructed to watch for bleeding and breathing. The patient may manifest symptoms of recurrent nerve injury, so all necessary equipment should be immediately available.

Minor substernal soreness is the frequent postoperative complaint. Carlens mentions that some patients complained of a slight smarting of the throat, a condition which he attributed to intubation.

A chest x-ray should be taken to rule out pneumothorax. The patient is allowed to eat and ambulate as soon as he is awake. If no further care is indicated, dismissal the day following the procedure is common.

Local versus general anesthesia

The advocates of local anesthesia feel that general anesthesia is used because of convenience to the surgeon and the patient.

The neck is the only place that local anesthesia has to be used, since the mediastinal dissection is painless. The area has a rich nerve supply from the vagus, the three sympathetic ganglia, and the thoracic sympathetic ganglia. There are few pain fibers within the tissues surrounding the trachea and great vessels. Pressure is what the patients feel at all times.

An advantage of local anesthesia is that the level of consciousness can be continuously monitored in those patients with obstructive disease of the carotid artery. Because many of the patients undergoing this procedure have chronic obstructive lung disease, there is an increased percentage of high risk for a general anesthetic. In addition, numerous biopsies may prolong anesthesia time, and these patients have limited pulmonary reserve.

A transtracheal block may be used to suppress coughing.

A major disadvantage is the ever present possibility of immediate thoracotomy. The time involved could be life-saving.

Because of the relationship between chronic obstructive lung disease and old age, adequate premedication is difficult; and a supplemental narcotic or Valium® is often required.

Future use

I feel that further use of this procedure will be much more prevalent in the future. More and more indications for it are being found; Carlens, for ex-
ample, is using it now for thymectomy and aspiration of cysts.

Conclusion
A thoracotomy is always painful and, in critically ill patients, may carry a high mortality. These patients may lose, as the result of an inoperative thoracotomy, one or two of the best months they have left to live.²

Mediastinoscopy is remarkably safe and has essentially no morbidity. Combine this with good diagnostic yield and patient tolerance, and you can see why it is becoming more and more popular.

The overall mortality is 0.09% with a 1.5% morbidity.⁵

The use of mediastinoscopy, following accepted findings, has improved the 5-year cure rate to 40-50% and has resulted in the avoidance of problems associated with unnecessary thoracotomy.⁵

REFERENCES

AUTHOR
Nancy J. Swanson, CRNA, is a 1963 graduate, Moline Public Hospital School of Nursing, Moline, Illinois. She is a 1972 graduate, Ravenswood Hospital Medical Center School of Nurse Anesthesia, Chicago, Illinois. She has served as a nurse anesthetist at the Cook County Hospital in Chicago. She is presently employed as a practicing anesthetist with Roswell Anesthesia Services, PA, in Roswell, New Mexico.

This paper was presented at the Annual Meeting of the New Mexico Association of Nurse Anesthetists, Roswell, New Mexico, in October, 1976.

ACKNOWLEDGEMENT
The author wishes to acknowledge Morton W. Dann, MD, FAC A, and Emmit M. Jennings, MD, FACS, for their assistance and encouragement during the preparation of this paper.