Aspiration biopsy of thoracic lesions

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Fluoroscopically guided aspiration biopsies of thoracic lesions have been executed for several years and have gained increasing favor with thoracic surgeons and physicians specializing in chest diseases.[1–4] At the Cleveland Clinic this method has provided a rapid means of ascertaining the nature of pulmonary nodules and mediastinal masses with exceedingly little trauma and small risk to the patient.[5] One of the primary benefits has been the ability to perform the examination on an outpatient basis and later route the patient for definitive therapy, thus either shortening the hospital stay or eliminating it. As a consequence, a significant number of bronchogenic carcinomas have been diagnosed and the patients have been treated without spending a single day in the hospital.[5]

The primary purpose of the examination is to determine the nature of a solid mass; if it is present in the mediastinum or in the pulmonary parenchyma it is suspected to be a neoplasm. We usually have employed this method to diagnose pulmonary tuberculosis, fungal infections, and specific bacteriologic abscesses, and to prove the presence of localized collections of fluid. We have not been successful in using it to identify lipomas or neural tumors, although this

has been described by Dahlgren and Nordenström.[1]

Method

Routine roentgenographic examinations of the chest are commonly used to identify and localize the lesion. Indeed, many of the solitary nodules in the lung are discovered accidentally in the examination of a patient for another problem which appears unrelated. Laminograms are only occasionally necessary and in the main can be dispensed with. Rarely, oblique projections may prove helpful in localizing the mass. The patient must be able to cooperate to the extent of holding his breath during the insertion of the needle. It is also desirable to recognize that the patient may have received anticoagulants and that severe emphysematous changes in the lung parenchyma can frequently lead to the presence of tension pneumothorax.

The patient is positioned on a horizontal x-ray table which in our institution is a special device with a yoke which can rotate around the patient; one arm of the yoke holds the x-ray tube and the other holds an image intensifier and television chain. This particular apparatus also provides for magnification of the image and has permitted us to approach exceedingly small lesions 7 to 8 mm in diameter. The patient is positioned so that the chest wall closest to the lesion is chosen and a direction of thrust of the needle perpendicular to the floor can be employed. Occasionally the skeleton will impose obstacles which make it necessary to use an oblique course; this is particularly true in lesions confined to the mediastinum. The skin is cleansed, and the skin and subcutaneous tissues are anesthetized; a thin-walled metallic needle of sufficient length, 18- or 20-gauge is advanced through the anesthetized skin and subcutaneous tissues and then kept poised over the lesion. With fluoroscopic guidance of the needle exerted through a rubber-shod forceps, the needle top is thrust through the parietal and visceral pleura into the pulmonary parenchyma and into the lesion. Passage through the pleura is made rapidly to minimize potential trauma and the production of pneumothorax. The needle is thrust firmly into the lesion and the apparatus is rotated to assure that the needle tip is in its proper position. The stylet is then partly withdrawn and the needle is rotated so that the beveled end cuts loose the material which is then aspirated through a syringe. A slight negative pressure is maintained in the syringe, and the needle and syringe are removed as a unit while the patient suspends respiration. Frequently, the specimen is small and contained entirely within the needle. It is blown out of the needle onto slides which are smeared and immediately immersed into absolute alcohol. The needle and syringe are then rinsed in normal saline solution, and this combined specimen is sent to the cytology laboratory. The method is varied only slightly when the procedure is done for bacteriologic culture, in that the needle and syringe are first rinsed in a small quantity of normal saline solution without added preservative. This specimen is kept sterile and is sent to the bacteriology laboratory.

For outpatients, a chest film is performed approximately 3 hours after the aspiration biopsy and is checked for the presence of pneumothorax. If there is no pneumothorax or a very small asymptomatic one, the pa-

tient is discharged from the radiology department. In the event of significant pneumothoraces, treatment of the pneumothorax is given in the radiology department with the use of an angiographic catheter which is fitted to a Heimlich valve. Patients with such devices are then discharged home or to adjacent hotel rooms and are closely observed; the tube usually is removed 24 hours later.

Material and results

This procedure has been done on more than 1000 patients; duplicate biopsies were performed in approximately 60 of these patients. The addition of the true positive and true negative results indicates an overall accuracy of 87%. The addition of one false positive and the false negative results together with a small group of 15 individuals wherein the results are still unclear accounts for the other 13% of patients examined.

Complications

No patient has died as a direct result of the aspiration biopsy. Three patients were extremely debilitated because of disseminated neoplasm and died several days after the biopsy procedure, one with extensive subcutaneous emphysema. One patient in need of psychiatric treatment committed suicide before learning the results of the biopsy. A hemothorax developed in one patient; it required minor surgical intervention after a small laceration of an intercostal artery had been inflicted by the biopsy needle. It is not uncommon to discover a small amount of intrapulmonary hemorrhage around the nodule that has had a biopsy, but this usually is asymptomatic and clears within a day or so. Other complications include transient hemoptosis of 2.3%, small pneumothorax of 11%, and large pneumothorax of 3%, requiring treatment. Still other complications including air embolism, empyema, and severe hemorrhage have been reported.[6] However, we have not observed any of these. A hypothetical complication of spread of tumor has not occurred in our series and has not been reported in any series employing aspiration biopsies with hollow needles. However, it has been reported with the use of Vim Silverman needles.[7]

Discussion

The primary purpose of this procedure is to determine whether a nodule in the lung is a neoplasm and what its cell type may be. A satisfactory result can only be achieved if there is close cooperation between the clinician and the radiologist and between the radiologist and the cytologist. The final opinion of the pathologic condition must fit the clinical picture. A negative result for neoplasm when there is clinical evidence that neoplasm may still be the accurate diagnosis should indicate the need for a repeat biopsy or another mode of investigation to confirm the diagnosis.

There are several points in the performance of this examination which must be emphasized. The needle should be advanced or retracted only during arrested respiration. This precaution should minimize the problems of pneumothorax and potential bleeding. One must not linger with the needle partially through the chest wall, since respiratory motion with the needle tip in such a position could lead to large lacerations of the visceral pleura.

Satisfactory positioning of the tip of the needle can be determined by

several methods including rotation of the patient when there is fixed fluoroscopic arrangement or rotation of the fluoroscopic equipment as described. Motion of the needle tip during respiratory activity and movement of the needle back and forth by the radiologist demonstrating motion of the pulmonary nodule will also help determine whether the needle tip is within the mass. Resistance and a hard, gritty sensation can frequently be felt when the needle tip comes in contact with a carcinoma. Although an attempt may be made to secure a core of tissue by withdrawing the stylet slightly and advancing and rotating the needle, it is generally best to realize that the procedure is of a cytologic nature and that aspiration of material that has been freed by rotation of the needle tip will be most adequate. An attempt should be made to use a superior surface of the rib for insertion of the needle rather than the inferior one to avoid lacerating the larger of the intercostal arteries. Patients are usually asked to suspend respiration during the period when the stylet is removed and the syringe is attached to minimize the remote possibility of air embolism by aspiration through the needle.

Our experience with percutaneous, fluoroscopically controlled aspiration biopsies of thoracic lesions has convinced us that this diagnostic procedure is safe and reliable. Patients are only slightly uncomfortable, and the examination can be completed in a very few minutes. The degree of discomfort is much less than that experienced by patients undergoing bronchoscopy, bronchial brushing, scalene node biopsy or mediastinoscopy. Our diagnostic results are superior to those of any other biopsy procedure including lung brushing, which is relatively ineffective with lesions other than those in the lumen of the bronchus.[8] There does not appear to be any other method short of thoracotomy which will yield results as accurate as aspiration biopsy.

The inevitable result of the examination, however, depends upon the ability of the cytopathologist, and his success depends in turn upon the ability of the radiologist to secure material of diagnostic quality. It is regrettable that the needle samples a tiny volume of tissue at the needle tip, and may unfortunately be within millimeters of material which may provide a positive diagnosis.

There is no portion of the thorax which is not potentially accessible to needle aspiration biopsy including the hila of the lung and mediastinum. We have had the experience of frequently placing our needles into the pulmonary artery without dire consequence. Our experience of incidentally needling the aorta, the heart, or aortic aneurysm also has not resulted in complications. Auscultatory evidence of a small shunt in the hilum following biopsy did develop in one patient; this may have been the result of the needle transgressing both a pulmonary artery and vein, but may also have been the result of extension of the neoplasm, since this murmur was identified several months after the biopsy.

The strongest and recurrent objection to the use of needle aspiration is fear of metastatic spread of the neoplasm. It is emphasized that this has not apparently proved to be the case, and seems to depend upon the use of small-bone needles.[1, 3, 4] The use of 18- and 20-gauge needles has been satisfactory in our hands, and the aspiration biopsies have also been done

with 21- and 23-gauge needles.[4] The smallest diameter needle that appears to be appropriate and productive of the best results can be used. One must weigh the actual or theoretical dangers of needle aspiration against those of thoracotomy and potential delay while other diagnostic measures are utilized primarily. Certainly cutaneous implants and other disseminations of pulmonary neoplasm have been well documented as a complication of thoracotomies. The determination of cell type in suspected bronchogenic carcinoma can also be of enormous value, since undifferentiated carcinomas are so often unsuccessfully treated by operation.

One may speculate about the future and dream of the eventual success in abolishing bronchogenic carcinoma and other neoplasms. A step short of that goal, however, may witness the radiologist playing a most significant role in obtaining tissue for cell culture and subsequent accurate diagnosis and medical treatment.

Lastly, it is important to emphasize an element frequently overlooked by physicians, and that is the patient's fear and anxiety. It is certainly much kinder to determine the nature of a pulmonary nodule as quickly as possible and with the least disruption to the patient's life. This, I believe, can be more easily accomplished by aspiration biopsy on an outpatient basis than by hospitalization and prolonged diagnostic studies which tend to lengthen the time between first awareness and final conclusion.

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