Biopsy Techniques in the Diagnosis
of Intrathoracic Lesions*

Including Lung Biopsy, Mediastinal Biopsy and Resection of the Deep
Cervical Fat Pad and Its Contained Nodes
Report of 12 Illustrative Cases

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Introduction

The purpose of this paper is to emphasize the value of certain infre-
quently employed biopsy techniques in the diagnosis of intrathoracic lesions. The
methods to be discussed include resection of the deep cervical fat pad and its contained nodes, mediastinal biopsy through an open thoracotomy and lung biopsy through an open thoracotomy. None of these procedures represent original ideas of the authors. We feel, however, that the use-
fulness and safety of the techniques to be discussed have not been fully appreciated and that reiteration of their merits is warranted.

The concept that intelligent treatment demands an accurate diagnosis is universally accepted by the profession. It has been only in comparatively recent years, however, that this fundamental principle has been fully applied to intrathoracic lesions. In the past the policy of “watchful waiting” was frequently adopted, therapy was applied on the basis of a presumptive diagnosis, or trial and error methods were employed. Recent improvements in thoracic surgical techniques, in anesthesia, and in pre- and postoperative care have greatly increased the safety of thoracotomy and have made many previously invulnerable pathological processes within the chest fully sus-
cceptible to surgical attack. There have been simultaneous improvements in irradiation methods, and chemotherapeutic agents having at least some degree of effectiveness against certain chest lesions have become available. Paralleling these advances, there has been an increasing demand for, and critical need of, an accurate histological diagnosis in patients with intra-
thoracic masses. Although newly developed methods of exfoliative cyto-

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The opinions or assertions contained herein are those of the authors and are not to be considered as official or reflecting the views of the Navy Department or the naval service at large.
Figure 1: (a) Posterior-anterior chest roentgenogram showing bilateral mediastinal mass.—(b) Right lateral chest film showing the central location of the masses.—(c) Photomicrograph of a node obtained on biopsy of the deep cervical fat pad which shows the characteristic appearance of Hodgkin's disease, granuloma type (X220).
logical study have contributed tremendously to the diagnosis of malignant lesions within the chest, direct biopsy remains the most certain means whereby a definitive diagnosis may be established.

It is not our purpose to discuss such proved biopsy methods as those carried out at bronchoscopy or esophagoscopy. Confirmatory lung or mediastinal biopsy of a unilateral lesion at the time of thoracotomy which has been undertaken with the intent of resecting the lung, lobe or mass in question will not be considered. These techniques are so widely accepted that they need no further advocacy. Biopsy through the thorascopc has such a limited field of usefulness that it deserves no more than a word for the sake of completeness. We have not used punch or needle biopsy in recent years because of our conviction that the procedure is generally contraindicated in view of certain faults inherent to the technique and considering the risks which it entails. Needle biopsies of thoracic lesions are necessarily blind procedures. The tissue obtained is frequently inadequate and may be misleading. Histological interpretation often proves unusually difficult and demands the services of a pathologist particularly trained and skilled in the examination of tissue obtained by that means. The hazard of complications such as pneumothorax, hemothorax, and intrapulmonary hemorrhage is ever present. If the lesion is malignant the implantation of tumor cells along the needle track in the lung, pleura, chest wall, or skin is at least an unpleasant theoretical possibility. The implantation of tumor cells in the pulmonary vascular bed and lymphatics is certainly something to be feared and is a risk that we feel should be avoided if possible. The rapid dissemination of the visible dyes through the pulmonary lymphatics and to the regional mediastinal nodes has been well established. It does not appear unreasonable to assume that liberated tumor cells could spread along the same route with comparable speed. The methods which we shall endeavor to emphasize, though not yet widely used, are felt to be relatively safe and to possess a high degree of usefulness.

Resection of the deep cervical fat pad and contained nodes. Among the procedures which offer much in the diagnosis of pulmonary and mediastinal lesions is the long used but little publicized method of resection of the deep cervical fat pad and the lymph nodes which lie within it. It is our impression that this useful technique has not received the widespread utilization which it merits in the investigation of intrathoracic pathology. Although used with great frequency in certain centers, its value does not appear to have been fully recognized throughout the country and little has appeared in the literature concerning its usefulness. In addition to its value as a purely diagnostic measure, exploration of this region may be utilized in determining operability in pulmonary malignancy. In some clinics this procedure has been adopted as a part of the study of patients with known or strongly suspected bronchogenic carcinoma of questionable resectability. If metastatic malignancy, compatible with a primary pulmonary lesion, is found in the deep cervical or superior mediastinal nodes upon resection of the deep cervical fat pad and its contained nodes, the case is usually judged inoperable. Although we have not adopted this policy
Figure 2: (a) Posterior-anterior chest x-ray film showing a left hilar mass and marked widening of the superior mediastinum. (b) Left lateral projection demonstrating the central position of the superior mediastinal mass. (c) Photomicrograph of section from a lymph node obtained on biopsy of the deep cervical fat pad. The histologic diagnosis was anaplastic carcinoma, metastatic to lymph node, compatible with origin in a bronchus (X220).
and still frequently perform palliative resections in the presence of known widespread mediastinal metastases, careful follow-up studies may well show that the degree of palliation achieved by pulmonary resection when the nodes in the deep cervical fat pad are involved is not, in the usual case, sufficiently worthwhile to justify pneumonectomy. In any event the resectability rate under such conditions is low. It would certainly seem that in poor risk patients where the question of resectability is great, proved metastases in the deep cervical, subclavicular, or superior mediastinal nodes would weigh heavily against the decision to attempt exirrative surgery.

The operative technique has been adequately described by Daniels and by Weiss and associates. The approach differs in no important respect from that used for temporary paralysis of the phrenic nerve. Briefly the operation consists of an incision 2 or 3 centimeters in length in the supravclavicular fossa about one inch above the clavicle, the midpoint of the incision being centered between the external jugular vein and the lateral border of the clavicular head of the sternocleidomastoid muscle. The skin, subcutaneous tissues, platysma muscle and superficial layer of the deep cervical fascia are divided, bringing the deep cervical fat pad into view. This fat pad is excised, all fat and contained nodes down to the anterior scalene muscle and medially to the carotid sheath being freed. The dissection is then carried downward into the superior mediastinum along the great vessels and by traction on the fat pad from above a large mass of adipose tissue can be delivered into the neck from the subclavicular and retrosternal regions. This mass of fat will invariably contain nodes which may be quite large and easily recognizable or they may be so small that they can be detected only after careful search by the pathologist. The operation is done under local anesthesia, it requires only a few minutes and causes little or no discomfort to the patient. There is no morbidity after the procedure. The following cases illustrate the diagnostic information that may be obtained by employing this technique.

Case Reports

Case 1: F.J.T. This 17 year old white male was admitted to the U. S. Naval Hospital, St. Albans, New York, on January 2, 1951 following the discovery of a mediastinal mass on his 35 millimeter induction chest x-ray film taken on December 6, 1950. He was asymptomatic and physical examination revealed a few palpable lymph nodes in the axillary and inguinal regions which were discrete and only minimally enlarged. Posterior-anterior and lateral chest x-ray films (Figures 1a and 1b) confirmed the findings of a mass 7 x 9 centimeters in size situated in the anterior and mid-mediastinum. Laboratory studies showed a total white blood count of 16,500 with a normal differential. His hemoglobin level was 11 grams and he showed persistent hyperglobulinemia. The PPD test was negative in the first strength. Bronchoscopy showed a 50 per cent narrowing of both major bronchi. Papanicolaou smears of the bronchial aspirate and biopsy of the left main stem bronchus were negative. The patient’s basal metabolic rate, angiocardiogram and sternal marrow were within normal limits. Left axillary lymph node biopsy on January 30, 1951 was reported as showing only chronic non-specific lymphadenitis. Deep cervical fat pad biopsy on March 6, 1951 was reported as showing Hodgkin’s disease of lymph nodes, granuloma type (Figure 1c). X-ray therapy was instituted. After a total skin dose of 800 r units the bilateral medias-
Figure 3: (a) Posterior-anterior chest x-ray film showing large bilateral mediastinal masses. — (b) Right lateral view which shows that the masses are centrally located. — (c) Photomicrograph of section of a node obtained upon biopsy of the deep cervical fat pad. The histologic appearance is typical of Boeck's sarcoid (X100).
tinal mass had completely disappeared. He was discharged to home to be followed by monthly physical examination and chest x-ray films.

Comment: Peripheral lymph node biopsy in this case failed to establish the diagnosis. Had a trial of irradiation been used the diagnosis would have remained uncertain and the primary irradiation could not have been as accurately gauged. Advice as to future therapy would necessarily have been based on guesswork. Not even a general prognosis could have been offered with any feeling of security. The knowledge achieved as the result of a simple, harmless operative procedure in this case appears to have been well worthwhile.

Case 2: K.C. This 78 year old white male was admitted to the U. S. Naval Hospital, St. Albans, New York, on January 15, 1951 with a history of cough, chills and fever and right sided chest pain of one month’s duration. His sputum was whitish in color and contained no blood. Physical examination revealed deviation of the trachea to the right, cardiac enlargement and auricular fibrillation. Chest x-ray films on admission showed a large area of consolidation about the upper and mid-portions of the left hilum with deviation of the trachea to the right (Figures 2a and 2b). The possibility of malignancy was strongly entertained.

Routine laboratory studies were within normal limits. Electrocardiograph showed ventricular fibrillation and typical right bundle branch block. A gastrointestinal series showed a small hiatus hernia. Barium enema demonstrated diverticulosis of the colon. Smear and culture of the sputum and bronchial aspirate were negative for acid fast bacilli and for neoplastic cells. Bronchoscopy showed fixation of the distal trachea. The left main stem bronchus was greatly narrowed. A bronchial biopsy was taken and reported negative for malignancy. A distinct bronchial lesion was not seen. The patient was digitalized with symptomatic improvement but serial x-ray films showed no change in the area of consolidation. On March 8, 1951 a deep cervical fat pad biopsy was performed and the specimen showed anaplastic carcinoma, metastatic to lymph node, compatible with primary bronchial origin (Figure 2c). The patient went rapidly down-hill and expired May 25, 1951. An autopsy was not obtained.

Comment: This patient, a sailor on the U.S.S. Maine when she was sunk in Havana harbor in 1898, had an age of record of 78 years. He appeared to be older. He had cardiac hypertrophy and right bundle branch block. He also suffered from auricular fibrillation. By any standard he was a poor surgical risk, particularly for an operation of the magnitude of radical pneumonectomy. Yet that operation would have been thoroughly justified had there been any real hope that a curative operation lay within the realms of reasonable possiblility. We believe that the retrosternal biopsy, which showed metastatic carcinoma, saved this patient a futile operation of great magnitude which may well have shortened his life. It would almost certainly have offered little hope of appreciably increasing his longevity or his comfort. Cases such as this have impelled us to consider closely the philosophy adopted by Harken and his associates to which we have previously referred. At the very least a positive retroclavicular biopsy informs the surgeon, with reasonable certainty, of the nature of the problem with which he is dealing. He may then act according to his own particular beliefs.

Case 3: G.W.M. This 27 year old man was admitted to the U. S. Naval Hospital, St. Albans, New York, on June 21, 1951. He was asymptomatic upon admission. His history revealed that a re-enlistment examination of June 1, 1951, including
Figure 4: (a) Posterior-anterior chest roentgenogram showing bilateral mediastinal masses. — (b) Right lateral film which shows that the masses are centrally placed. — (c) Photomicrograph of section of node obtained on biopsy of the deep cervical fat pad. The appearance is that of Hodgkin's lymphoma, granuloma type, of lymph nodes (X220).
chest x-ray films (Figures 3a and 3b), disclosed bilateral mediastinal masses not noted on a previous examination in June 1948. He had had vague gastrointestinal complaints for two months preceding his hospitalization. A complete gastrointestinal evaluation disclosed no abnormality and his symptoms subsequently subsided. His family history contained the information that his father had died from pulmonary tuberculosis.

His admission physical examination showed only mild exogenous obesity in an otherwise normal adult male.

A complete hemogram was normal. His initial urine specimen contained one plus albumin and many cellular elements. Subsequent urine studies were negative. The serum proteins and phosphatase studies were within normal limits. Stool studies were reported as negative. Hepatic and renal function were normal. His admission chest x-ray films revealed bilateral peribronchial lymph node enlargement and increased vascular lung markings consistent with Boeck's sarcoid. Intravenous pyelography was reported as normal. Chest x-ray films taken one month after admission disclosed a decrease in the size of the parahilar mass on the right side. A slight purulent discharge was noted at the right middle lobe bronchial orifice on bronchoscopy. This area was flushed with saline and aspirate studies were conducted for M. tuberculosis and for neoplastic cells by the Papanicolaou technique. The smears were negative for both mycobacterium tuberculosis and malignant cells. Circulation times and electrocardiograms were normal. The tuberculin test was negative. Protein bound iodine studies showed findings in the normal range. Deep cervical fat pad resection was done and the excised lymph nodes showed changes compatible with Boeck's sarcoid (Figure 3c).

Comment: The value of an accurate histological diagnosis in this case seems clear. Although Boeck's sarcoid is a disease of uncertain etiology and one whose behavior is largely unpredictable, it cannot be denied that such a diagnosis is reassuring in a case where one of the lymphoblastomas has been considered as a distinct possibility. This patient was not subjected to useless irradiation. Neither was he given a grave prognosis. Should he develop severe symptoms attributable to his mediastinal masses, which he did not have when under our care, ACTH or Cortisone could be given with reasonable assurance of at least temporary relief.

Case 4: J.D.H. was admitted to the sick list because a chest x-ray film examination showed bilateral mediastinal masses. He was asymptomatic on admission. Physical examination was negative. Further roentgen studies confirmed the presence of mediastinal masses (Figures 4a and 4b). An axillary lymph node biopsy on May 12, 1951 showed chronic lymphadenitis. Bronchoscopy on June 15, 1951 was normal; the aspirate was negative for acid fast bacilli. Electrocardiogram on May 29, 1951 was normal. Routine laboratory studies were within normal limits. The Kahn test was negative. Deep cervical fat pad biopsy on June 30, 1951 showed Hodgkin's lymphoma, granuloma type, of lymph nodes (Figure 4c). Radiation therapy was begun on July 2, 1951 and discontinued August 7, 1951. The patient received a total tumor dose of 2,945 r units. Three weeks later the mediastinal masses had almost completely disappeared. He remains asymptomatic.

Comment: The comments offered relative to Case 1, apply with equal force to this one. The value to the patient and to his physician of an accurate histological diagnosis seems evident.

Case 5: M.J.S. This 37 year old white man was admitted to the U. S. Naval Hospital, St. Albans, New York, on June 25, 1951 complaining of swelling of his head, face and neck which had first appeared one month previously. Upon admission he also complained of dyspnea and orthopnea. Shortly after entry, dizziness,
Figure 5: (a) Posterior-anterior chest x-ray film showing bilateral superior mediastinal masses. — (b) Right lateral film shows the extensive involvement of the superior mediastinum. — (c) Photomicrograph of section of node obtained on biopsy of the deep cervical fat pad. The histologic diagnosis was Hodgkin's disease of lymph node showing irradiation effects (X100).
hoarseness, dysphagia and cyanosis were noted. Physical examination showed marked distention of the face and neck veins. He presented a moon-face, bull-like neck, and a dusky-ruddy complexion. Telangiectasis was present over the chest, shoulders, back and abdomen. Superficial venous distention was noted in the same areas. There was moderate exophthalmos. The neck was examined with difficulty due to the swelling but there appeared to be enlargement of the nodes in the anterior cervical chain. The blood pressure was 160/100 in the upper extremities. Fundoscopic examination disclosed retinal venous engorgement. The left testis was small and atrophic. The venous pressure was 500 mm. of water in the right arm and 440 mm. of water in the left arm. The circulation time (decholin—arm to tongue) was 60 seconds on the right and 48 seconds on the left. The remainder of the physical examination was within normal limits. Posterior-anterior and lateral chest roentgenograms (Figures 5a and 5b) showed a bilateral lobulated superior mediastinal mass extending from the thoracic inlet to the level of the bifurcation of the trachea. In the lateral view the mass was seen to be centrally located. Barium swallow showed a normal esophagus. An angiocardiogram disclosed findings consistent with superior vena caval obstruction and utilization of the azygos and hemi-azygos systems for return blood flow from the upper part of the body. Biopsy of a superficial supraclavicular lymph node showed only chronic non-specific lymphadenitis on histologic study. Because of the patient's precarious condition, x-ray therapy was instituted. He received a total tumor dose of 3,100 r units. Regression of the mass and clinical improvement was prompt and striking. However, in order to obtain an accurate diagnosis, the deep cervical fat pad was excised on the left and subclavicular and retrosternal nodes thus obtained for histologic study. Histologic examination of the nodes showed findings compatible with Hodgkin's disease with irradiation effects (Figure 5c). This patient will be discharged from the service and advised to have periodic check-up examinations, including chest x-ray films, and further x-ray treatment when indicated.

Comment: The value of an accurate diagnosis in this case is obvious. A thoracotomy will not be done. Further treatment can be given with the assurance born of a precise knowledge of the nature of the lesion. The proper disposition of the case, as pertains to further military service, has been made apparent. In general terms, a prognosis of reasonable accuracy can now be offered.

Biopsy of a mediastinal mass using the open thoracotomy approach. A great variety of tumors, both benign and malignant, occur within the mediastinum. The malignant neoplasms may be primary in that site or metastatic from other regions, particularly from the lung (bronchogenic carcinoma). Finally, numerous non-neoplastic masses of abnormal nature are found in the mediastinum. Aneurysms of the heart and great vessels and diaphragmatic herniae are examples of the latter. Many of these masses, neoplastic and otherwise, will prove amenable to surgery. This is particularly true of those which are unilateral in distribution. Others will require radiation therapy or treatment with the newer chemotherapeutic agents. The group of lymphoblastomas provides the classic example of mediastinal masses which usually cannot be treated with success by surgical means. Rational therapy of neoplastic lesions obviously cannot be instituted without an accurate histological diagnosis. This implies the necessity for biopsy of the tumor mass. The results of a "trial of irradiation" are often equivocal. Malignant lesions which possibly could be
Figure 6: (a) Posterior-anterior chest x-ray film showing large right paratracheal superior mediastinal mass — (b) Right lateral chest x-ray film which demonstrates the central location of the mass — (c) Photomicrograph of a section from the mass obtained at right superior mediastinal biopsy. The histologic appearance is consistent with mediastinal tuberculosis (X100).
successfully excised may, in certain instances, show an appreciable diminution in size after moderate radiation. Other masses, on the contrary, which cannot often be extirpated with success, such as certain types of Hodgkin's disease, may show almost no response to roentgenotherapy in the usual test dosage (750 r units). Even though the tumor may show some degree of response, subsequent therapy cannot be accurately planned while the diagnosis remains in doubt. Neither can a prognosis be offered with confidence. In general, roentgenologists are loath to undertake therapy unless the histological nature of the tumor to be irradiated has been definitely established. Surgeons are becoming less prone to agree to the employment of irradiation unless the tumor has been proved to be of a radiosensitive variety and shown to be one which cannot be excised. Only in extremely poor risk patients or those desperately ill have we hesitated to advise and carry out exploratory transthoracic mediastinotomy when the diagnosis of a lesion in that location remained uncertain after more simple diagnostic procedures had been exhausted. We have used a standard postero-lateral intercostal incision in most cases, for in our hands that approach provides the best and easiest access to all portions of the mediastinum. In an occasional case, where the lesion lay far anteriorly, we have used an anterior intercostal approach. The following cases illustrate the use of the procedure.

Case 6: C.M.* A colored male 30 years of age complained of pain in the right chest, shoulder and arm of one month's duration. He had dyspnea on exertion. Posterior-anterior chest films showed a lobulated area of homogenous density in the right paratracheal region (Figure 6a). Lateral x-ray showed the mass to be centrally located (Figure 6b). Bronchoscopy showed distortion of the lower trachea and right main stem bronchus by extrinsic compression but no intrinsic lesion was seen. The tuberculin test was four plus in the first strength. Angiocardiography revealed complete obstruction of the left subclavian vein at its junction with the innominate. Other special studies were non-contributory. Right thoracotomy was performed on September 19, 1950. A large, densely adherent right paratracheal mass was found. Frozen section showed granulomatous inflammation. Partial resection was carried out but complete removal was technically impossible. The paraffin sections showed findings compatible with the diagnosis of mediastinal tuberculosis (Figure 6c). Smears from the necrotic center of the excised tissue were negative for acid fast bacilli on Ziehl-Neelsen stain.

The postoperative course was uncomplicated. The patient was maintained on a bed rest regimen and given a prolonged course of streptomycin and para-aminosalicylic acid. His lesion has shown marked regression. Repeat angiocardiograms made four months after operation showed complete relief of the subclavian vein obstruction. The patient is still under treatment.

Comment: There was rather strong presumptive evidence that this patient had a malignant mediastinal tumor. Lacking a precise histological diagnosis, a trial of irradiation would doubtless have been undertaken with ample justification and intensive irradiation would have been entirely defensible. The results of mediastinal biopsy emphasizes the error of such a program. Those findings indicated the proper therapeutic approach. The patient is well on the road to recovery and we have reason to anticipate a complete clinical cure. Pulaski and associates have used exploratory

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*This case was reported in detail in another publication.
Figure 7: (a) Lateral chest roentgenogram showing large bilateral mediastinal masses—(b) Left lateral projection which shows that the masses are centrally located—(c) Photomicrograph of section from a node obtained on right superior mediastinal biopsy. The histologic appearance is that of Beck's sarcoid (X100).
mediastinotony in the investigation of undiagnosed mediastinal masses which proved on histological study to represent tuberculous lymph nodes. Their patients, who were placed on a therapeutic regimen similar to that employed in the case just described, showed comparable clinical responses.

Case 7: P.F.G. A 21 year old white man was hospitalized because of a marked bilateral mediastinal lymphadenopathy which was discovered on routine chest roentgenograms (Figures 7a and 7b). He complained of moderate weakness and slight dyspnea on exertion. Physical examination was negative. There was no peripheral adenopathy. The tuberculin test was three plus in the first strength. Studies for acid fast bacilli were negative. Bone marrow studies were normal. Peripheral blood was normal. A roentgenographic bone survey showed a small area in a metacarpal bone and another in the skull suggestive of osteolytic lesions. A “trial of irradiation” consisting of a total skin dose of 750 r units was given over a sharply localized, small, well shielded field centering over the largest of the mediastinal masses on the right. One month later the same mass showed no regression.

Right thoracotomy was performed on September 28, 1950. Many greatly enlarged succulent discrete nodes were found extending in a chain from the thoracic inlet to the diaphragm. That group lying above the right hilum and along the right side of the trachea was removed for microscopic study. The histologic diagnosis was Boeck’s sarcoid (Figure 7c).

The postoperative course was uncomplicated. When his wound had healed he was granted 30 days convalescent leave. Chest x-ray films upon his return showed striking regression of all lesions, including those on the left as well as those on the operated side. Although he was symptom free, the patient was discharged from the military service because of the uncertain course of his disease.

Comment: This patient with an undiagnosed mediastinal lesion, lobulated in appearance and presenting bilaterally, was given a test dose of x-ray prior to his transfer to the thoracic surgery service. There was no diminution in the size of the irradiated mass following that therapy. It was therefore correctly concluded that he did not have a highly radiosensitive tumor, specifically, that his mediastinal masses probably did not represent one of the lymphoblastoma group. The correct diagnosis was established by mediastinal biopsy. One can scarcely fail to conjecture, however, as to the subsequent management of this case had the mediastinal x-ray therapy been given over a large field and had the regression of the lesions, which took place spontaneously several weeks later, followed shortly after irradiation. Fallacious conclusions as to the probable nature of the patient’s disorder would have been almost inevitable. It is to be particularly noted that the lesions which showed the striking diminution in size had not been irradiated. The masses in the area which had been treated by x-ray had been surgically excised when they proved to be non-radiosensitive. This case dramatically illustrates, in our opinion, the possibility of an erroneous diagnosis that exists when the diagnosis is based on the response to irradiation rather than on histological evidence. Such an error could lead to useless irradiation and would almost certainly prompt a prognosis which would very probably prove to be grossly inaccurate.

Case 8: B.B.C. This 25 year old patient entered the hospital because of precordial pain, shortness of breath, and palpitation developing after strenuous exertion. Previous to this episode there were occasional sharp pains localized in the pre-
Figure 8: (a) Posterior-anterior chest x-ray film showing a large mass projecting from the left border of the heart. (b) Left lateral view which shows that the mass lies in the middle mediastinum. (c) Photomicrograph of section of tissue obtained on biopsy of a cardiac tumor mass. The histologic diagnosis was “sclerosing hemangioma” (X220).
cordial region. These symptoms subsided in 24 hours. An electrocardiogram showed
changes suggestive of an anterolateral wall coronary infarction but ballistocardiograms on four occasions were completely normal. Chest roentgenogram (Figure 8a) showed a rounded area of increased density, regular in contour, projecting to the left from the left border of the heart. In the lateral view (Figure 8b) this mass was again seen as an almost perfectly spherical shadow of increased density overlying the cardiac silhouette. In this view it measured 9.3 cms. in diameter. At
the anterior cardiophrenic angle the mass reached the chest wall and posteriorly it extended about 3 cms. beyond the shadow of the heart. The mass showed ap-
parent paradoxical motion on fluoroscopy. It exhibited transmitted but not ex-
panscal pulsation. The esophageal contour was normal on barium swallow. Bronchoscopic was negative. Studies of the sputum for acid fast bacilli and of the bronchial aspire for neoplastic cells were negative. Angiocardiography was per-
formed on two occasions. In neither instance did the mass opacify. Left thorac-
cotomy and pericardiectomy was performed on November 29, 1949. A large, very firm spherical mass the size of a small grapefruit was seen occupying the wall of the left ventricle. In some areas the mass was smooth, white and glistening while in others there was rough tissue appearing somewhat like granulation tissue. Exploratory needle aspiration showed the mass to be uniformly firm and dense. Nothing was obtained upon attempt at aspiration. Two biopsies were taken. The mass bled freely from the biopsy sites. The histological diagnosis was sclerosing hemangioma (Figure 8c).

Comment: Preoperatively the possibility of the mass in this patient repre-
senting a left ventricular aneurysm, filled with organized clot, was strongly entertained. A teratoid tumor and pericardial coelomic cyst were among other possibilities considered. An accurate diagnosis was most im-
portant from the standpoint of therapy and in order to advise the patient intelligently. He has been allowed to return to his occupation as a truck driver. Periodic chest x-ray films over a period of more than two years have shown no change whatsoever in the size or contour of his mass. The patient is entirely free of symptoms.

Lung biopsy using the open thoracotomy approach. The justification for
the early employment of exploratory thoracotomy in the presence of un-
diagnosed unilateral solid pulmonary infiltrates suspected of being neo-
plastic has been firmly established. Operation under those circumstances
has been widely adopted by thoracic surgeons. Many authors, most re-
cently Overholt, have strongly advocated early exploratory thoracotomy
in the management of so-called “silent” unilateral localized pulmonary
lesions. The utilization of lung biopsy for the diagnosis of diffuse pulmonary
lesions, especially those of bilateral distribution, has achieved much less
popularity. No one can dispute the fact that vigorous efforts should be
made to arrive at a diagnosis without, or prior to, surgery in these cases.
The attending physician must be particularly alert to prove or disprove,
if possible, the presence of pulmonary tuberculosis. Efforts along these
lines frequently fail, however. For both prognostic and therapeutic reasons
an accurate diagnosis is so important that we advocate direct lung biopsy
in such a situation. An intercostal incision has been employed in carrying
out lung biopsy. The incision is placed over the most dense portion of the
mass, or, where serial films have shown its development and spread. We
have chosen to obtain the biopsy from or near the site of origin. Thus an
Figure 9: (a) Posterior-anterior chest x-ray film showing diffuse bilateral pulmonary lesions. (b) Right lateral projection which shows the principal involvement to be in the azygus and posterior portions of the right upper lobe. The histologic appearance is that of sarcoidosis (X220).

Figure 9a: Posterior-anterior chest x-ray film showing diffuse bilateral pulmonary lesions.

Figure 9b: Right lateral projection which shows the principal involvement to be in the azygus and posterior portions of the right upper lobe. The histologic appearance is that of sarcoidosis (X220).
anterior, lateral or posterolateral incision has been used as dictated by
the situation in the individual case. The procedure is not an unduly time
consuming or shocking one and is well tolerated even by patients in poor
general condition. Their convalescence from the operation has been rapid,
morbidity has been almost none and there has been no mortality. We have
not yet employed the approach suggested by Klassen.8 His technique ap-
peals to our imagination, however, because of its apparent speed, safety
and simplicity. We propose to give the method a trial when next presented
with the type of case where its use is recommended by the originator,
namely, a diffuse symmetrical bilateral pulmonary infiltration which has
defied diagnosis by means short of biopsy. The following cases demonstrate
the use and value of direct lung biopsy in the study of diffuse bilateral
pulmonary lesions.

Case 9: C.C.C. This 25 year old white male was transferred to the U. S. Naval
Hospital, St. Albans, New York, on October 3, 1950 complaining of vague chest
pain and a 20 pound weight loss. Physical examination was essentially negative.
Chest x-ray film revealed extensive bilateral upper lobe infiltration. Past history
revealed that he had had a negative chest roentgenogram on June 18, 1948. The
patient had been hospitalized on October 3, 1949 because of findings of a right
upper lobe infiltration. Complete work-up was negative at that time and he was
discharged to duty with the diagnosis of Pulmonary Fibrosis, cause undetermined.
He was re-admitted to the hospital one month later for further study and had
been continuously on the sick list since that time. Sixteen monthly smears and
cultures of the sputum and several of the bronchial aspirate were negative for
mycobacterium tuberculosis. The PPD skin test was three plus in the second
strength. Histoplasmin and coccidioidin skin test were negative. Routine blood
studies, including the erythrocyte sedimentation rate, were within normal limits.
Skeletal survey, including x-ray films of the hands and feet, was negative. Bron-
choscopy revealed nothing significant. The patient continued to have a low grade
elevation in temperature and mild chest pain. He was given a prolonged course
of para-amino salicylic acid and streptomycin with no discernible improvement.
Chest roentgenograms (Figures 9a and 9b), in fact, showed an increase of his
lesions while receiving that therapy.

On May 1, 1951, through a right thoracotomy incision, a wedge resection of a
portion of the superior segment of the right lower lobe was performed. The lung
was found to be filled throughout with nodular infiltrations of varied size. The
upper lobe was found adherent to the mediastinum and thoracic wall and there
were pleural adhesions posteriorly over the superior segment of the lower lobe.
The patient's postoperative course was benign. The pathological report was chronic
granulomatous inflammation of lung, probably sarcoidosis (Figure 9c). Sarcoidosis
was suggested by the well formed tubercles, fibrous tissue, absent caseation and
bizarre giant cells. Smears and cultures of the biopsy specimen were negative
for acid fast bacilli.

Comment: This patient had been hospitalized for 16 months with the
diagnosis of pulmonary tuberculosis and had been continuously under
treatment for that disease while on the sick list. Repeated and intensive
efforts to obtain bacteriological verification of the clinical diagnosis had
failed. His lesions increased while under streptomycin therapy. When ad-
mitted to the thoracic surgical service the patient's apparent state of
health was by no means that to be expected from the appearance of his
chest roentgenograms. He was afebrile, he had no cough or expectoration,
FIGURE 10a: Posterior-anterior chest roentgenogram showing widespread, diffuse bilateral pulmonary lesions.

FIGURE 10b: Lateral view also demonstrates the diffuse involvement.

FIGURE 10c: Photomicrograph of section from tissue obtained at biopsy of the lingula. The histologic diagnosis was eosinophilic granuloma of lung (X400).
his nutritional status was excellent and he was gaining weight. In short, he looked and felt well. Although the future of patients with sarcoidosis is difficult to forecast accurately, the importance to this patient of knowing that he does not have tuberculosis is apparent. He can now be discharged from the sanitorium. Cortisone or ACTH can be safely employed if desired.

Case 10: P.Y.* This 42 year old white male was admitted November 15, 1949 with a history of a "cold" of one month's duration and a dry non-productive cough for two weeks prior to admission, associated with a 20 pound weight loss and marked fatigue. His past history revealed exposure to asbestos for seven years preceding entry to the hospital. Physical examination revealed a diminution of breath sounds bilaterally throughout the lower one-half of the lung fields. There were no rales. Chest x-ray films (Figures 10a and 10b) on admission showed evidence of bilateral discrete parenchymal infiltration in both lungs, more prominent in the region of the mid-lung zone. There was no definite evidence of cavitation. The admission diagnosis was probable bilateral pulmonary tuberculosis.

Routine work-up showed moderate anemia. The tuberculin reaction was positive in the second strength. Sputum studies by smear and culture were negative for acid fast bacilli. No asbestos bodies were found and cultures of the sputum for fungi revealed only monilia. Bronchoscopy showed mucopurulent secretions in the bronchial tree. Smear and culture of the aspirate were negative for fungi and acid fast bacilli. Papanicolaou cellular studies were negative for neoplasia. Gastrointestinal series, barium enema, electrocardiogram and respiratory function studies were within normal limits. The patient continued to have a low grade elevation of temperature.

On January 16, 1950 a lung biopsy from the lingular division of the left upper lobe was done through a left lateral thoracotomy incision. Histologic studies showed focal chronic granulomatous inflammation of the lung with marked eosinophilic reaction; etiology undetermined* (Figure 10c). The microscopic appearance of the lesions bore a strong resemblance to that seen in eosinophilic granuloma of bone. Histologically, also, this case resembled Loeffler's disease of the lung but clinically it differed in that the lesions in Loeffler's syndrome are characteristically fleeting and migratory. Similar cases, also proved by lung biopsy, have been reported by Farinacci and associates. The patient's postoperative course was benign. He was discharged to home February 4, 1950. Since that time he has been followed in the Out-patient Department and his chest x-ray films have shown steady regression of the pulmonary lesions. At the present time his chest roentgenograms present an essentially normal appearance. He is working full time and is entirely free of symptoms.

Comment: In this case also the diagnosis of pulmonary tuberculosis was strongly considered. The entire management of the case, not to mention the prognosis, was radically altered as a result of the diagnosis established by lung biopsy.

Case 11: J.H. This 24 year old white male was admitted to the sick list September 23, 1950 because a routine chest film on recall to active duty revealed a nodular density far laterally at the level of the right third anterior interspace. For three months the patient had had right subscapular pain and for one month a dry cough. Physical examination was essentially negative. Routine laboratory studies were within normal limits. Review of his chest x-ray film dated June 21,

*Note: Detailed histologic studies of this case, with others of similar type, are to be reported in detail in another publication by the Department of Pathology of this hospital.
Figure 11: (a) Posterior-anterior chest x-ray film showing widespread, diffuse bilateral pulmonary infiltrations. (b) Posteroanterior fluoroscopic chest x-rays: (1) extreme of the lesion (2) microphotograph of section from tissue obtained at biopsy of the anterior segment of the right upper lobe. The histologic diagnosis was terminal bronchial alveolar cell carcinoma (XX/100).

FIGURE 11a

FIGURE 11b

FIGURE 11c
1949, taken prior to recall to active duty, showed a similar lesion. This film had been interpreted as negative. The diagnosis of pulmonary tuberculosis was made on clinical evidence. All sputum and gastric washings were negative for acid fast bacilli. A PPD skin test was positive in the first strength. The histoplasmin and coccidioidin tests were negative. Bronchoscopy was negative. The bronchial aspirate showed no neoplastic cells. The patient's course in the hospital was febrile with roentgen studies showing a diffuse spread of the disease, compatible with hematogenous tuberculosis. They also indicated the development of a pericardial effusion (Figures 11a and 11b). He was placed on streptomycin and para-aminosalicylic acid with no improvement. Pericardiocentesis on two occasions produced 500 and 800 cubic centimeters of frankly bloody fluid which contained abnormal cells of indeterminate type. The slides were reviewed by Dr. Papanicolaou who considered them suspicious of malignancy (Class III).9 No primary site could be found. Muscle and peripheral lymph node biopsies were negative. A lung biopsy was performed on January 27, 1951. The specimen was obtained from the original lesion in the anterior segment of the right upper lobe. Histologic study showed a terminal bronchiolar or alveolar cell carcinoma of the lung (Figure 11c). Although the patient was in very poor general condition at the time of thoracotomy, he withstood the procedure well and it did not appear to produce any demonstrable deleterious effects. His subsequent course was progressively downhill until his death on March 16, 1951. Autopsy showed extensive bilateral bronchiolar carcinoma with widespread metastases.

Comment: Again in this case a diagnosis of pulmonary tuberculosis was made on the basis of clinical evidence without bacteriological proof. The patient was placed on an antituberculosis regimen but failed to respond. Since many features of his disease did not appear characteristic of tuberculosis, lung biopsy appeared to be justified in order to establish an accurate diagnosis. Unfortunately, the presence of a condition for which no effective treatment is available was verified. However, this scarcely can be used as an argument against the biopsy technique employed nor can it be said to negate the value of the procedure.

Case 12: C.G.S. This 29 year old white male was well until April 1949, when he developed jaundice associated with back pain and anorexia. Due to the persistent signs of biliary obstruction an exploratory laparotomy was performed in May 1949 and a questionable mass was felt at the distal end of the common duct. A cholecystectomy was performed with T-tube drainage of the common duct. In December 1949 the patient had a similar episode. Studies showed moderate liver parenchymal disease with intermittent obstruction. A routine chest roentgenogram on February 2, 1950 revealed a left lower lobe infiltrate. PPD, histoplasmin and coccidioidin skin tests were negative. Repeated smears and cultures were negative for acid fast bacilli and fungi. On May 18, 1950 another exploratory laparotomy was performed with the finding of an obstruction in the common duct, thought to be due to a stone. The biliary tract was dilated and T-tube drainage again instituted. Serial chest x-ray films revealed a spread of the original pulmonary lesion to involve the entire left lower lobe with multiple infiltrations throughout both lower lung fields (Figures 12a and 12b). Bronchoscopy was normal. Papanicolaou stains of the bronchial aspirate was reported as suspicious of malignant change. On May 7, 1951 a lung biopsy was performed with wedge excision of a portion of the anterior segment of the left lower lobe. At operation the entire lower lobe was found to be consolidated and of liver-like consistency. Smaller areas of similar involvement were present in the upper lobe. A slimy mucoid material exuded from the cut surface of the lung. There were no air leaks when the biopsy was taken, for the pulmonary parenchyma had been totally invaded by what proved to be car-
Figure 12: (a) Posterior-anterior chest x-ray film showing extensive lesions in both lower lung fields. (b) Left lateral view which shows that both the upper and lower lobes are involved. (c) Photomicrograph of section from tissue obtained at biopsy of the left lower lobe. The histologic diagnosis was mucoid carcinoma, compatible with primary bronchiolar carcinoma of the lung or metastases from a primary malignancy of the bowel (X220).
cinoma. Histologic examination (Figure 12c) showed the lesion to be a mucoid carcinoma, most likely a terminal bronchiolar or alveolar-cell carcinoma, although metastasis from a primary in the gastrointestinal tract could not be definitely excluded. Thoracotomy was well tolerated by this chronically ill patient. His postoperative course was benign. However, his general condition continued to deteriorate slowly. Repeat x-ray film studies of the large and small bowel and upper gastrointestinal tract were again negative. The patient has been discharged to home for terminal care. The prognosis is judged hopeless. Although still alive at this writing (August 26, 1951), a recent follow-up letter from his family states that his downhill course continues. This patient has since died. Postmortem examination showed a primary mucinous adeno-carcinoma of the pancreas. The pulmonary lesions were metastatic.

Comment: Although lung biopsy did not conclusively establish the site of origin of the tumor, the procedure did essentially clarify the diagnosis, enable a prognosis to be offered, and point to a rational plan of management of the case. It is again unfortunate that the lesion found in this case was not one amenable to therapy, but the pulmonary lesions could have been inflammatory and multiple infarcts was another one of the possibilities considered preoperatively. The fact that a lesion which could not be successfully treated was found at lung biopsy certainly lessened, but by no means destroyed, the usefulness of an accurate histologic diagnosis.

SUMMARY

1) Ideal therapy of intrathoracic lesions cannot be undertaken without an accurate histological diagnosis.

2) The role of bronchoscopic and esophagoscopic biopsy in the investigation of thoracic lesions has long been firmly established and the necessity for early exploratory thoracotomy in the management of undiagnosed unilateral solid pulmonary infiltrates suspected of representing bronchogenic carcinoma has been widely accepted in recent years.

3) There are other biopsy techniques available for the study of intrathoracic disease that do not appear to have been generally utilized. These include: (a) Resection of the deep cervical fat pad and its contained nodes, (b) mediastinal biopsy at open thoracotomy and (c) lung biopsy at open thoracotomy. We have used each of these methods in an appreciable series of cases and in practically every instance it has been possible to establish a definite histological diagnosis. The procedures have occasioned minimal morbidity and no mortality. They appear to merit more widespread use in the investigation of chest lesions posing difficult diagnostic problems.

4) Cases are reported to illustrate the use of each of the three foregoing methods.

RESUMEN

1) No puede emprenderse el tratamiento ideal de las lesiones intratorácicas sin un diagnóstico histológico exacto.

2) El papel de la biopsia broncoscópica y esofagoscópica de las lesiones torácicas ha sido firmemente establecido hace tiempo y la necesidad de la exploración por toracotomía temprana en el diagnóstico y tratamiento de los infiltrados unilaterales sólidos sospechosos de carcinoma bronquigénico ha sido ampliamente aceptado en los años recientes.
3) Hay otras técnicas para el estudio de las enfermedades intratorácicas, cuyo uso no parece haberse generalizado. Tales incluyen: (a) resección de la grasa profunda cervical y de sus ganglios incluidos, (b) biopsia mediastínica durante la toracotomía, y (c) biopsia del pulmón por la toracotomía a cielo abierto. Hemos usado cada uno de estos métodos en una serie apreciable de casos y prácticamente en cada caso ha sido posible establecer un diagnóstico histológico definido. El procedimiento tiene una morbilidad ocasional mínima y ninguna mortalidad. Estos procedimientos merecen mas difusión en su uso para la investigación de las lesiones del torax que presentan dificultad para el diagnóstico.

4) Se presentan casos que ilustran cada uno de los tres métodos.

RESUME

1) Le traitement idéal des lésions intra-thoraciques ne peut être entrepris sans un diagnostic histologique préalable.

2) Le rôle de la biopsie bronchoscopique et oesophagogastrique dans le diagnostic des lésions thoraciques est solidement établi. De même, on a largement accepté ces dernières années la nécessité d’une thoracotomie exploratrice précoce pour préciser la nature d’infiltrats pulmonaires denses unilateral, suspects de représenter un cancer bronchique.

3) Il existe d’autres techniques de biopsie pour l’étude des affections intrathoraciques que ne semblent pas avoir été utilisées de façon générale. Elles comprennent: (a) la résection du ganglion cervical et des nodules qu’il contient, (b) la biopsie médiastinale après thoracotomie large, (c) la biopsie pulmonaire après thoracotomie large. Nous avons utilisé chacune de ces méthodes pour un nombre appréciable de cas, et pratiquement pour chacun d’eux il à été possible d’établir un diagnostic histologique précis. Ces techniques n’ont causé qu’une faible morbidité et pas de mortalité. Elles semblent mériter de se généraliser dans la recherche des lésions pulmonaires posant des problèmes diagnostiques difficiles.

4) Les auteurs rapportent des cas illustrant chacune de ces trois méthodes.

REFERENCES


10 Papanicolaou, George N.: Personal communication.