TUMORS OF THE CHEST

Tumors of the chest present a very interesting and at times puzzling group of conditions which may tax to the very limit the diagnostic and therapeutic acumen of even the most experienced physician.

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Because of the wide variety of structures normally within the chest, many different types of masses may be encountered . . . some of them commonly . . . others infrequently . . . many very rarely. Some may be easily recognized. Others require considerable study for their proper evaluation. Still others defy any accurate clinical or preoperative diagnosis and may even baffle the pathologist after removal when all local relationships and site of origin are accurately known.

Probably no other individual in the world knows more about [t]umors of the chest than Doctor [K]insella. He writes with an au[th]ority that stems from tremen[d]ous experience in gross and [m]icroscopic pathological observation, diagnosis, and surgical technique.

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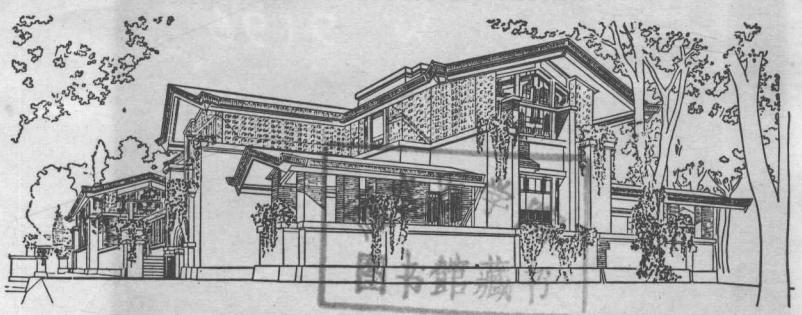

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Preface

TUMORS of the chest present a very interesting, and at times very puzzling group of conditions which may tax to the very limit the diagnostic and therapeutic acumen of even the most experienced physician. Virtually an unknown field except for tumors of the chest wall prior to the days of x-ray studies of the chest, it increased very rapidly as x-ray films in the Public Health Surveys and routine hospital admissions revealed many hitherto unsuspected and clinically unrecognized conditions. There are no accurate figures on the exact incidence of the chest tumors in the general population, but certain studies of large groups of individuals have revealed approximately two tumors per 5,000 films made.

Chest tumors, exclusive of those arising from breast, skin and subcutaneous tissues, may for purposes of description be considered under tumors of the chest wall, tumors of the mediastinum and diaphragm, and tumors of the lung. Within each category, they may be divided into benign, primary malignant, metastatic tumors, and inflammatory masses which may be confused with tumors. Because of the wide variety of structures normally within the chest, a great variety of masses may be encountered, some of them commonly, others infrequently, and many very rarely. Some may be easily recognized; others requires considerable study for their proper evaluation; while still others defy any accurate clinical or preoperative diagnosis, and may even baffle the pathologist after removal when all local relationships and site of origin are accurately known.

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Chapter 1

Mode of Discovery

WHILE some thoracic tumors present themselves exteriorly and hence are easily recognized as such, the majority are deeply placed and do not come to the patient's attention. Some thoracic tumors produce symptoms for which the patient seeks relief and which will direct attention to a local tissue or organ for study as to the possible cause of the trouble. Many, however, produce no such localizing signs and are found only by careful study while many more are completely silent and hidden, and are discovered accidentally or at least unexpectedly in the course of examination, oftentimes while searching for other things. Routine x-ray studies, either on community-wide surveys or on routine hospital admission, have brought to light thousands of chest tumors completely unsuspected by the individual or his clinician.

HISTORY

The history of the patient with a chest tumor may be significant, especially in the patient who has discovered a "lump" himself or one who has chest pain, tightness, shortness of breath, dysphagia, cough, expectoration, hemoptysis, wheezing, orthopnea or cardiac disturbance. It may serve to direct the physician's attention to a certain intrathoracic organ or structure for an explanation of the symptom. On the other hand, probably the majority of tumors even including some of large size, produce few or no symptoms to direct the physician's attention to it. Many may remain completely silent for long periods of time, even when known to exist. History taking should include questions relative to function or malfunction of the organs normally resident within the chest, those which traverse it, and even to some of its close neighbors such as thyroid, stomach, colon, which may invade the chest but are not normally resident therein.

A history of distant organs and past happenings may also be important in determining the nature of an intrathoracic mass. A past history of trauma may explain the presence of the spleen, omentum, stomach, colon, small intestine or liver within the thoracic cage. A previous history of goiter or a thyroid operation may give the clue which leads to the recognition of a displaced or intruding substernal thyroid. A history of urinary or gastrointestinal bleeding may lead to the discovery of a malignant tumor in the urinary tract, colon or stomach with metastatic extension, perhaps presenting as a chest tumor. A history of joint trouble, a draining sinus, fistula in ano, or urinary symptoms may give the clue to the recognition of a tuberculous process which may also be the cause of the questionable chest lesion. The history must be complete and extensive as all good histories should be. It may well pay off for the time and care spent upon it.

PHYSICAL EXAMINATION

Inspection

Tumors of the chest wall bulging outwards may be visible on simple inspection. Tumors of the ribs and sternum and also

cartilages, scapulae and clavicles usually present in this way, as do ulcerating abscesses of empyema, chondritis, suppurating parasternal nodes, and osteomyelitis; whereas many tumors of the ribs, cartilage and intercostal nerves only rarely present externally. Any tumor in the chest may alter respiration, rib or diaphragmatic motion, cause bulging, retraction or pulsation in intercostal spaces, and change the general contour of the chest to give visible evidence of its presence. Many such alterations are significant.

Palpation

Careful palpation of the chest may reveal many findings of diagnostic importance. Muscle spasm, muscle atrophy, local induration or softening, local temperature changes, change in excursion or mobility, normal or abnormal pulsations, alterations in tactile fremitus, palpable vibrations or thrill, may all have diagnostic significance.

Percussion

Percussion of the chest and its contents by direct and indirect techniques is still a valuable method of examination, in outlining organs and abnormal masses. Alteration in resonance, tympany, dullness, and flatness may help to establish the diagnosis without special studies.

Auscultation

The stethoscope still is a valuable diagnostic instrument, when duly appreciated and utilized by the examiner. Too commonly, it is totally discarded and complete reliance placed upon the laboratory studies to make or confirm the diagnosis. Alterations in the heart tones, their character and positions, the presence of murmurs or bruits, alteration in breath sounds from normal to distant or their absence in local areas, amphoric transmission, the presence of a local wheeze or rhonchus, may be of great aid. Variations in these findings may indicate emphysema, pneumothorax, pleural effusion, consolidations of various types and bronchial obstructions and compressions, and may give the clues which establish the diagnosis. Auscultation of the abdomen as well as the chest should be important and familiarity with it more so. The recognition of bowel sounds in the chest in diaphragmatic hernias, both traumatic and congenital, and the recognition of a perisplenic friction rub as distinguished from a pleural friction rub, may be of value to the clinician.

General Physical Examination

The making of a complete physical examination is always important, but especially so in the study of a patient presenting some bizarre condition within the chest. Many comparatively simple things at a distance from the thorax may give the clue which establishes the diagnosis of the condition within the chest. Headache, swallowing difficulty, or the eye signs of a cerebral lesion may point to a cerebral metastasis from carcinoma of the lung. Alteration in voice and phonation may call attention to a vocal cord paralysis secondary to bronchogenic carcinoma, substernal thyroid or other malignancy within the chest. The eye changes of a Horner's syndrome, lack of sweating, difference in color of the two sides of the face may call attention to a sympathetic nerve trunk interruption by bronchogenic carcinoma, lymphoma, aneurysm, or neurogenic tumor. Changes in the neck, axilla, or groin may give evidence of leukemia or Hodgkin's disease to explain other masses within the chest. The finding of an abdominal or pelvic mass may point to an abdominal pri-

mary malignancy with metastasis appearing in the chest as an isolated tumor. Pelvic examination may reveal a local tumor to explain an otherwise mysterious pleural effusion (Meig's syndrome). Alteration in reflexes or knee jerks may call attention to central nervous system lues to suggest that an intrathoracic mass may be an aneurysm. Innumerable examples could be cited, which emphasize the importance of a complete and thorough physical examination on all patients, even though all interest and information seems to point exclusively toward the thoracic cage.

SPECIAL EXAMINATIONS

X-ray

Probably the single most important examination for the recognition and diagnosis of thoracic tumors is the roentgen-ray examination of the chest. For screening purposes, a single 14 by 17 inch x-ray picture will reveal the majority of thoracic tumors, even though an occasional tumor such as a small mediastinal dermoid or teratoma, a small thymic tumor or an occasional carcinoma may be hidden by the cardiac shadow or be lost in the mediastinum. The small 70 mm., or slightly larger film, will usually reveal the larger thoracic tumors but may not show some of the smaller tumor masses. Stereoscopic 14 by 17 inch films of the chest are of distinct value in certain situations but do not as a rule give as much information as may be obtained by the single posterior-anterior and lateral views. Without question, the best secondary view to be obtained should be the lateral chest film either right or left, depending upon the side in which the tumor lies. The lateral chest film not only completes the three dimensional view of the tumor mass but definitely localizes its position in the front, middle or back of the chest which aids greatly in the differential diagnosis for different tumors have certain choice locations for their occurrence.

Chest films, both posterior-anterior and lateral, made with increased penetration for bone detail may show bone erosion or destruction or the presence of calcium or bone or teeth within the tumor mass which is of distinct help in differential diagnosis. Planigrams in the posterior-anterior or lateral position or both may give valuable information as to location, density, softening or cavitation, the presence or absence of calcium or bone, and some detail as to narrowing, displacement or compression of trachea or bronchi, and the width of the subcarinal angle. Posterior-anterior and lateral chest films made with the esophagus filled with barium may also aid in the localization and differential diagnosis as to whether tumors are of the mediastinum or closely related to it, such as intramural esophageal tumors, diverticulae, esophageal wall tumors, diaphragmatic hernia and other mediastinal masses. Visualization of the stomach, small intestine and colon may help considerably in eventration or displacement of the diaphragm, in diaphragmatic hernias, and at times in reduplication of intestinal segments.

A roentgen kymogram may occasionally be of value in helping to determine whether a given mass presents an expansile or transmitted pulsation in a differential diagnosis between an aneurysm and a tumor riding on the aorta or pericardium. Bronchograms using iodized oil or dionosil or one of the other opaque media may reveal bronchial tumor, stricture or obstruction, tracheal or bronchial compression or displacement, and at times may reveal a cavity or abscess communicating with a bronchus. They may also clearly show the displacement of the lung by tumor or pleural fluid accumulation, and at times may out-

line a fistula between bronchus and esophagus. Fluoroscopic study may enable one to recognize pulsation, shifting, the angles of one organ with another, and last of all, diaphragmatic motion.

Diagnostic Pneumothorax or Pneumoperitoneum

Diagnostic pneumothorax or pneumoperitoneum may be used to advantage upon occasion to differentiate between tumors of the chest wall and the lung, or between one in the mediastinum or in the lung, or to separate the lung from the diaphragm to more clearly outline a mass in this region. Aspiration of pleural fluid and its replacement with air may clearly visualize pleural deposits or underlying tumor in the lung, chest wall or mediastinum which has been obscured by the fluid. Diagnostic pneumoperitoneum may help to differentiate between masses in the liver or in the diaphragm and those lying in the mediastinum, pericardium or lung.

Chapter 2

Diagnostic Procedures

Thoracoscopy

THORACOSCOPY may at times give information to establish the diagnosis and perhaps save the patient an unnecessary thoracotomy. When used after diagnostic pneumothorax or after fluid has been aspirated from the pleural space and replaced with air, one may through the thorascope recognize tumor implants on the surface of the lung or pleura and through a secondary opening may obtain biopsy material to establish the diagnosis of a malignant process that has metastasized to the pleura; and prove the condition is not amenable to surgery with any hope of cure.

NEEDLE BIOPSY

Direct needle biopsy of peripherally located chest tumors may furnish material to permit a definite diagnosis of the nature of the presenting tumor. It should not be used as a routine measure in a patient otherwise suitable for surgery, but probably should be confined to the patient unsuitable for major surgery for one of many reasons and in whom a pathological diagnosis is desirable before resorting to radiation therapy, intravenous injections or similar non-surgical treatments. It is of little value in the more centrally developing malignant processes. The procedure itself is not wholly without risk as serious bleeding can be initiated and dissemination of infection as well as tumor cells can be brought about in this way.

LABORATORY STUDY

It goes without saying that all patients presenting chest tumors should have a routine examination of urine and blood, including at least a hemoglobin, leukocyte and differential count, and sedimentation rate. A low hemoglobin reading may be an indication of serious bleeding which has occurred or of the cachexia resulting from a malignant tumor. Alterations in the leukocyte count may give a clue to an inflammatory process, to necrosis of a tumor mass or to leukemic process otherwise unsuspected. In like manner, the differential count may suggest a leukemic process, pyogenic infection or an eosinophilic disturbance. The sedimentation rate may be elevated in infection, abscess, carcinoma, necrosis of tissue and pleural effusion.

The urine examination for sugar is important because of the special care needed in surgery upon the diabetic. The finding of albumin or abnormal cells gives the clue to a malignancy of the bladder or a hypernephroma or renal tuberculosis, which may be significant in the consideration of the presenting lung mass. Such findings may give the clue to indicate intravenous urography or cystoscopy and retrograde pyelograms, or ureteral cultures for better evaluation of the urinary tract. Renal function studies may be indicated and in some cases, liver function studies should be made in patients with a history of jaundice, liver enlargement or suspected liver metastasis.

BONE MARROW BIOPSY

Sternal bone marrow biopsy may be particularly valuable in patients with lymph node enlargements in whom it may occasionally give information concerning a blood dyscrasia or may show the granulomas of sarcoid or tuberculosis and rarely metastatic tumor or myeloma.

SPUTUM STUDY

Careful examination of the sputum may suggest bronchiectasis, lung abscess or empyema with bronchial fistula depending upon whether it is pure pus, mucopurulent, or foul smelling. The presence or absence of blood should also be noted. The presence of hair or greasy material suggests a draining dermoid. Bits of tissue should be examined microscopically for carcinoma or other tumor. Microscopic study of the sputum, fresh or preserved, for tumor cells in the hands of experienced pathologists is a valuable method for diagnosing carcinoma of the lung, but unless a rather wide experience has been acquired, it can lead to serious error. An inflammatory lesion such as bronchiectasis can produce cells easily confused with malignant cells.

Sputum smears should be routinely examined for the presence of tubercle bacilli. Tuberculosis is frequently hidden and obscured by or confused with other conditions. Special cultures for tubercle bacilli should be almost routinely made on patients who have cough or expectoration. Exploration or definitive surgery for carcinoma should not be delayed, however, for the six or eight weeks necessary for reports on such cultures if malignancy is strongly suspected. Culture for secondary organisms and sensitivity studies should be made frequently in order that the proper antibiotics for control of the predominant organisms may be accurately determined. Potassium hydroxide preparations of fresh sputum may reveal fungi of clinical significance. Cultures for fungi on special culture media may be diagnostic under certain conditions, but care must be used in interpreting the findings because of the number of saphrophytes encountered.

Pleural fluid if available must be studied bacteriologically by smear and culture for secondary organisms and for tubercle bacilli. Negative culture for tubercle bacilli does not necessarily rule out tuberculosis for even in the presence of known clinical tuberculosis, over half of these fluids will not show organisms on either smear, culture or guinea pig inoculation. A bloody pleural fluid on first tap is strongly suggestive of malignancy, primary or metastatic, though it is occasionally seen in the presence of benign tumors, tuberculosis and other inflammatory lesions. The presence of blood in fluid obtained at subsequent aspirations is less significant as it is frequently traumatic in origin. A search for malignant cells in pleural fluid should always be made and may confirm the diagnosis of a malignant lesion. A bloody pleural effusion containing malignant cells is more often the result of a primary bronchogenic carcinoma than metastatic tumors, but there are exceptions to this finding. Diagnostic errors may easily be made on certain acute inflammatory lesions which produce cells showing mitotic figures closely resembling malignant cells.

BRONCHOSCOPY

Bronchoscopic examination carefully done by an experienced bronchoscopist thoroughly familiar with normal intrabronchial relationships and their variations is of extreme value in diagnosis and at times in treatment of intrathoracic diseases. This inspection must not only include visualization of the larynx and vocal cords, tracheal walls and the major bronchi for intrinsic

lesions but must record evidences of displacements, abnormal pulsations, external rigidity or compression, alterations of the subcarinal angle and positions of various secondary orifices resulting from extrinsic causes. Localization of the source of secretions or bleeding may be equally as valuable as the visualization of a tumor. Recognition and removal of a foreign body of extrinsic or of local origin may be of help. Inspection of the larynx and vocal cords should also be made. Paralysis of the left vocal cord from malignant infiltration under the aortic arch is not an infrequent complication of carcinoma of the lung.

Since the introduction of telescopes which may be introduced through a bronchoscope, the field of bronchoscopic visualization of the major bronchi, secondary and even at times a portion of the tertiary divisions in some segments has been greatly enhanced. Right angle telescopes permit the visualization of the orifices of the upper segments of right and left lower lobes which cannot be seen through the direct bronchoscope. The fore-oblique telescopes in like manner facilitate the exploration of the middle lobe and the lingula and some of the basal segments. The retrograde telescope has a very restricted field of usefulness. The use of curved aspirating tubes and curved biopsy forceps may occasionally procure material not otherwise obtainable.

ESOPHAGOSCOPY

Esophagoscopy can be equally helpful, not only in diseases of the esophagus but in some processes originating in adjacent structures. Recording of displacements, compressions, bulgings, pulsations, perforations and so forth may aid greatly in making the final diagnosis of certain intrathoracic conditions. Compression of the esophagus by a vascular ring or its perforation by a bronchogenic carcinoma are only two examples of the help that may be obtained in this way.

BRONCHIAL AND ESOPHAGEAL BIOPSY

Biopsy of intrinsic masses in the bronchial or esophageal lumen offer one of the best means of arriving at a positive diagnosis. At times biopsy through the normal mucosa in the region of the carina will give evidence of submucosal carcinomatous infiltration extending well beyond the limits of visible tumor. Carinal mucosal biopsy may give as high as 50 per cent positive biopsy results in Boeck's Sarcoid.

BRONCHIAL WASHINGS AND ASPIRATED MATERIAL

In the absence of definite biopsy material, microscopic and cultural studies of material aspirated from the bronchial tree or obtained by irrigation and aspiration from a certain isolated segment may demonstrate carcinoma cells or the causative organism of an inflammatory process. These should be almost routine when tissue cannot be obtained in any other way.

LYMPH NODE BIOPSY

Biopsy of presenting lymph nodes, particularly from the axillary or cervical region, may furnish material to establish a diagnosis of carcinoma, sarcoid, tuberculosis or lymphoblastoma. Information may at times be obtained by resection of the fat pad overlying the scalenus anterior muscle on one or both sides with microscopic section of the small lymph nodes contained therein. This material is especially valuable in carcinoma of the lung, lymphoblastoma and sarcoid, particularly the latter, where a high percentage of positive nodes will be found.

It must not be assumed that this entire battery of examinations and tests must be

carried out on every patient who presents a thoracic tumor or a suspicion thereof; in fact, not even a small fraction of them may be necessary or advisable for the majority of tumors encountered. In certain situations, many of them may be necessary or advisable, whereas, in other situations the whole battery of tests may not add anything in a diagnostic way to the information that can be obtained by simple posterior-anterior and lateral chest films. One can literally spend hundreds of dollars of the patient's money and much of his time and energy to no avail. Good clinical judgement here may mean a great deal to the patient's pocket book. The exact nature of many thoracic tumors cannot be accurately diagnosed preoperatively, even if every test in the book is applied, prior to surgical intervention.

It makes no difference to the patient in many instances whether an exact diagnosis is made beforehand or not. If the tumor is there, and the relative chances of its being benign or malignant are known, and if it must be removed, there is really nothing to be gained by many additional examinations. Frequently the surgeon with the lesion before him cannot tell exactly what it is, and the pathologist may be able to reach an accurate diagnosis only after extensive study. The diagnostic studies, therefore, should be held to the minimum consistent with careful work in determining what therapeutic procedure should be followed. By and large there are not many chest tumors which may be trusted very far. There are too many malignant tumors among them and even a number of the benign tumors may cause serious trouble for the patient. Taken as a whole, the majority of them are best treated by surgical means. There is only one location in the chest, namely the anterior pericardiophrenic angle, in which the majority of the conditions encountered may be treated by observation only with little chance of serious complications. In all others, the percentage chances of trouble are too great to be ignored.

Chapter 3

Surgical Approach

DIRECT surgical approach to the tumor itself is indicated in most chest wall tumors except the intrathoracic neurogenic tumors, for the majority must be excised en masse because of their malignant potentialities. It is well to remember in approaching such tumors that reconstruction of the chest wall must be accomplished; consequently, due thought must be given to the placing of the incision and to saving the flat muscles, pectoralis major, seratus anterior and latissimus dorsi, for subsequent use in the reconstruction procedure. The maximum amount of bony chest wall consistent with the proper surgical treatment of the lesion must be conserved for stabilization purposes in conjunction with muscular or fascial transplants, wire mesh or plastic prostheses.

The anterior intercostal approach with section of one or two cartilages is adequate for the removal of small anterior mediastinal tumors such as cysts, thymomas, smaller teratomas, pericardiophrenic angle cysts, and if structures are not too adherent, middle lobe lobectomy. Lobectomy or total pneumonectomy may be carried out through this exposure, but some of the other exposures are more convenient. For some of the larger anterior mediastinal teratomata, total thymectomy and for some cardiac work, a bilateral curved sub-mammary incision with bilateral intercostal incisions, and transection of the sternum at the level of the third or fourth interspace opening both pleural cavities affords excellent exposure. A low cervical collar incision with vertical extension down the midline into the thorax with splitting of the sternum may give adequate exposure for deliverance of the large substernal mass through the superior aperture of the thorax. It is well to remember, however, that many of these tumors, when freed from their upper attachments and their blood supply, may be delivered through the collar incision without the necessity of splitting the sternum if intratracheal anesthesia is used to maintain a free airway.

The direct lateral approach, with or without the resection of one rib, with the patient lying on the contralateral side affords excellent exposure for the majority of intrathoracic lesions, for the lung, anterior and posterior mediastinum are readily accessible. It has the disadvantage in the patient who has profuse pulmonary secretions which tend to flood the dependent lung and interfere with aeration and in the case of tuberculosis where such aspiration may bring about bronchogenic spread of disease. This is not as important now with adequate chemotherapy available as it was previously when no such protection was at hand. It has the added disadvantage of impeding the expansion of the dependent lung, predisposing to carbon dioxide build-up and changes in the hydrogen ion concentration of the blood, unless the anesthesiologist is especially vigorous in his assisted respiration.

The posterolateral approach, with or