Fluoroscopy of the Chest

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A postero-anterior teleorontgenogram of the chest is primarily a "scout" film, and diagnosis based solely on such an examination is often little more than guesswork. However, this film serves admirably in detecting most lesions, and aids in determining what additional studies need to be performed. Unless the clinical or roentgen diagnosis is evident, one should then proceed with further roentgen study.

As a general rule this should begin with fluoroscopy. A complete chest fluoroscopy can be accomplished within a few minutes if the examiner applies a well-organized approach. For purposes of instructing students and residents, we have divided pulmonary fluoroscopy into five phases which we have designated as Observation, Rotation, Breathing, Ingestion and Tilting. Their first letters spell the word ORBIT, which serves as a mnemonic.

1. Observation. After preliminary fluoroscopy of the entire chest, including the heart, attention is directed to the lesion in question. Its size, shape, homogeneity and margination are closely studied. The presence or absence of pulsation should be noted. However, this is of little significance unless opposite sides of the lesion can be seen simultaneously, since differentiation between transmitted and intrinsic pulsation cannot otherwise be made. Even under those conditions aneurysms cannot be reliably distinguished from tumors, since aneurysms often contain clot which interferes with expansile pulsation, and tumors occasionally surround a vessel and may then appear to pulsate expansively.

2. Rotation. By slightly rotating the patient (10 to 20 degrees) one can quickly establish whether a density lies anteriorly or posteriorly. Storch1 utilizes the sternum and spine as reference points. If, on rotation, the lesion moves in the same direction the spine moves, it is posterior, whereas if it moves with the sternum it is anterior in location (Fig. 1). The amount of movement of the lesion indicates how far it lies from the center of the thorax (the vertical axis on which the patient is rotated). Thus, peripheral lesions shift more with rotation than central ones.

Rotation serves to separate a lesion from adjacent structures so that a clearer view of it is obtained. Obviously, if the lesion can be separated entirely from a superimposed structure by rotation, there is little likelihood that it is connected with that structure. Rotation is also helpful in differentiating hilar node enlargement from vascular shadows, the nodes remaining rounded while vascular shadows elongate or disappear as the patient is turned.

As a lesion comes closer to the fluoroscopic screen, its image appears smaller and sharper. If a density is smaller in the postero-anterior projec-
Figure 1: Right superior mediastinal mass localized by rotation during fluoroscopy.

Spot films: A. Straight frontal view. B. Ten degrees rotation to right. C. Twenty degrees rotation. With increasing rotation, the lateral border of the mass (retouched) shifts away from the right border of the spine (dotted line) and moves in the same direction as the manubrium (retouched). This indicates that the mass lies far anteriorly in the thorax. A thymic cyst was found at operation.
tion (patient facing the screen) than in the antero-posterior, it lies in the anterior half of the thorax. The patient must be in true frontal position and in contact with both table top and screen for the results of this maneuver to be valid.

Another method of localization can be utilized. With the patient facing the screen, the shutters are opened fairly wide and the screen positioned so that the image of the lesion lies on one side of the visible fluoroscopic beam. The screen is slowly shifted transversely in the direction of the lesion, which now seems to move. The greater this apparent movement, the more posterior is the lesion. Localization by this method requires considerable practice and experience, so it is not widely used. However, by taping a coin to the skin over the image of the lesion and observing the relative movement between the coin and the lesion as the screen is shifted, the interpretation is simplified.

3. Breathing. It is important to study the movement of the abnormal shadow as the patient breathes. During inspiration the spine remains relatively immobile while the ribs move upward, the diaphragms and lungs move downward, and the vascular markings spread apart. By careful observation during respiration it is often possible to relate a lesion to the mediastinum, thoracic wall, heart, diaphragm, or lung. A point of reference is taken in sequence on each structure in close proximity to the abnormal density, and the relative movement between this structure (rib, vertebra, segment of the heart, etc.) and the density in question is noted. If the two move together as a unit, a connection between them is postulated, but even the slightest amount of independent movement indicates that they are not intimately associated.

A recent case serves to illustrate the value of this technic (Fig. 2). A mass was discovered in the left lower posterior thorax adjacent to the

![Figure 2A](image1)
![Figure 2B](image2)

*Figure 2: Mass in posterior segment of left lower lobe. Upper border of the mass (arrow) moves slightly in relation to the overlying ninth thoracic vertebra and posterior ribs (see text). The localization was confirmed at operation. A. Inspiration. B. Expiration.*
spine. Fluoroscopically, the left diaphragm showed limitation of motion. With respiration the mass moved slightly in relation to the adjacent immobile vertebral bodies and the superimposed posterior ribs. It was, therefore, concluded that the mass did not arise in the spine or chest wall, but was primarily a lower lobe lesion. This was also supported by the observation that the mass moved as a unit with the vascular markings in the adjacent lung. At operation, the mass was found in the posterior basal segment of the left lower lobe.

The effect of respiration on the heart and mediastinum should also be carefully observed. In obstructive emphysema, as well as in collapse, the mediastinal structures shift in the direction of the lesion on inspiration and in the opposite direction on expiration. The paradox of enlargement

**FIGURE 3A**

**FIGURE 3B**

*Figure 3*: Paradoxical respiratory effect on heart during an attack of bronchial asthma. Fluoroscopy revealed limited diaphragmatic excursions with minimal increase in heart size during expiration. A. Inspiration. B. Expiration.

**FIGURE 4A**

**FIGURE 4B**

*Figure 4A*: Teleoroentgenogram in a cardiac patient with unexplained chronic pulmonary infiltrate at the right base.—*Figure 4B*: Esophago-gastric junction filled with barium, revealing an unsuspected cardiospasm. The lung changes were attributable to aspiration of esophageal contents.
of the heart shadow on inspiration and shrinkage on expiration occurs in bilateral obstructive emphysema, as seen in bronchial asthma, the "bronchiolitis" of infants, and in partial tracheal obstruction (Fig. 3).

The Valsalva and Müller maneuvers, coughing, sniffing, and snorting may aid in differentiating between a vascular shadow and a non-vascular mass, since alteration of the intra-alveolar pressure causes vascular structures to change in size. These technics may profitably be combined with the Trendelenburg and upright positions in the study of mediastinal masses. They are of particular help in differentiating mediastinal lymph node enlargement from vascular shadows. Diaphragmatic excursion can often be accentuated by sniffing.

4. Ingestion. Ingestion of barium is an integral part of chest fluoroscopy and should never be omitted. By this means an unsuspected esophageal abnormality which is the underlying cause of the pulmonary disease may be shown (Fig. 4), or gastro-intestinal segments in the thoracic cavity, directly accounting for the abnormal roentgen appearance, may be revealed.

Evidence of impingement on the esophagus often aids in the localization of a mass lesion and may be the only indication of enlarged mediastinal lymph nodes. This is especially true of the bifurcation nodes, enlargement of which often produces an extrinsic pressure defect on the esophagus at the level of the carina, usually best seen in the left oblique view (Fig. 5). This may be the only clue to a correct pre-operative diagnosis of pulmonary carcinoma, as pointed out by Fleischner.

5. Tilting. Examination of the patient in the prone, supine, Trendelenburg, lordotic, or decubitus positions is often rewarding. The decubitus examination may be made by utilizing a stretcher in front of the upright fluoroscope, but tilting the upright patient to right and left in the frontal view, and bending at the waist in the lateral view are more practical methods. The lordotic position is easily assumed during upright fluoroscopy, and is accomplished through the use of sand bags under the lower

**FIGURE 5A**

Figure 5A: Teleorontgenogram of chest. The right hilum is enlarged and is more dense than the left.—**FIGURE 5B**: Left anterior oblique view of the middle third of esophagus showing the indentation caused by enlarged carinal lymph nodes.
ribs in supine fluoroscopy. The recognition of pleural fluid, the demonstration of fluid levels, the delineation of middle lobe disease, and the displacement of pulmonary densities from overlying structures are facilitated by applying these gravitational methods.

**Roentgenography**

The exposure of spot films during fluoroscopy is an important part of the examination since it provides a permanent record of the findings, and brings out details that are difficult to demonstrate by other means.7

After fluoroscopy, additional films are obtained as indicated. The proper degree of rotation for oblique projections and the need for such positions as the lateral, lordotic, decubitus, supine, prone, and erect are determined at fluoroscopy. Expiration films are obtained when indicated by fluoroscopy, and centering for detail roentgenograms and laminagrams8 is also facilitated.

In addition to fluoroscopy, many other roentgen methods of examination of the chest are available. Excellent descriptions of these can be found in articles by Cohen and Geffen,9 Rigler,10 and Robbins, Hale, and Merrill,11 and only brief mention of them is made here. Bucky films of the chest, spine, and upper abdomen, stereoscopy, laminography in frontal, lateral, and oblique planes, selective and "lung mapping" bronchography, pulmonary angiography, and diagnostic pneumothorax and pneumoperitoneum all have their specific indications.

However, there is no adequate substitute for careful chest fluoroscopy. As one gains experience with this oft-neglected method, the realization of its value in the problem case is soon appreciated.

**SUMMARY**

The chest teleoroentgenogram serves as a "scout" film for the detection of intrathoracic lesions. When the diagnosis is not apparent, further roentgen study of the patient is indicated, and, as a rule, this should begin with fluoroscopy.

Adequate fluoroscopic examination of a chest lesion should include the following:

1. Observation of the finer details of the lesion.
2. Rotation of the patient to determine relationships between the lesion and the adjacent normal structures.
3. Breathing maneuvers to detect vascular components and to assist in localization.
4. Ingestion of barium to ascertain origin in, or displacement of, the gastro-intestinal tract.
5. Tilting of the patient into various positions to evaluate the effects of gravity on the lesion.

Exposure of spot films during the fluoroscopic examination is essential to provide a permanent record of the findings, and additional views should
be obtained after fluoroscopy to bring out further details.

Fluoroscopy is one of the most important and rewarding methods of roentgen examination of the chest.

RESUMEN

El roentgenograma del tórax, sirve como una película de “exploración” para el descubrimiento de las lesiones intratorácicas. Cuando el diagnóstico no es aparente, se requiere un estudio ulterior y como regla éste debe empezar por la fluoroscopía.

El examen fluoroscópico adecuado debe incluir lo siguiente:
1. Observación de los más finos detalles de la lesión.
2. Rotación del enfermo para determinar las relaciones entre las lesiones y las estructuras proximales.
3. Provocación de le respiración para descubrir la participación vascular y ayudar a la localización.
4. Ingestión de bario para aclarar el origen en o el desplazamiento del tubo digestivo.
5. Movilizar el enfermo en formas varias para estimar el efecto de la pesantez sobre las lesiones.

La toma de películas enfocadas, durante el examen fluoroscópico es esencial para obtener un registro permanente de los hallazgos y aspectos adicionales deben obtenerse después de la fluoroscopía para mayor detalle.

La fluoroscopía es uno de los métodos más importantes y satisfactorios para el examen del tórax.

RESUME

La téléradiographie thoracique se comporte comme un élément de “reconnaissance” pour la découverte des lésions intrathoraciques. Quand le diagnostic ne s’y inscrit pas, il y a lieu de continuer les investigations radiologiques. Dans la règle, il y a lieu de commencer par la radioscopie.

Un examen radioscopique valable pour la lésion thoracique comporte les recherches suivantes:
1. Observation des plus petits détails de la lésion.
2. Rotation du malade derrière l’écran pour rechercher les relations entre la lésion et les éléments normaux voisins.
3. Manoeuvre respiratoire pour mettre en évidence une participation vasculaire et pour préciser la localisation.
4. Ingestion de baryte afin de préciser l’existence d’une lésion ou le déplacement du tractus gastro-intestinal.
5. Examen du malade en diverses positions, afin de mettre en évidence l’effet de la pesanteur sur les lésions.

La prise de clichés localisés au cours de l’examen radioscopique est essentielle pour permettre d’avoir un témoignage permanent des constatations faites, et afin de mettre en évidence de nouveaux détails.

La radioscopie est une des méthodes les plus importantes et les plus profitables dans l’examen radiologique du thorax.
REFERENCES