Obliteration of Segmental Pulmonary Artery Borders: A Method of Localizing Right Lower Lobe Infiltrates

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The borders of a pulmonary artery are obliterated when the vessel is in anatomic contact with an adjacent alveolar infiltrate. Whenever specific segmental arteries are noted to be so affected, disease can be localized to that particular segment or lobe. Cases of infiltrative processes in the right lower lung field on the posteroanterior roentgenogram are presented illustrating this method of localization.

Various roentgenographic studies aid the physician in defining the location and extent of pulmonary infiltrates. Segmental localization of an intrapulmonary density can usually be accomplished by obtaining posteroanterior (PA) and lateral chest roentgenograms. However, when one is confronted with an abnormality within the lung, only the PA chest film may be available for appraisal. In the presence of multiple infiltrates in both lungs, it may be difficult to locate precisely the segmental distribution even after viewing the lateral film. Physicians involved with roentgenographic interpretations should therefore be acquainted with the various radiographic signs that assist in the segmental or lobar localization of intrapulmonary densities.

In viewing the PA chest roentgenogram, there is superimposition of two or more lung segments on one another in all areas except the apices. Indeed, an opacity appearing next to the right heart border may reside in the medial segment of the middle lobe or the medial basal or posterior basal segments of the right lower lobe. In such an instance, a useful radiographic sign for localization of an opacity adjacent to the border of the heart, or aorta, is the "silhouette sign."

The principle of localization of opacities of water density utilizing the "silhouette sign" is as follows: "An intrathoracic lesion touching a border of the heart, aorta, or diaphragm will obliterate that border on the roentgenogram. An intrathoracic lesion not anatomically contiguous with a border of one of these structures will not obliterate that border."

Thus, an infiltrate in the medial segment of the middle lobe usually obliterates the adjacent contiguous heart border, whereas the heart border is preserved in lower lobe involvement. A detailed study of the "silhouette sign" is available elsewhere.

Obliteration of the borders of pulmonary vessels has been noted to occur with parenchymal infiltrates. The application of this finding for localizing an infiltrate to a lobe or segment has not previously been emphasized. It is the premise of this report that when a segmental artery, or a branch thereof, is found to have its borders obliterated by an infiltrate ("obliteration sign"), the infiltrate is located within the same segment as the vessel so affected. The principle involved is the same as that described for the "silhouette sign."

The clinical application of the "obliteration sign" for the localization of infiltrates is dependent upon the recognition of specific lobar or segmental arterial branches within the lung. It is often difficult to locate the various segmental arteries on the PA chest roentgenogram. The distribution of arteries within the lung parenchyma is indeed quite variable. However, a general pattern of branching does exist. Arterial branches within the basal segments of the right lower lobe can frequently be identified by their pattern of distribution and tracing their origin from the pars basalis of the right pulmonary artery. The segmental artery of the posterior basal

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segment can usually be discerned as the artery adjacent to the lower portion of the right heart border and can be traced to the inferior trunk. It can frequently be seen to pass behind the dome of the diaphragm. This artery is easily identified on the lateral film of the chest, coursing inferiorly and posteriorly within the substance of the posterior basal segment (Fig 1B).

This report considers the application of the "obliteration sign" as an aid in localizing infiltrates in the right lower lung field on the PA roentgenogram. Particular attention is given to the arterial supply of the posterior basal segment. Applying this sign to the basal segmental arteries in the left lower lobe is also useful. Localization of a density in the left lower lung field may also be apparent by identifying an intrapulmonary opacity in the retrocardiac area or applying the "silhouette sign" to the left heart border. Localizing infiltrates in other lung areas utilizing the "obliteration sign" alone has not proved accurate because of the difficulty in recognizing specific vessels.

The following case reports illustrate this method of localization of pulmonary infiltrates in the right lower lung field.

CASE REPORTS

CASE 1: A 19-year-old army private was admitted with a four-day history of chills, fever and headache. A cough, productive of purulent sputum, had been present for three days. His lungs were described as being "clear" on examination, but the chest roentgenograms revealed an infiltrate in the right lower lung field (Fig 1).

Comment: The infiltrate in the right lower lung field is not in anatomic contact with the heart or diaphragm, thus the borders of these structures remain clear. Directing attention to the pulmonary vessels, it can be seen that the arterial borders in the region of the infiltrate are obscured. The vessels so affected can be traced to the pars basalis of the right pulmonary artery thus localizing the infiltrate to the right lower lobe. This location is confirmed on the lateral film of the chest.

CASE 2: A 24-year-old army private was admitted with a history of upper respiratory infection of three weeks' duration and a three-day history of chills, fever and increasing cough, productive of clear sputum. Rales were audible in the right lung base posteriorly. A four-fold rise in complement fixation titer to Mycoplasma pneumoniae antigen was obtained. The chest roentgenogram is shown in Fig. 2.

Comment: This case illustrates obliteration of vascular outline by a minimal infiltrate. The specific vessels involved are branches of the posterior basal segmental artery, thus localizing the pneumonia to that segment. This location was confirmed on the lateral film of the chest.
CASE 3: A 47-year-old truck driver presented with a history of cough, sputum production and a transient fever of three days' duration. Physical examination of the chest revealed rales at the right base posteriorly. The chest roentgenograms are shown in Fig 3.

Comment: This case is of particular interest, for it serves to illustrate how one may localize an opacity to the medial basal segment. The right heart border is distinct, thus placing the pneumonia in the right lower lobe. The arterial pattern within the posterior basal segment is evident through the infiltrate, suggesting that the infiltrate is anterior to the posterior basal segment, namely, in the medial basal segment. The location is confirmed by its position on the lateral chest film.

CASE 4: A 17-year-old army private was admitted with a history of fever, chills, cough and purulent sputum production for one week. Right chest pain was present one day prior to admission. A few coarse rales were audible, scattered throughout the right lung. A four-fold rise in complement fixation titer to Mycoplasma pneumoniae was obtained. Chest roentgenogram is shown in Figure 4.

Comment: Localization of the infiltrate within the middle lobe is apparent by recognizing obliteration of the lower portion of the right heart border. Of special note is the preservation of the outline of the arterial tree within the lower lobe as seen through the infiltrate on the PA chest roentgenogram.

CASE 5: A 24-year-old army sergeant was admitted to the hospital with a one-day history of chills, fever and cough, productive of purulent sputum. Rales were audible over
were pneumonia. Lung in not obliterated, comment: are the through infiltrate.

FIGURE 4 (Case 4). PA roentgenogram showing middle lobe pneumonia. The lower lobe vascular pattern is visible through the infiltrate.

the entire right hemithorax and dullness was present over the right lower anterior chest. Diplococcus pneumoniae were obtained on blood culture. The chest roentgenograms are shown in Figure 5.

Comment: The inferior portion of the right heart border is obliterated, indicating disease within the middle lobe. Also noted, however, is obliteration of the vascular pattern of the basal segments of the right lower lobe, suggesting disease in that lobe as well. The lateral view demonstrated the middle lobe as well as the right lower lobe pneumonia. The left lung was not involved.

DISCUSSION

Obliteration of vascular borders is a useful sign to determine the presence of an alveolar infiltrate on the chest roentgenogram. Applying this sign for the localization of infiltrates is dependent upon identifying specific arterial branches within lobes or segments. Since the arterial supply to the posterior basal segment can usually be identified on the PA chest roentgenogram, obliteration of its borders by an infiltrative process indicates disease within that segment. Other specific lower lobe segmental arteries may be difficult to identify accurately, except to state that they are branches of the pars basalis and are therefore located within the lower lobe.

Arterial branches within the middle lobe may be apparent on the PA chest roentgenogram. Careful attention will often reveal that their origin is from the pars interlobularis of the pulmonary artery and in this way may be distinguished from lower lobe basal segmental vessels.

It is apparent that if obliteration of the vascular pattern in the posterior basal segment is not present, then an infiltrate presenting adjacent to the right heart border may reside in the middle lobe or the medial basal segment of the lower lobe. Obliteration of the right heart border in such a case would indicate middle lobe disease, though medial basal segment involvement in addition may not be excluded. Attempts to identify medial basal segment vessels on the PA chest roentgenogram have been largely unsuccessful because of the variability of their origin. Medial basal segment involvement is suggested from the PA chest roentgenogram, as in case 3, when an infiltrate appearing adjacent to the right heart border does not obliterate that border and the arterial pattern within the posterior basal segment remains clearly defined.

It has been previously stated that if two diseased areas are superimposed on the PA chest roentgenogram, only that portion that obscures the cardiovascular border can be localized, utilizing the "silhouette sign". By recognizing obliteration of the vascular outline in the lower lobe segments, lower

FIGURE 5 (Case 5). Close-up of PA roentgenogram showing pneumonia in right lower lung field. Middle lobe involvement is obliterating the right heart border. Lower lobe pneumonia has caused obliteration of the vascular pattern within the lower lobe basal segments.
lobe disease can be identified in the presence of middle lobe involvement with obliteration of the right heart border (Fig 5).

An infiltrate may present within the middle lobe without being in anatomic contact with the heart border or the minor fissure. Such densities may be localized from viewing the PA chest roentgenogram only if the proximal portion of a middle lobe artery can be identified and the peripheral portion is found to have its borders blurred. The vascular pattern in the lower lobe will be apparent through the infiltrate (Fig 4).

An adequately penetrated roentgenogram is necessary for proper interpretation of the radiographic signs discussed above. An underpenetrated film can result in false obliteration of the vascular borders by a superimposed infiltrate. Motion of the patient at the time the roentgenogram is obtained can also cause blurring of the vascular structures.

In appraising the vascular pattern within the lower lobe in the presence of a middle lobe infiltrate, an adequately penetrated film is essential. If vascular structures are visible through the heart shadow, but are obliterated through a middle lobe infiltrate, then right lower lobe disease is likely to be present.

REFERENCES

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CARDIORESPIRATORY FUNCTION IN THE AGED

Cardiac output falls from an average of 3.75 L per minute per square meter of body surface in twenty year olds to 2 L per minute in ninety year olds. The amount of oxygen that the blood takes up from the lung and transports to the tissues during exercise falls substantially with age. The blood of twenty year old men takes up, on the average, almost 4 L of oxygen per minute, whereas at age seventy-five the rate is only 1.5 L per minute. Another measurement reveals that in order to double the level of oxygen uptake during exercise the older individual must move about 50 per cent more air in and out of his lungs. The decline in respiratory function also reflects a loss in simple mechanical efficiency. As to maximum breathing capacity, there is a decline of about 40 per cent between the ages of twenty and eighty.