The Demonstration of Left Atrial Enlargement by Body Section Radiography

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The enlarged left atrium may be poorly demonstrated in conventional roentgenograms. It can be delineated clearly in such cases by appropriate body section films. Body section radiography may also be helpful in the study of other ill-defined cardiac and vascular contours and in the demonstration of intracardiac calcification.

Although the signs of left atrial enlargement are well known, they are sometimes difficult to demonstrate in conventional roentgenograms. We have found body section radiography helpful in delineating enlarged left atria in patients in whom the enlargement was not satisfactorily defined by the standard roentgenologic method of heart study.

Body section radiography is a technic of comparatively recent development. Since Bocage first studied the method in 1917, numerous refinements and modifications have been introduced and have variously been called stratigraphy, planigraphy, tomography and laminography.1, 2 The basic principle of all of these techniques is the same. Simultaneous parallel reciprocal movement of the x-ray tube and film cassette about a fulcrum of adjustable height takes place during the exposure. Only one section of selected depth and predetermined thickness corresponding to the position of the fulcrum is continuously in focus. Details in this section alone are clear, other levels being blurred out in the process. The importance of such a technique has long been recognized in the study of lesions in the chest, where superimposition of tissues of different density may obscure underlying infiltrations or cavities. It has less frequently been applied to the study of laryngeal, bone or other lesions.

A recent report describes the use of planigraphy for the visualization of intracardiac calcification,3 but the method has so far had little application in the study of the heart.

All of our laminographs were made with a General Electric Ordograph. This is a hydraulically driven mechanism with a tube travel of 15 inches, 40 inches above the table top. The average technical factors employed were 86 kilovolts, 50 milliamperes, 2 1/2 seconds with Bucky technique. The desired levels were estimated by reference to a 6 foot, 14 x 17 inch chest film in each case and numerous cuts were made at 1 cm. intervals on 10 x 12 inch film. We have found that satisfactory films can almost always be obtained between 10 and 14 cm. from the table top, thereby permitting economy in the use of only four or five films.

Because the left atrium occupies a relatively concealed position behind the heart in the frontal projection, the recognition of left atrial enlargement in conventional roentgenograms

![Fig. 1. Advanced left atrial enlargement. Anteroposterior film taken with Bucky technique showing deviation of barium filled esophagus to the left instead of to the right.](image-url)
Fig. 2. A. Conventional right anterior oblique roentgenogram of the same patient referred to in figure 1. Barium filled esophagus is straight and does not indicate left atrial enlargement, although retrocardiac space is obscured. B. Body section roentgenogram of the same patient in the right anterior oblique position. Marked enlargement of the left atrium is clearly shown.

Fig. 3. A. Conventional right anterior oblique roentgenogram of patient with advanced mitral stenosis. Barium filled esophagus shows slight posterior displacement. B. Right anterior oblique body section roentgenogram of same patient. Note markedly enlarged left atrium not demonstrated by barium column in A. Mitral valve calcification is clearly visible.
depends largely upon its impingement on, or displacement of, contiguous structures, particularly the barium filled esophagus and the bronchi. As the left atrium enlarges the following changes take place:

I. *Displacement of the Barium Filled Esophagus*. As the left atrium enlarges it first expands posteriorly, compressing and displacing the esophagus. As a result of the normal eccentric position of the esophagus to the right of the midline and some clockwise rotation of the heart, the barium filled esophagus is usually
displaced to the right as well as posteriorly. This deviation is most easily observed in the right anterior oblique or lateral view. Frequently the esophagus "slips off" or is displaced to the left instead of to the right (fig. 1) so that it does not follow the contour of the enlarging left atrium (fig. 2A). This may be the result of: (1) The occasional normal occurrence of a left eccentric position of the esophagus, (2) concomitant enlargement of the right ventricle and right atrium displacing the left atrium and the esophagus to the left, (3) esophageal adhesions to the left and (4) adhesions to an elongate tortuous aortic arch. In body section films the border of the enlarged left atrium can be seen despite the obscuring shadow of the spine and without dependence on the position of the esophagus (fig. 2B).

Even though the barium filled esophagus is displaced posteriorly it sometimes fails to indicate the degree of left atrial enlargement (fig. 3A). In such cases the appropriate body section film clearly indicates the size of the enlarged left atrium (fig. 3B).

II. Appearance of the Left Atrium on the Right Upper Cardiac Contour in the Frontal Projection (Double Contour). As the left atrium continues to enlarge it extends to the right, first approaching the right border, and later forming the upper part of the right border above and overlapping the right atrium. In conventional roentgenograms the left atrial border is often ill defined, concealed by the right atrial border or obscured by hilar shadows (fig. 4A). Body section films in the frontal projection at appropriate levels clearly delineate the left atrial border from other structures with which it may be confused (fig. 4B).

III. Elevation and Compression of the Main Stem Bronchi. Further enlargement of the left atrium takes place superiorly, widening the bronchial angle from the normal of about 70 degrees, to as much as 100 degrees or more, and sometimes compressing both bronchi. This can occasionally be seen in conventional films but is often not well visualized (fig. 5A). The position of the bronchi can readily be demonstrated by body section films in the frontal projection at an appropriate level (fig. 5B).

Body section radiography might profitably be applied to any of the cardiac and vascular contours when they are obscured by superimposition of other structures. It may aid in determining heart size when the borders are concealed by pulmonary consolidation or pleural effusions. Its use in the differentiation of vascular shadows from other intrathoracic masses is well known to radiologists although not so widely applied as it might be. This includes the differentiation of pulmonary arteries from other hilar masses (fig. 4A and 4B) and the differentiation of aortic aneurysms from other mediastinal masses. Mention has already been made of the demonstration of intracardiac calcification8 (fig. 3B).

Summary

Body-section radiography is a useful roentgenologic technic which has had little application in the study of the heart. Its use in the identification of left atrial enlargement is described. The method may advantageously be applied to the delineation of other cardiac and vascular contours when they are not clearly defined in conventional roentgenograms.

Summario in Interlingua

Radiographia sectional es un utile technica roentgenologic que ha habite pauc application al studio del corde. Es describite su uso in le identification de allargamento sinistroatrial. Le metodo es usabile con advantage in le delineation de altere contornos cardiac e vascular quando istos non es clarmente definite in roentgenogrammas conventional.

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