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The Value of Standard Chest Roentgenograms for Classification of Pulmonary Hypertension

LARS BJÖRK

Department of Diagnostic Radiology, University Hospital, Uppsala, Sweden

ABSTRACT

In a blind study of 184 standard chest roentgenograms and based on seven simple criteria, the pulmonary artery pressure was correctly diagnosed as normal or moderately elevated due to increased left atrial pressure or elevated due to increased pulmonary flow in 88%, 90%, and 78% of the cases respectively.

INTRODUCTION

It is well known that pulmonary hypertension, regardless of the etiological disease process, causes definite changes in the pulmonary vascular bed and these changes are observable radiographically (7, 8). Tomography and cardiac catheterization have been widely used in clinical diagnosis and in experimental studies concerning pulmonary hypertension (1, 2, 4, 6, 9). The use of the routine posterior–anterior chest roentgenogram in the diagnosis of such diseases has also been discussed.

Pulmonary hypertension is a general term that can be significant to many pathological processes. It can be said to refer to that state in which the left atrial pressure is more than the accepted norm of 8–10 mmHg[3]. Valvular defects, septal defects, pulmonary vascular changes, etc., can lead to this rise in pressure. However, the causal factors may be divided into groups and subgroups according to the pathological dynamics involved, i.e., increased flow, increased post-capillary resistance, etc. The members of a group have in common a particular type of pulmonary vascular change. Thus it is possible not only to diagnose pulmonary hypertension but also to get some idea of the etiology (7, 8).

Several studies have been made to demonstrate the roentgenologic aspects of pulmonary hypertension. Healey et al. (7) studied the appearance of the pulmonary artery in relation to pulmonary hemodynamics. More recently, more quantitative studies have been made, such as the measurement of the right descending pulmonary artery (2). In this study a normal range was established in inspiration and in expiration and observations were made as to the changes that came about in pulmonary hypertension. Alternatively, in a study by Viamonte et al. (14), on a single cause of pulmonary hypertension, mitral stenosis, it was emphasized that the qualitative observation of eight different changes connected with pulmonary hypertensions was necessary. These included the shape of the pulmonary artery segment, the distance from the midline to extreme border of the right hilus, the diameter of the right lower lobe pulmonary artery, the narrowing of vessels of the lower lobes, prominence of pulmonary vessels of the lower lobes, abrupt narrowing of the intrapulmonary arteries, tortuosity of the intrapulmonary vessels and abnormal peripheral bilateral hypovascularity. One or combinations of these changes may lead one to suspect a number of abnormalities. Discussion of changes due to the pulmonary edema of severe hypertension also are found in the literature (4).

It is now readily accepted that these phenomena are present and may be observed in the routine radiograph. Most of the studies hint at the possibility of diagnosis strictly on the basis of the routine roentgenogram plus clinical observation (9). It is possible in some cases to diagnose pulmonary hypertension without the use of special techniques such as cardiac catheterization. There is some controversy, however, as to the actual practicality of the use of chest roentgenograms of this purpose. The present study is an attempt to evaluate the accuracy of the diagnosis of pulmonary hypertension made from observation of standard chest roentgenograms.

MATERIAL AND METHODS

In the present study, routine chest radiograms from 184 adult patients were observed. These films were taken from the files without selection. All patients had undergone cardiac catheterization within a few days after the chest films were taken. The chest radiograms were then observed for the following seven criteria, which were chosen in order to make the study as objective as possible:

1. The shape of the pulmonary artery segment; i.e., whether it was concave, convex, or straight.
2. The distance from the midline (measured from the center of the vertebral column) to the widest part of the right hilus. The upper limit of normal used was 5.5 cm (10).
3. The diameter of the right descending pulmonary artery taken at its widest point after the departure of the middle basilar artery. The upper limit of normal used was 1.5 cm (10). A very wide diameter was used as evidence of increased flow.
4. The presence or absence of upper vessel dilatation with lower vessel constriction (venous dilatation). This pattern was considered as evidence of an increased resistance hypertension.
5. The presence or absence of general dilation or arterial dilation which was considered evidence of increased flow hypertension.
6. The presence or absence of Kerley's septal lines, expecially "B" lines.
7. The calculation of the cardiac volume from standard chest films according to the method described by Jonsell (8). The upper limit of normal used was 500 ml/m^2 of body area for men, and 450 ml/m^2 for women.

The observer of the criteria had no knowledge and the history of the patients or of the clinical or catheterization findings.

With these data recorded, the patients were divided into one of three groups in the following manner:

Group I was the group of patients considered not to have pulmonary hypertension.

Group II was cases with hypertension caused by increased resistance.

Group III was patients with increased flow hypertension.

When this grouping was complete, the cardiac catheterization material was retrieved from the files and correlated to the radiological data observed. Patients in Group I were considered rightfully grouped if they had a left atrial mean pressure of less than 10 mmHg (pulmonary capillary pressure was used if the left atrial pressure was unavailable) and a pulmonary arterial pressure of less than 35 mmHg in systole. (Right pulmonary arterial pressures were taken if possible.) If left arterial pressure was more than 10 mmHg, then a patient belonged to Group II. In Group II, all patients were found to have a pulmonary artery pressure of less than 55 mmHg. If the patient had a left to right shunt he was considered to belong to Group III. All patients in Group III were found to have a systolic pulmonary artery pressure of more than 55 mmHg.

RESULTS

Of the 184 films inspected, 110 were classed in group I, 52 in group II and 22 in group III. In group I the predictions were 88% accurate. Of the 13 wrong, 12 should have been in group II and one should have been in group III. In group II the predictions were 90% accurate and of the five wrong all should have been in group I. Six patients were wrong in group III, all should have been in group I. This represented an accuracy of 73%. Over all groups, there was an accuracy of 87%.

After the data was collected and correlated, the following observations were made. Group III had convex pulmonary artery segments in 78% of the cases, with group II having 9% and group I having only a single case (Table I). 64% of group II had straight pulmonary artery segments with group III having 22% and group I 18%. 82% of group III had a hilar diameter of over 5.5 cm, while only 42% of the group II patients and 28% of the group I patients had the same sign. All of the actual group III patients had descending pulmonary artery diameters of more than 1.5 cm, groups II and I having 54 and 39% respectively. Also, all of the predicted group II were said to have general dilations and the one group I patient that was actually a group III was not designated generally dilated. 75% of group II was designated as having upper dilatation with lower constriction along with 25% of group I. There were only 12 recognized examples of septal lines in the entire sample. 88% of group III had a calculated heart volume of more than 500 ml/m^2, all but one of which were more than 750. In 2 patients the calculation could not be made. 59% of group II and 24% of group I were above the 500 level.

DISCUSSION

The present study, although as objective as possible, necessarily contained certain subjective aspects. The acknowledgement of the presence or absence of a number of the traits observed most certainly could vary from observer to observer. The differences between group II and III do not depend entirely on objective criteria although every effort was made to be unbiased and consistent. In cases where it was necessary to use the pulmonary capillary pressure instead of the left

	Percent of groups		
	I	II	III
Convex pulm. artery segment	1	9	78
Straight pulm. artery segment	18	64	22
Hilar diameter over 5.5 cm	28	42	82
R. descending pulm. artery diameter over 1.5 cm	39	54	100
Upper vessel dilatation with lower constriction	25	75	5
General dilatation of vessels	25	25	95
Heart volume over 500 (450) ml/m^2	24	59	88
Kerley's lines	5	11	6
No. patients in group	108	59	17

atrial pressure or the main pulminary trunk pressure instead of the right pulmonary artery pressure, there is obvious room for error especially in the borderline cases.

The scarcity of Kerley's lines could mean that they are of little use in the differentiation or it could mean that the observer was lacking in his ability to recognize their presence. There is also a possibility that due to the nature of the sample, these pathological changes had already reversed due to treatment.

It may be possible that the use of this or a similar method can aid the clinician in diagnosis or more probably in the follow up of patients with suspected pulmonary hypertension. Findings that fit in group II may be taken as a danger signal that warrants immediate consideration to the numerous pathological states that can cause these changes in the roentgenogram. By the same token, a group III observation can be taken as strong evidence that a shunt of some sort is present or that some contributional factor has caused an increase in flow.

The observation of routine chest roentgenograms in this manner may also reduce the necessity of cardiac catheterization to some extent. In any case, scrutiny of chest films for the changes occurring in pulmonary hypertension is a simple and fairly accurate method that should be used in combination with clinical and other findings in the routine evaluation of patients with cardiac disease.

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Address for reprints:
Lars Björk, M.D.
Department of Diagnostic Radiology
University Hospital
S-750 14 Uppsala
Sweden