

Diagnostic Value of Plain Chest Roentgenogram in Rheumatic Mitral Valvular Disease

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ABSTRACT Rheumatic fever and rheumatic heart disease are still important community health problem in developing countries. The aim of this diagnostic test was to determine the diagnostic role of plain chest roentgenogram in patients with rheumatic mitral valvular disease. Subjects were patients with rheumatic mitral disease without other valvular lesions, congenital heart disease, or anemia, who visited the out-patient clinic, Department of Child Health, Cipto Mangunkusumo Hospital, Jakarta, between June and August 1995. There were 52 subjects enrolled to this study. Determination of type valve lesions, the presence of left atrial dilatation, and cardio-thoracic ratio (CTR) were performed from plain chest film by 2 pediatric radiologists using a semiquantitative table. The results were compared with echocardiographic findings used as gold standard. The chest plain roentgenogram accuracy in determining valvular lesion was 77% (CI90%; 67.4%-86.6%). Chest plain roentgenogram diagnostic index in discovering left atrial dilatation gave excellent result (>80%). The correlation between CTR and left ventricular mass (LVM) was 0,63 ($p < 0.001$) in all rheumatic mitral valvular lesions. We conclude that plain chest roentgenogram still has its place in determining type of rheumatic mitral valvular lesion, and it has some help in the management of patients with rheumatic mitral valve disease. [*Paediatr Indones* 1996;36:102-108]

Introduction

In developing countries, rheumatic fever (RF) and rheumatic heart disease (RHD) are still a community health problem.

Rheumatic mitral valve disease (RMVD) is an important cause of heart disease in children, besides congenital heart disease (CHD),¹⁻³ since 75-90% of rheumatic heart disease involved mitral valve.^{2,4,5}

The implementation of echocardiography in patients with RMVD gives many advantages. It can determine cardiac changes accurately such as the type and severity of the valve abnormality, the

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presence of left atrium (LA) dilatation, cardiac contractility, etc.⁷⁻⁹ Also with this sophisticated diagnostic tool, the presence of left ventricular mass hypertrophy as a manifestation of chronic adaptation of the heart to chronic pressure or volume overload of systemic circulation can be determined.

On the other hand, chest plain roentgenogram in postero-anterior view (CPRPA) has also a role in diagnosing the type valve abnormality in rheumatic and CHD patient.^{10,11} Up till now, there is no published study indicating the role of CPRPA as a diagnostic tool in determining cardiac changes in RMVD. The aim of this study was to determine the accuracy of CPRPA in diagnosing the type of RMVD (regurgitation, stenosis, or combine); diagnostic test index (sensitivity, specificity, accuracy, and predictive values) of CPRPA in determining the presence of LA dilatation; and the correlation between cardio-thoracic ratio (CTR) and left ventricular mass (LVM), using echocardiography as a gold standard.

Methods

This diagnostic test study was performed cross sectionally. Patients with RMVD in both acute rheumatic fever and rheumatic heart disease were enrolled to this study. All patients fulfilled modified Jones criteria with mitral valve abnormality. The exclusion criteria were the presence of other valve abnormality, congenital heart disease (CHD), or anemia.

All ARF and RHD patients with mitral valve disease who visited the out patient clinic, Division of Cardiology, Department

of Child Health, Cipto Mangunkusumo Hospital, Jakarta, between June and August 1995 were enrolled to the study. They had been managed on a monthly basis for receiving benzathine penicillin or its substitutes to prevent streptococcal infection.

There were 56 subjects enrolled to this study; of them, 4 patients were excluded due to inadequate result of CPRPA. All patients underwent complete physical examination, including measurements of body weight, height, duration benzathine penicillin prophylactic management, and clinical cardiovascular diagnosis. Body surface area was estimated by using a nomogram based on the following equation:¹²

$$BSA = 0.007184 \times W^{0.425} \times H^{0.725}$$

where, BSA = body surface area in m², W=body weight in kg, H=height in cm.

Plain chest roentgenogram

Postero-anterior (PA) view of plain chest roentgenogram was made in all patients after echocardiographic examination was performed. Plain chest plain film were interpreted by 2 pediatric radiologists. The diagnosis of CPRPA type mitral disease was made with a guide of modified Colcher et al semiquantitative table.^{11, 13,14} (See Fig. 1). The diagnosis of LA dilation on CPRPA was made if one or more of these finding (zone 5th bulging/double contour, zone 3a bulging, and or elevation of the left main bronchus) was present. The cardio-thoracic ratio was calculated in AP plain chest film a usual way, by the radiologist.

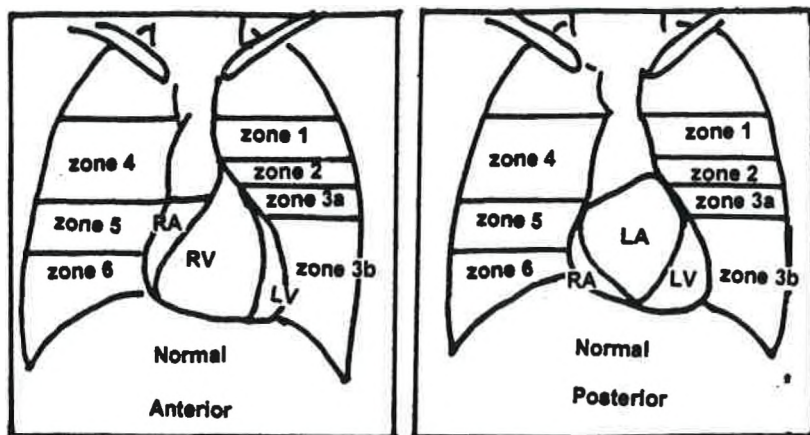


Figure 1. Chest plain roentgenogram zone according Colcher et al (modification). RA = Right atrium; LA = Left atrium; RV = Right ventricle; LV = Left ventricle

Echocardiography

In nearly all patients, complete echocardiographic examination¹⁵ (i.e. 2-dimensional, M-mode, and echo-Doppler with color flow mapping) had been performed, so that the specific valvular lesion or lesions were known. For the purpose of the study, standard M-mode echocardiography was performed using 2.5 MHz transducers. With the patient lying on a left lateral decubitus position, left ventricular measurements were performed from short axis parasternal view. With the same position left atrium and aorta ratio were also determined. Left ventricular

measurement, left atrium aorta ratio, and typing mitral valve abnormality were made by one of two authors, as a pediatric cardiologist (BM or STP). Left ventricular mass was calculated in all patient using the modified ASE (American Society of Echocardiography)-cube criteria:¹⁶

$$LVM=0.8 \times 1.04 \times [(LVID+PWT+IVS)^3 - LVID^3] + 0.6 \text{ gm}$$

where LVM = left ventricular mass, LVID= left ventricular internal dimension in diastole, PWT = ventricular posterior wall thickness in diastole, IVS = interventricular septal thickness in diastole.

LVM was then indexed for body surface area. In boys, LVM of more than 103 gm/m² indicated left ventricular hypertrophy; whereas in girls the comparable value were 84.2 gm/m².

Analysis

Sensitivity, specificity, accuracy, predictive value were presented in per cent; 90% confidence interval of each value was also supplied in per cent. The confidence interval was calculated using the following formula:

$$CI = P \pm 1.645 \sqrt{PQ/N}$$

where CI = 90 % confidence interval of proportion (in decimal); P = proportion of interest, Q = 1 - P, N = number of observed patients.

Coefficient correlation r (Pearson) and regression correlation between CTR and LVM were calculated using Microstat and Epistat computer programs.

Results

Characteristics of the subjects

Most of patients belonged to RHD group, there were only only 2 ARF cases. Half of cases were male. The mean of age was 14.5 (SD 3,9) years old. The mean of duration benzanthine penicillin prophylaxis was 5.8 (SD; 3.8) years. See Table 1.

Accuracy of CPRPA in determining the type of mitral valve disease

Chest plain roentgenogram found MR in

34 patients, MS in 4 patients, and 14 patients. The accuracy of CPRPA to discovered the type of mitral valve disease was 77 % (see Table 3).

Sensitivity, specificity, and predictive value chest plain roentgenogram left atrial dilatation

Most of diagnostic test index of CPRPA gave a excelent value (>80%), whereas negative predictive value <80%, as shown in Table 4.

Table 1. Characteristics of 52 patients with rheumatic mitral valve disease

Age (yr)	
range	6.5-21
mean (SD)	14.5 (3.9)
Sex	
male	26
female	26
Diagnosis	
ARF	2
RHD	50
BP duration (yr)	
range	0.25-16
mean (SD)	5.8 (3.8)

ARF = acute rheumatic fever; BP = benzathine penicillin; RHD = rheumatic heart disease; SD = standard deviation

Correlation between CTR and LVM

Correlation between CTR and LVM was good with r (Pearson) value was 0,63 and p<0.001 of all rheumatic mitral valve disease patients. When 4 isolated MS was excluded, r value better (r=0,66; p<0.001) as shown in Figure 2.

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Table 2. Type mitral valve disease, LA dilatation, and left ventricular hypertrophy in 52 patients based on echocardiography examination

Finding	No. of cases
Isolated MR	26
Isolated MS	4
MR + MS	22
LA dilatation	35
LVH	29

MR = mitral regurgitation; MS = mitral stenosis; LA = left atrium; LVH=left ventricular hypertrophy

Table 3. Accuracy CPRPA in determining the type of mitral valve disease in 52 patient rheumatic mitral valve disease

	Echocardiography			
	MR	MS	MR+MS	Total
MR	26	-	8	34
CPRPA MS	-	2	2	4
MR+MS	-	2	12	14
Total	26	4	22	52

Accuracy = $40/52 = 77\%$ (CI, 90%: 67,4 - 86,6%)
 MR = mitral regurgitation; MS = mitral stenosis; CI = confidence interval CPRPA = chest plain roentgenogram in posteroanterior view

Discussion

Since Colcher et al (1956) stated in their preliminary study that postero-anterior

Table 4. Sensitivity, specificity, accuracy, positive and negative predictive value of CPRPA atrial dilatation in 52 rheumatic mitral valve disease patients

CPRPA	Echocardiography		
	LA dilatation		
	Yes	No	Total
Yes	30	2	32
No	5	15	20
Total	35	17	52

Sensitivity = 85.7% (CI 90%: 77.8% - 93,6%)
 Specificity = 88,2% (CI 90%: 80,9% - 95,5%)
 Accuracy = 86.5% (CI 90%: 78.8% - 94.2%)
 PPV = 93.7% (CI 90%: 88.2% - 99.2%)
 NPV = 75% (CI 90%: 69% - 81%)

Note: CPRPA = chest plain roentgenogram in posteroanterior view; LA = left atrium; PPV=positive predictive value; NPV=negative predictive value.

chest plain roentgenogram was able to detect in mostly patient with rheumatic valve disease compared with cardiac operation finding. Their study enrolled 150 patient. Up to now, as far as the authors know, there was not further study had been done to evaluate role of chest plain roentgenogram in diagnosing rheumatic valve disease. In 1976, Kelley et al noted that enlargement of left atrial appendages that can be detect from chest plain roentgenogram, had a significant finding. Because enlargement of that region in patient with mitral valve disease related with rheumatic etiology. Based on those literature, we made a modification of Colcher et al semiquantitative guidance. In this study, the Colcher et al semiquantitative table (modified) gave a good guidance in determining the type of mitral

valve lesion in rheumatic patient. This guidance can be applied as a simple diagnostic tools in remote area, where echocardiography was not available.

In determining left atrial dilatation, chest plain roentgenogram had a excellent result because most of diagnostic test indexes (sensitivity, specificity, accuracy, and positive predictive value) were > 80 %. Whereas negative predictive value was 75 %. Even the latest index was lower than 80 %, it value not influence the excellency of chest plain roentgenogram in deciding the existence of left atrial dilatation. Because negative predictive value is depend on the prevalence of the abnormality from the population. As we know, the population of this patient mostly consist of patient with mitral valve involvement which usually caused left atrial dilatation.

However, if we can not find LA dilatation from chest plain roentgenogram in patient with mitral valve disease, we suggest to perform further examination such as lateral chest roentgenogram with Barium or electrocardiography, to confirm the negative finding.

Correlation value (r) > 0.6 means that between CTR and LVM had a fair relation , so may be those can substitutable each other, especially in patient non-isolated MS rheumatic mitral valve disease. On the other hand, if the CTR value was increase, we can make sure that LVM value will increase too. Serial left ventricular mass value is a important element in study of hypertrophy, as a product of chronic adaptation of the heart to pressure or volume overload of the systemic circulation, in patient with valvular disease. So, if the echocardiography was not available, chest plain roentgenogram may be has a predictive value in determining the present of left ventricular hypertrophy.

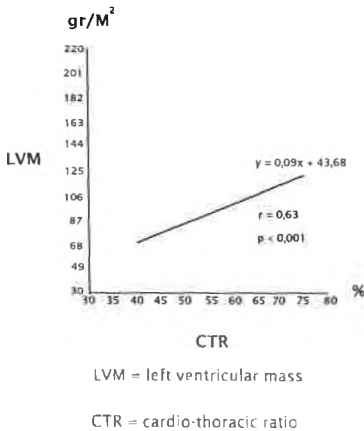


Figure 2a. Scatter diagram and regression correlation between CTR and LVM in all 52 patients rheumatic mitral valve disease (MR, MS, and MR-MS)

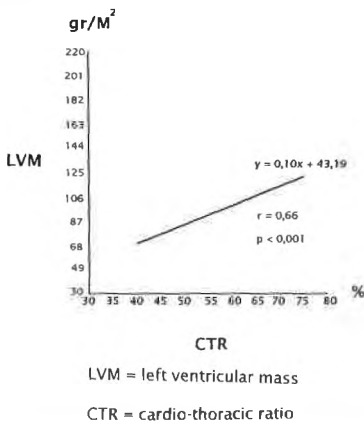


Figure 2b. Scatter diagram and regression correlation between CTR and LVM in 48 patient rheumatic mitral valve disease without isolated mitral stenosis (MR and MR-MS)

Finally, it seem that chest plain roentgenogram had diagnosis role as echocardiography had in patient with rheumatic mitral valve disease, even with several limitations.

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