Clinical Significance of Cardiomegaly
Changes in Cardiomegaly During the Course of the Follow-up Period in Valvular Heart Diseases

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RHEUMATIC carditis, hemodynamic overload, congestive failures, atrial fibrillation, follow-up period, surgical or medical treatment, pregnancy, delivery, infectious diseases and other complication are considered to be factors affecting the cardiomegaly. It is a purpose of this investigation to examine the characteristic features of cardiomegaly reflected on the chest x-ray in various valvular heart diseases comparing the changes of the cardiothoracic ratio (CTR) of the chest x-ray during the course of the follow-up period.

MATERIAL AND METHODS

87 cases of patients were selected at randomly among the patients whose initial visit at the Heart Institute Japan, Tokyo Women’s Medical College before 1964 and the follow-up period of 10 to 19 years but included the patients died with the short follow-up period. There were 36 men and 51 women, with age range of 9 to 73 years at the initial visit. These patients were consisted of 25 cases of mitral stenosis (MS, MSi), 14 cases of mitral insufficiency (MI, MIi), 17 cases of mitral stenoinficiency (MSi), 7 cases of aortic stenosis (AS, ASi), 10 cases of aortic insufficiency (AI, AIs) and 14 cases of mitral and aortic valvular diseases (M and A).

The changes in the CTR and clinical pictures during the course of the follow-up period in these valvular heart diseases were compared and examined.

RESULTS

Mitril stenosis: Mitral stenosis is a disease subjected to be treated surgically. There are only a few cases followed-up more than 10 years. These cases are mild and have almost no symptoms. The CTR of these cases was about 50% and left atrium showed normal or slight enlargement. The established atrial fibrillation makes more enlargement of left atrium and increases the CTR. (Fig. 1). Severe cases with clinical features of tricuspid insufficiency and died with congestive failure showed the increases CTR of 60 to 70% due to the enlarged right heart. Cases with excellent outcome after the mitral commissurotomy showed the CTR of 50 to 60% and normal or slightly enlarged left atrium in 9 to 18 years after the operation. Cases with restenosis showed symptoms in 3 to 12 years after the operation and increased enlargement of left atrium, pulmonary congestion and CTR by the right heart enlargement due to restenosis. However the decreased CTR, improvement of pulmonary congestion and alleviation of the right ventricular overload on ECG were brought about by re-operation (Fig. 2). Death occurred in 13 to 21 years after the operation. The increase in CTR due to the left atrial and right heart enlargement finally reaches more than 80% of CTR. These cases showed clinical features of tricuspid insufficiency and intractable failure.

Mitril insufficiency: There are some cases without clinical symptoms and cardiomegaly for more than 10 years in younger age group. Temporary increase in the CTR by pregnancy and delivery in female was occasionally observed. In some cases the CTR showed about 60% after the development of rheumatic carditis in their teenager. The CTR gradually increases by pregnancy, delivery, atrial fibrillation and congestive

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Fig. 1.

Fig. 2.

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failure accompanied by temporary pulmonary infection by the time of their early thirties. The left ventricular hypertrophy on ECG usually accompanied by the ST-T changes (Fig. 3). With the increase in years of the follow-up period, the patients with chronic congestive failure showed the CTR of 80% due to the enlarged left and right heart. The patients with replaced by the artificial
Fig. 5.

Fig. 6.
valve usually showed the decreased CTR in the early period after the operation due to the removal of volume overload on the left heart.

Mitral stenoinssufficiency: Ages at the initial visit of this group are widely distributed and the patients with atrial fibrillation, congestive failure and their CTR more than 60% were frequently observed. The influence on the right heart
seemed to be stronger than mitral insufficiency alone and the CTR reaches more than 80% in 8 to 10 years. The ECG showed LVH and progressive right axis deviation suggestive of RVH. Clinical features of these cases showed prominent tricuspid insufficiency (Fig. 4). In some they are still living in 10 years in spite of their CTR more than 80%.

Aortic stenosis: Symptoms appeared late in ages at the initial visit more elder, ranging from 28 to 73 years of age. There are not remarkable changes in the CTR of 50 to 55% during the follow-up period. Left atrial enlargement and pulmonary congestion are prominent at the onset of left heart failure. However at the terminal stage the patients with combined failure and pleural effusion usually showed the increased CTR of more than 60%. The ECG showed predominant changes of the ST-T waves on the left ventricle in the elder patients. A-V block and intraventricular conduction disturbance were observed (Fig. 5).

Aortic insufficiency: In some cases there are asymptomatic without cardiomegaly for more than 10 years. In others, they developed rheumatic carditis at their teen-ager and showed the increased CTR of more than 60% and lowered diastolic blood pressure but there are no remarkable changes in the CTR thereafter. LVH and ST-T changes on ECG are gradually progressive (Fig. 6). The patients with congestive failure usually showed the CTR of 65 to 70%, left ventricular and atrial enlargement, pulmonary congestion and pleural effusion. The patients treated by the artificial valve replacement usually showed the decrease in the CTR in the early period after the operation (Fig. 7).

Mitral and aortic valvular diseases: The results of the coordinated hemodynamic overload of various valvular diseases could be seen by chest x-ray.

**DISCUSSION**

In cardiac measurements evaluating the heart function from the cardiac size in the chest x-ray, there are measurements of CTR and cardiac silhouette volume. The latter has been reported to correlate well with the size of the left heart. In evaluating the left atrial enlargement, left atrial index is effective. The changes in cardiomegaly in various valvular heart diseases were evaluated from the changes in the CTR during the course of the follow-up period. It is considered that the changes in the CTR during the course of the follow-up period well reflect the changes of the pathophysiologic findings of these valvular heart diseases.

Mitral stenosis is a disease indicative of operative treatment. Mild and long follow-up cases of mitral stenosis seems to be the non-progressive mitral obstruction. Left atrium in these cases showed normal or slight enlargement without the increase in the CTR and mild pulmonary congestion. On the other hand, cases with progressive mitral obstruction showed the increase in pulmonary congestion, pulmonary hypertension and the CTR more than 60% due to the enlarged right heart. Cases with restenosis, chronic congestive failure, tricuspid insufficiency and low cardiac output, usually showed the increased CTR more than 80%.

Mitral insufficiency has a main features of volume overload on the left heart and the hemodynamic overload on the lung is mild in the compensated state. The heart shows gradual enlargement with repeated left heart failure and chronic right heart failure and some cases showed the increased CTR more than 80%. There were some patients with no cardiomegaly for more than 10 years without any symptoms among younger patients.

The patients with mitral stenoininsufficiency showed stronger hemodynamic influences on the lung than mitral insufficiency alone and developed symptoms in the early stage. The heart showed the enlargement to the right and left, and the patients with chronic right heart failure showed the increased CTR more than 80%. The enlargement of the heart of these patients were largest among the patients with other valvular disease.

In mitral valvular diseases, the established atrial fibrillation makes more enlargement of left atrium and is one of factors to be a progressive pathophysiological state. Usually the CTR is increased after the established atrial fibrillation.

In mitral valvular diseases, the hemodynamic changes produced by pregnancy and delivery were causes of deteriorating state and cardiomegaly of various degree was accompanied.

The age of patients with aortic stenosis is more elder (28 to 73 years) and their follow-up period is short. Causes of aortic stenosis are not uniform. The latent period is long in the natural course of aortic stenosis. However with the onset of angina pectoris, syncope and left heart failure, the deterioration is rapid. It is difficult to
evaluate the concentric hypertrophy of aortic stenosis by the changes in the CTR during the course of the follow-up period. Usually no apparent increase in the CTR was observed even in the early stage of left heart failure with left atrial enlargement apparently due to the elevated end-diastolic pressure of the left ventricle and evidence of interstitial edema in the lung. The left and right heart were enlarged in the terminal stage of combined heart failure and the CTR was increased more than 60%.

The patients with aortic insufficiency usually belong to the younger age group of less than 30 years of age. They showed a good clinical course for several years and no remarkable changes in the CTR were observed during the course of the follow-up years, regardless of the amount of regurgitation unless they have no complication of endocarditis (rheumatic or bacterial) during the course. The patients with congestive failure usually showed the CTR of 65 to 70%.

The surgical treatment with a good outcome for valvular heart diseases eliminates the hemodynamic overload and usually the decrease in the CTR is observed.

CONCLUSION

The sequential follow-up of the CTR for 15 years from the initial visit are shown in Fig. 8.

1) Mitral stenosis: The patients with non-progressive mitral obstruction and without symptoms show their CTR of about 50% and no cardiomegaly. When the mitral obstruction is progressive and the right heart enlargement is created by the progressive increase in hemodynamic overload, the CTR usually reaches to 60 to 70%.

2) Mitral insufficiency: The overload on the right heart is gradual in spite of the enlargement of the left heart in mitral insufficiency. The increase in the CTR is also slow in speed. The patients with chronic right heart failure show the CTR of 80%. There are some cases without cardiomegaly during the course of the follow-up period.

3) Mitral stenoininsufficiency: In mitral stenoin-sufficiency the CTR usually show the increased CTR and its speed of increment is rapid due to both the volume overload of mitral insufficiency and the pressure overload of mitral stenosis. In 8 to 10 years after the initial visit the CTR reaches to more than 80%.

4) Aortic stenosis: The age at the initial visit is more elder and the follow-up period is short. They showed the CTR of about 50% during the course and at the terminal stage with combined heart failure the patients showed the CTR more than 60%.

5) Aortic insufficiency: The patients with a small amount of regurgitation show the CTR of about 50% during the course of the follow-up years. The patients with a large amount of regurgitation show the CTR of 60 to 70% during the course. The patients with congestive failure usually show the CTR of about 70%.

6) The surgical treatment with a good outcome improves the hemodynamics and bring about the decrease in the CTR in the early stage after the operation.

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