The age-specific clinical and anatomical profile of mitral stenosis

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ABSTRACT

Introduction: This cross-sectional study on the age-specific clinical and anatomical characteristics of mitral stenosis was conducted at the Department of Cardiology at Kottayam Medical College, South India.

Methods: The clinical profile, laboratory details and transthoracic echocardiographical features of 203 consecutive patients with mitral stenosis were studied. Wilkins score was used to assess the valve morphology and the feasibility of balloon mitral valvotomy (BMV)/closed mitral valvotomy (CMV). Patients were grouped according to age, into Group I (younger than 40 years; 68 cases), Group II (40–65 years; 78 cases) and Group III (older than 65 years; 57 cases) for analysis.

Results: The mean age of the patients was 53 years. History of rheumatic fever was less common in Group III (37 percent in Group I vs. 20 percent in Group III, p-value is equal to 0.05). Acute pulmonary oedema occurred commonly in Group III (six percent in Group I vs. 36 percent in Group III, p-value is less than 0.001). Incidence of ischaemic strokes increased with increasing age (three percent in Group I vs. 12 percent in Group II, p-value is equal to 0.05; 12 percent in Group II vs. 25 percent in Group III, p-value is equal to 0.05; and three percent in Group I vs. 25 percent in Group III, p-value is less than 0.001). Prevalence of atrial fibrillation (AF) increased progressively with increasing age (nine percent in Group I vs. 30 percent in Group II, p-value is less than 0.001; 30 percent in Group II vs. 64 percent in Group III, p-value equal to 0.003). Clinical features of pulmonary hypertension was highest among Group I (66 percent in Group I vs. 42 percent and 43 percent in Groups II and III, respectively, p-value is equal to 0.01). The mean duration of exertional dyspnoea, history of paroxysmal nocturnal dyspnoea, mean NYHA class, mean left atrial sizes, mean mitral valve areas and mean mitral valve gradients did not vary significantly among the three groups. Mitral valve scores were prohibitive for BMV/CMV in significant numbers of older patients (seven percent in Group I vs. 38 percent in Group II vs. 80 percent in Group III; p-value is less than 0.001).

Conclusion: When compared to the trends in developed countries, the mean age at presentation of mitral stenosis is similar, but the degree of valve deformity is higher. Incidence of pulmonary oedema, AF and stroke increases with advancing age in mitral stenosis.

Keywords: atrial fibrillation, mitral stenosis, mitral valvotomy, pulmonary oedema, rheumatic heart disease, stroke

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INTRODUCTION

Acute rheumatic fever (ARF) and its chronic sequel, rheumatic heart disease (RHD), have become rare in most developed nations, but remain unchecked in developing countries and in some poor, mainly indigenous populations of the developed countries.[1] Because of the dramatic decline in the incidence of ARF in much of the developed world over the past 70 years, mitral stenosis, once a common valvular problem, is now distinctly uncommon in many countries. Nevertheless, because mitral stenosis maintains a high prevalence in developing countries and among emigrants from those countries to the developed countries, continued awareness of the condition is warranted. Mitral stenosis accounted for only 9.5% of all the cases of chronic valvular heart diseases in a large cohort of patients from the Europe.[2] But in a recent Indian study, 41.5% of cases of chronic RHD in adults had mitral stenosis.[3]

Rheumatic mitral stenosis is an acquired progressive form of valvular heart disease, characterised by diffuse thickening of the mitral valve leaflets, fusion of the commissures and shortening and fusion of the chordae tendineae. The clinical and the anatomical features of mitral stenosis are age-dependent and the clinical presentation

may vary widely at different age groups, though the degree of valve obstruction may be similar. This is because of the higher frequency of atrial fibrillation (AF), the greater degree of valve deformity and calcification, and the increased frequency of coexistent coronary artery disease in the older age groups.[4,5] Elderly patients tend to have calcified, thickened, and relatively immobile valves, often with significant subvalvar disease, and are usually unsuitable for balloon valvuloplasty.[6] Even though the prevalence of mitral stenosis is high in India, the age-specific clinical and anatomical characteristics of the disease are not well studied among Indian patients. In an attempt to address this issue, this study was conducted among the patients attending the cardiology services at Kottayam Medical College, a tertiary-care teaching hospital and the largest referral centre for five districts of Kerala, South India, with a population of about six million.

METHODS

The patients were selected from the cases of RHD evaluated in the outpatient and inpatient units of the Department of Cardiology, Kottayam Medical College, between January 2005 and May 2006. Informed consent was obtained from each of the participants, and the study was approved by the institutional review board. A detailed history was obtained from each of the patients about the cardiac symptoms like exertional dyspnoea, paroxysmal nocturnal dyspnoea, palpitation, angina and syncopal episodes. Episodes of acute pulmonary oedema were confirmed by the description of the patient regarding sudden onset of dyspnoea treated by hospitalisation and administration of nasal oxygen and parenteral drugs, or when available, by checking the medical records of the patient. Previous history of cerebrovascular accidents / transient ischaemic attacks, rheumatic fever, infective endocarditis and other medical comorbidities were also sought. Detailed history was obtained from each participant regarding chronic illnesses like diabetes mellitus, hypertension, coronary artery disease (CAD), chronic kidney disease, cerebrovascular accidents (CVA), chronic obstructive airway disease (COAD), rheumatological disorders and rheumatic heart disease, and also regarding medications for any diseases in the past. All the medical records of the patients were verified when available, to search for any significant ailments in the past.

Each patient was examined in detail to detect AF, pulmonary arterial hypertension (evidenced by clinical features like left parasternal heave, palpable epigastric pulsations due the hypertrophic right ventricle, loud pulmonary component of second heart sound and pulmonary regurgitation murmur) and congestive heart failure. Baseline haematological and biochemical investigations, along with electrocardiography (ECG) and chest radiography, were performed in each of the participants. Detailed transthoracic colour Doppler echocardiography (EnVisor B 0.2, Philips Ultrasound, Andover, MA, USA) was carried out using standard techniques in each participant. Mitral valve area was assessed by 2D planimetry and pressure half-time methods. Degenerative changes of the mitral valve were scored using the echo score developed by Wilkins et al.[7] To assess cases for the presence of pulmonary arterial hypertension (PAH), the pulmonary artery systolic pressure was calculated from tricuspid regurgitation jet velocity and diastolic pressure from pulmonary regurgitation jet velocity, using the modified Bernaulli equation. Right ventricular systolic pressure was calculated based on tricuspid regurgitation gradient. Right ventricular systolic pressure more than 50 mmHg and right ventricular systolic dimension more than 2.6 cm were considered as evidences of significant PAH. Those patients with significant mitral regurgitation, more than mild lesions of the other valves and the previous history of commissurotomy (percutaneous or surgical) were excluded from the study.

The ECG evidence for right ventricular hypertrophy (R wave/S wave ratio > 1 in chest lead V1) and radiographical evidence for main pulmonary arterial dilatation (> 3 cm) were examined in each of the participants. The Wilkins score of the stenotic mitral valve was used to assess the feasibility of closed mitral valvotomy / balloon mitral valvotomy (CMV/BMV). The patients with mitral stenosis were categorised into three age groups; viz. Group I: age < 40 years, Group II: age between 40 and 65 years, and Group III: age > 65 years, for the purpose of analysing the age-specific clinical and anatomical characteristics. Statistical analysis was performed using the Statistical Package for Social Sciences version 11.5 (SPSS Inc, Chicago, IL, USA). Univariate analysis was done using Z-test for the proportions. The results with p values ≤ 0.05 were considered statistically significant.

RESULTS

203 consecutive patients meeting the inclusion criteria during the study period were included in the final analysis. The mean age was 53 (range 17–90) years. Only 70 patients (34.5%) were males. 57 patients (28.1%) were older than 65 years. 82 patients (40.4%) had been diagnosed earlier to have mitral stenosis and 32 (15.8%) had been told that they had some valvular heart disease for which they had been referred for cardiac evaluation. 65 patients (32%) had AF but only 21 patients among them (32.3%) were receiving

Table I. The baseline clinical characteristics of patients in the three different groups.

Clinical variables	Group I (n = 68)	Group II (n = 78)	Group III (n = 57)	p-value (I vs. II)	p-value (II vs. III)	p-value (I vs. III)
No. (%) of females	47 (69)	52 (67)	34 (60)	NS	NS	NS
Mean (range) duration of exertional dyspnoea (years)	4.8 (1–9)	6.5 (⅔–12)	4.9 (1.5–16)	NS	NS	NS
Mean NYHA class	II	II	II	NS	NS	NS
No. (%) with history of PND	18 (26)	22 (28)	22 (39)	NS	NS	NS
No. (%) with history of acute pulmonary oedema	4 (6)	11 (14)	19 (33)	NS	0.01	< 0.001
No. (%) with previous history of rheumatic fever	25 (37)	23 (29)	11 (19)	NS	NS	0.05
No. (%) with history istory of ischaemic stroke	2 (3)	9 (12)	14 (25)	0.05	0.05	< 0.001
No. (%) with atrial fibrillation	6 (9)	23 (29)	36 (63)	< 0.001	0.003	< 0.001
No. (%) with clinical features of PAH	44 (65)	32 (41)	24 (42)	0.01	NS	0.01
No. (%) with clinical signs of pliable mitral valve	66 (97)	70 (90)	39 (68)	NS	0.03	0.001

NYHA: New York Heart Association; PND: paroxysmal nocturnal dyspnoea; PAH: pulmonary arterial hypertension; NS: not significant

Table II. The electrocardiographic, radiological and echocardiographic abnormalities seen among the three groups of patients during the evaluation for pulmonary artery hypertension.

Investigation, no. (%)	Group I (n = 68)	Group II (n = 78)	Group III (n = 57)	p-value (I vs. II)	p-value (II vs. III)	p-value (I vs. III)
RVH in ECG	24 (35)	21 (27)	7 (12)	NS	0.05	0.004
MPA dilatation in chest radiograph	45 (66)	37 (47)	27 (47)	0.05	NS	0.05
RVD > 2.6 cm	35 (51)	23 (29)	19 (33)	0.01	NS	0.04
RVSP > 50 mmHg	35 (51)	36 (46)	18 (32)	NS	NS	0.03

RVH: right ventricular hypertrophy; MPA: main pulmonary artery; RVD: right ventricular dilatation; RVSP: right ventricular systolic pressure; NS: not significant

oral anticoagulation. All the 25 patients (12.3%) who had CVA due to ischaemic strokes had AF, and mitral stenosis was detected in 16 of them (64%) only after the occurrence of stroke. Three of the patients (1.5%) had a history of treatment for infective endocarditis.

Of the 203 patients with mitral stenosis, 68 patients (33.5%) belonged to Group I, 78 patients (38.4%) belonged to Group II and 57 patients (28.1%) to Group III. Approximately two-thirds of patients in each group were females. Eight patients in Group III (14%) and three patients in Group II (3.8%) were taking treatment for diabetes mellitus type 2. Six patients in Group III (10.5%), four patients in Group II (5.1%) and one patient in Group I (1.5%) were taking treatment for hypertension. Three patients in Group III (5.3%) and three patients in Group II (3.8%) had ECG abnormalities suggestive of CAD. Four patients in Group III (7%) and one patient in Group II (1.3%) had COAD and three patients in Group I (4.4%) had bronchial asthma. Two patients in Group III (3.5%) and three in the Group II (3.8%) had mild renal impairment. Two Group III patients (3.5%) and one Group II patient (1.3%) had peripheral arterial embolism affecting the femoral arteries. 12 patients in Group III (21.1%) and two among Group II (2.6%) had osteoarthritis. The clinical parameters analysed are depicted in Table I. Of the 59 patients with a previous history of rheumatic fever, only 14 patients in Group I and four patients in Group II were taking penicillin prophylaxis against rheumatic reactivation. Of the 34 patients with history suggestive of acute pulmonary oedema, 21 had sudden onset of palpitations immediately preceding the event, presumably due to AF and 28 of those with the history of pulmonary oedema had AF at the time of cardiac evaluation.

The mean left atrial diameters measured in Groups I, II and III were 4.7 (range 3.6–5.2) cm, 4.5 (3.7–5.3) cm and 4.9 (3.9–5.6) cm, respectively, and their mean mitral valve area were 0.92 (0.78–1.82) cm^2, 0.9 (0.79–1.94) cm^2 and 0.86 (0.76–1.66) cm^2, respectively, while their mean mitral valve gradients were 11.2 (6.4–18.8) mmHg, 10.4 (7.9–17.3) mmHg and 9.7 (7.7–19.9) mmHg, respectively. None of these echocardiographically-determined parameters among the three groups showed statistically significant

Table III. The echocardiographic scores of the mitral valve and the suitability for balloon mitral valvotomy or closed mitral valvotomy among the three age groups.

Echocardiographic parameter, no. (%)	Group I (n = 68)	Group II (n = 78)	Group III (n = 57)	p-value (I vs. II)	p-value (II vs. III)	p-value (I vs. III)
Mitral valve score						
≤ 8	60 (88)	42 (54)	13 (23)	< 0.001	< 0.001	< 0.001
9–11	7 (10)	31 (40)	31 (54)	< 0.001	NS	< 0.001
> 11	1 (2)	5 (6)	13 (23)	NS	0.008	< 0.001
Calcification score > 2	2 (3)	26 (33)	38 (67)	< 0.001	< 0.001	< 0.001
Subvalvular score > 2	9 (13)	28 (36)	34 (60)	< 0.001	0.01	< 0.001
Not suitable for BMV / CMV	5 (7)	29 (37)	45 (79)	< 0.001	< 0.001	< 0.001

BMV: balloon mitral valvotomy: CMV: closed mitral commissurotomy; NS: not significant

differences when analysed. The ECG, radiological and echocardiographic abnormalities seen among the three groups of patients during the evaluation for PAH are shown in Table II. The echocardiographic scores of the mitral valve and the suitability for balloon mitral valvotomy or closed mitral commissurotomy among the three age groups are compared in the Table III.

DISCUSSION

Rheumatic fever and RHD still remain important public health problems in India resulting in considerable cardiac morbidity and mortality. Even though some studies show trends towards reduction in the prevalence of RHD in Indian schoolchildren,[8] the prevalence of rheumatic fever and RHD in adults did not show much reduction over the past two decades.[3,9,10] The higher mean age at presentation of the patients and the higher number of patients aged more than 65 years with mitral stenosis in the present study are similar to the epidemiological trends of this disease in the western countries.[2,4,11]

The past history of rheumatic fever was surprisingly less common in our Group III patients compared to the patients in the older age groups in Shaw et al's study.[4] Arthralgias without frank arthritis is common in many patients with rheumatic fever in India,[10] and the patients in the older age groups or their treating physicians might have ignored the episodes of arthralgias of rheumatic process which had occurred in their younger age. The higher incidence of acute pulmonary oedema in Groups II and III might be related to the higher prevalence of AF in these groups. Other factors like coexistent CAD might have contributed to the higher incidence of acute pulmonary oedema in these groups, but the reported prevalence of CAD in Indian patients with RHD[12] is much less than that reported in the Western literature.[2,4,13] Though the prevalence of overt CAD was less among these groups of patients (as evidenced by ECG and echocardiography), some of them might have had subclinical CAD.

The prevalence of AF increased with the increase in the age of the patients in our series as well, similar to the observations made by others.[4,14-16] The overall prevalence of AF in our cases was much higher than that reported in a large-scale study on RHD from southern India.[3] This difference might be due to the higher mean age of the patients in our study. The vulnerability to develop AF in mitral stenosis is reported to be higher in those with higher left atrial pressures[17] and larger left atrial sizes.[13,14] Contrary to these observations, we found only insignificant differences in the mean left atrial sizes and the mean mitral valve gradients between the three age groups, but a significantly higher rate of AF in older age groups. We presume that advanced age is a major risk factor for the development of AF in our patients with mitral stenosis. Subclinical CAD might be one important reason for the higher prevalence of AF in these patients but this hypothesis could not be proven without invasive coronary evaluation.

Coexistent AF was the main risk factor for the occurrence of ischaemic strokes in the older age groups in our cases. The fact that many of these patients had ischaemic stroke even before the diagnosis of mitral stenosis should alert the clinicians in this geographical area, because the mitral mid-diastolic murmur may easily be missed during clinical examination and one should be careful to avoid this error while examining the patients with effort intolerance. Prompt administration of anticoagulation in those with AF would prevent many thromboembolic events in patients with AF and mitral stenosis.

The clinical, ECG, radiological and the echocardiographic features of PAH were significantly higher in the younger age group (Group I) patients as well, comparable to observations in earlier studies.[18,19] The degree of severity of mitral stenosis[20] and the left atrial compliance[21] were found to be the factors determining the severity of PAH, though the right heart disease can progress independent of the mitral valve narrowing.[22]

The mean pulmonary artery pressures were significantly higher in our Group I patients even though there were no statistically significant differences in the mean left atrial diameters, mean mitral valve areas and the mean mitral valve gradients among the three groups. Higher degrees of reactive pulmonary microvascular changes[23] and reduced left atrial compliance in younger patients might be the reason for the higher incidence of PAH in them.

Though a statistically significant difference was not observed in the mean duration of symptoms among the three age groups, the elderly group might have had a longer duration of the disease. Surprisingly, there were no statistically significant differences in the left atrial dimensions and transmitral gradients among the three groups, and the prevalence of PAH was significantly lower in the elderly (Group III) when compared to the younger age group (Group I). A more indolent course of the disease in the older age groups when compared to the younger age groups,[23] and probably a greater left atrial compliance in the older age groups, might be the reasons for the lower prevalence of PAH among them. Left atrial compliance and stiffness are important determinants of left atrial pressure,[24,25] and higher age as such may not have a direct effect on left atrial pressure.[24]

Balloon mitral valvotomy (BMV) or closed mitral valvotomy (CMV) improves the functional status and cardiac survival in the patients with mitral stenosis.[11,15-20,26,27] The mitral valve morphology (assessed by the Wilkins score) was unsuitable for BMV/CMV in a significant number of patients in Group II and the majority of patients in Group III. There was no statistically significant difference in the mean mitral valve area observed in older patients when compared to the younger patients (Group I), in contrast to the observation made by Shaw et al.[4] But the calcification scores were significantly higher in the older patients in our study when compared to Shaw et al's observations, rendering many of our older patients unsuitable candidates even for palliative BMV/CMV. Mitral valve replacement, the only treatment option for these patients, would be associated with greater procedure-related morbidity, mortality and expenditure. The longer duration of subclinical disease before the diagnosis of the valve lesion could be one reason for the more severe valve deformity in our cases.

Contrary to the observations made by previous Indian studies,[3,9,23] the mean age of cases of mitral stenosis was much higher in our study. It was similar to the mean age observed in the Western studies.[2,4,11] The higher mean age of cases might reflect the peculiarities unique to the population of Kerala when compared to the population of other Indian states. The health indices of Kerala, including the expectancy of life at birth,[28] are much better than those of the other Indian states and are comparable to those of many developed nations like the United Kingdom.[29] The high number of elderly subjects with mitral stenosis observed in our study may be related to the large number of aged individuals in the Kerala population. But, the worst mitral valve degenerative changes were observed in the elderly subjects even in those with less severe stenotic valves. A major limitation of our study was that mitral stenosis is less prevalent in the developed countries making this study less relevant to the clinical practice there. However, because of the high prevalence of mitral stenosis in developing countries and the high numbers of migrant population from these countries in some developed countries, our observations are important for clinicians worldwide.

In conclusion, the age-specific differences in the clinical and anatomical features of mitral stenosis were obvious in our patients. The mean age of the cases at presentation was higher than that reported from other Indian states. The incidence of acute pulmonary oedema and the prevalence of AF both increase steadily with advancing age, whereas the prevalence of PAH is higher among the younger age group. Mitral valve calcification and the degenerative changes are more severe in older patients, rendering them unsuitable candidates for BMV/CMV. In patients with mitral stenosis, the incidence of ischaemic stroke increases with advancing age and coexistent AF, and mitral valve lesions are often diagnosed during the evaluation of a stroke.

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