INNOCENT SYSTOLIC MURMURS IN HEALTHY YOUNG MALES: A STUDY OF THE CHARACTERISTICS AND PREVALENCE IN THE SAF PRE-ENLISTEE POPULATION

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SYNOPSIS

Twenty healthy male subjects with innocent systolic murmurs were studied. Of these, eleven had clinical and radiological evidence of the straight back syndrome. In all subjects, an early or mid ejection systolic murmur was detected. In those with the straight back syndrome, the murmurs tended to be louder and maximally heard at the pulmonary area. In the majority of the 20 cases, there were characteristic changes in the intensity of the murmur with posture and respiration.

Chest roentgenography in the subjects with straight back syndrome showed loss of the normal dorsal kyphosis, marked narrowing of the AP diameter (mean 9.8cm) and reduction in the ratio of the PA diameter to transthoracic diameter (mean 0.36).

In 4 subjects, the electrocardiogram showed voltage criteria of left ventricular hypertrophy. The electrocardiograms were all otherwise normal.

M-mode and 2-D Echocardiogram was normal in all the 20 cases studied. Using the characteristics of the innocent murmur defined in this study, the prevalence of such murmurs in a sample of 215 consecutive normal pre-enlistees was found to be 30.6%.

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INTRODUCTION

Systolic cardiac murmurs are frequently encountered in clinical practise and, in particular, during the medical screening of large numbers of otherwise healthy subjects. The clinical differentiation of innocent cardiac murmurs from those arising from organic heart disease is of paramount importance. This study sets out to define the characteristics of cardiac murmurs in a sample of subjects without clinical or echocardiographic evidence of heart disease, and focuses particularly on those with the straight back syndrome. Based on these findings, the second part of this study is aimed at determining the prevalence of innocent cardiac murmurs in the pre-enlistee population seen at the Medical Classification Centre.

MATERIALS AND METHODS

The Medical Classification Centre is responsible for the medical examination and classification of all enlistees prior to National Service. Each enlistee passes through a series of screening tests namely haemoglobin determination, eye testing, urine 'labstix' testing, routine Chest X-ray, measurement of height, weight and blood pressure and finally physical examination by the Medical Officer.

Our study population comprises 20 subjects who had cardiac murmurs without any clinical evidence of organic heart disease. These subjects, who were otherwise healthy, were randomly drawn from the general population of enlistees. A detailed clinical history and physical examination was performed and ascultation of the chest was carried out with the subject in supine, standing and squatting positions. Each subject was specifically examined for evidence of the straight back syndrome[1] and thoracic cage abnormalities.

A resting electrocardiogram and a postero-anterior and lateral chest X-ray was done for each subject. Each lateral X-ray was examined for loss of the normal dorsal kyphosis and the antero-posterior diameter measured from the anterior edge of the body of the right thoracic vertebra to the posterior border of the sternum. The trans thoracic diameter was measured at the level of the diaphragm and the ratio of the A-P to trans thoracic diameter thus derived.

A separate random sample of 26 healthy enlistees without clinical or radiological evidence of the straight back syndrome, and who did not have any cardiac murmurs, were similarly studied to act as a control group.

The 20 subjects with murmurs were referred to the Cardiologist who verified the clinical findings and who performed M-Mode and 2D Echocardiographic examination on all the subjects, using Hewlett-Packerd Doppler System.

Using the ascultatory characteristics ascertained, we subsequentlyexamined consecutive healthy pre-enlistees to determine the incidence of innocent systolic murmurs in that population. Each subject was examined in a supine, erect and squatting position. All those with murmurs detected had resting ECGs done.

RESULTS

The study population comprised 20 males of ages ranging from 17 — 21 years with a mean of 18.2 years. There were 17 Chinese, 2 Malays and 1 Indian (Table 1).

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Table 1
COMPOSITION OF STUDY POSITION

Sample size	:	20
Age Range	:	17 to 21 years
Mean	:	18.2 years
Ethnic group	:	Chinese = 17 Malay = 2 Indian = 1

The ascultatory findings for the study population are shown in Table 3. The murmurs were all ejection systolic in nature. 55% of them were mid systolic in timing while the remainder were heard in early systole. No late systolic murmurs were detected.

The majority of the murmurs (75%) were of grade 2/6 intensity while the rest were grade 3/6. No thrills were noted in any of the cases. The site of maximal intensity of the murmur was most commonly at the pulmonary area (45%), followed by the 4th left intercostal space, (30%) and apex (25%). Radiation of the murmur was found only in one case where the murmur radiated up along both carotid arteries in the supine position.

The second heart sound was normally split in all cases.

Third heart sounds (S3) were detected in 50% of the cases and were best heard at the apex.

None of the subjects examined had fourth heart sounds. The murmurs became softer on inspiration in the majority of cases (70%) and in 5 cases, the murmur was inaudible on deep inspiration.

The intensity of the murmur also varied with the posture of the subject. In a large proportion of cases, the murmur became softer on standing and louder on squatting (70%). In the remaining 30% of cases, there was no change in intensity of the murmur with change of posture.

In addition to these ascultatory findings, the ECGs of 4 of the subjects were noted to be "abnormal" in that the combined magnitude of SV1 and RV5 was greater than 40m, being 41, 43, 44 and 45mm respectively. The first of these cases also showed a left axis deviation and mild cardiomegaly on the PA chest X-ray, with a CT ratio of 0.52.

The echocardiogram for all the subjects were normal. Specially, none of them had echocardiographic evidence of mitral valve prolapse or hypertrophic obstructive cardiomyopathy (HOCM).

Of the 20 subjects, 11 had clinical evidence of the straight back syndrome and 9 did not. The clinical diagnosis of straight back syndrome was confirmed by the loss of the normal dorsal kyphosis on lateral chest X-ray. The radiological findings in the 2 groups were compared with that of the normal control group (Table 2).

With reference to Table 2, using the student's T-test (2-tail), the difference between the means for both the PA diameter and the ratio of PA diameter to transthoracic diameter for the SBS and non-SBS group, were found to be statistically significant ($p < 0.01$ in both instances).

With respect to these measurements; it is apparent that the non-SBS group is very similar to the normal control population.

We wanted to ascertain if there were any significant differences in the clinical findings between those with straight back syndrome and those without. The findings are tabulated in Table 3.

Only 4 of the 20 subjects had symptoms. Of these, 2 had pricking left chest pain which was unrelated to exercise and the other 2 reported occasional postural giddiness coming on when standing up suddenly from a squatting or sitting position. In the latter 2 subjects, there was no history of syncope or falls.

It is interesting to note that while the mean height of the subjects in the SBS group was significantly greater than the non-SBS group ($p < 0.05$ using a one-tail student's t-test), the mean weight was significantly less than the non-SBS group ($p < 0.05$ using a one-tail student's t-test). This is probably a reflection of the generally asthenic body habitus that is associated with the straight back syndrome.

The ascultatory findings indicated that more subjects in the SBS group had grade 3/6 murmurs and that the maximal site of the murmur in the SBS group was most commonly in the pulmonary area. In this study, all the subjects were noted to have normally split second heart sounds and none of them had accentuation of the P2 component.

DISCUSSION

The innocent systolic murmur is a very common clinical finding particularly in children and young adults. Several studies on the incidence of innocent systolic murmurs have been reported. Mcleren el at screened 12050 black school children, aged 2 to 5 years, and found innocent systolic murmurs in 72% of them.[2] In another series[3] a survey of 200 normal white school children, aged 2 to 12 years, showed a prevalence rate for innocent systolic murmurs of 84%. The incidence of innocent systolic murmurs in adults is less well studied. Cotter et al[4] studied 107 asymptomatic 40 year-old-men in Edinburgh and detected innocent systolic murmurs in 16% of them. In our present study, which is based on a healthy young male adult population, aged 18 to 20 years, we found a prevalence of innocent systolic murmurs of 30.6%.

Given the frequency of occurrence of innocent murmurs and the fact that a misdiagnosis of organic heart disease in such cases will lead to unnecessary investigation and

Table 2
CHEST X-RAY FINDINGS IN STUDY GROUP COMPARED WITH CONTROL GROUP

	STUDY POPULATION: (N = 20)				CONTROL POPULATION: (N = 26)	
	SBS (11)		NON SBS (9)			
	Mean (cm)	SD (cm)	Mean (cm)	SD (cm)	Mean (cm)	SD (cm)
PA Diameter	9.8	0.8	11.6	1.3	11.8	2.0
PA Diameter / Transthoracic Diameter	0.36	0.018	0.43	0.02	0.44	0.079
CT ratio	0.42	0.034	0.43	0.05	0.42	0.055

Table 3
CLINICAL FINDINGS IN SBS GROUP COMPARED WITH NON-SBS GROUP

CLINICAL FINDING	SBS (N = 11)	NON-SBS (N = 9)	TOTAL
Symptoms			
Chest pain	1	1	2
Occasional postural giddiness	2	0	2
Physical Measurements			
Height (cm): Mean	171.0	166.0	
SD	4.8	3.9	
Weight (kg): Mean	54.0	62.9	
SD	5.8	14.7	
Asculatory Findings			
Intensity of murmur: 2/6	7	8	15
3/6	4	1	5
Maximal site of murmur			
Apex	2	3	5
LSE 4	2	4	6
Pulmonary Area	7	2	9
S3	4	6	10
S4	0	0	0
Change with Inspiration			
Decrease intensity	6	3	9
Disappears	2	3	5
No change	3	3	6
Change on Standing			
Decrease intensity	9	5	14
No change	2	4	6
Change on Squatting			
Increase intensity	9	5	14
No change	2	4	6

anxiety, it is of importance to define the characteristics of the innocent murmur so as to allow more accurate clinical diagnosis, with the aid of electrocardiography and chest roentgenography.

In our study population, organic heart disease was excluded on the basis of clinical examination, ECG, chest X-ray and Echocardiographic examination. Our results show that the typical innocent systolic murmur is an early or mid ejection systolic murmur, of 2/6 or 3/6 intensity and most often maximally heard at the pulmonary area, although it may also be loudest at LSE 4 or the apex. The murmur typically decreases in loudness with inspiration although in 30% of the cases, there was no change. There is also a characteristic decrease in the intensity of the murmur on standing, which increases again on squatting. In a proportion of our cases, however, no postural change occurred. Third heart sounds were heard in 50% of cases but no fourth heart sounds were detected.

These findings concur well with the findings in other studies. There is good evidence that innocent systolic murmurs arise at least partly, and probably totally, from turbulence in the aortic root.[5] The intensity of the murmur corresponds to the ejection of blood from the ventricles and has a crescendo-decrescendo contour. As most of the blood is normally ejected early in ventricular systolic, the corresponding murmur is usually short and peaks early in systole. The site of the origin of the murmur results in it being usually loudest in the second left intercostal space (pulmonary area). The innocent murmur generally decreases on standing as this leads to a decrease in the ejection velocity and is not associated with additional findings of heart disease such as ejection click, diastolic murmur or cardiomegaly.

Of particular importance in our population, is the necessity to exclude the presence of mitral valve prolapse, which is also commonly encountered. The murmur of mitral valve prolapse is typically late systolic in timing, is usually best heard in the apex or LSE 4, and may be associated with a mid systolic click. The murmur becomes longer on assuming an upright position and may even become pan-systolic in timing, but shortens again on squatting.[7] These characteristic findings, allow ready clinical differentiation from the innocent murmur in the vast majority of cases.

It is also necessary to distinguish the innocent systolic murmur from the murmur of aortic and pulmonary stenosis. The murmur in valvular aortic stenosis tends to be louder (grade 3/6 or more), is often associated with an ejection click and radiates strongly into the neck.[6, 8] Mild degrees of pulmonary stenosis, however, may produce murmurs identical to the innocent murmurs. The presence of an ejection click and an abnormally widely split S^2 may allow differentiation. In addition, significant grades of pulmonary stenosis are, in the majority of cases, associated with helpful ECG changes, namely, R:S ratio in lead V1 exceeds 1, and S waves are often accentuated in V6.[9]

Another condition which needs to be differentiated from the innocent murmur is hypertrophic obstructive cardiomyopathy (HOCM). This murmur is often best heard at the lower left sternal edge and apex and tends to increase with the valsalva maneouvre and upright position, and to decrease with prompt squatting.[6] In addition, in HOCM there may be characteristic changes on ECG and echocardiogram allows one to confirm the diagnosis.

In this study, we have looked specially at the problem of the straight back syndrome as related to the innocent systolic

murmur. This syndrome, first described by Rawling in 1960,[10] is very commonly encountered in our pre-enlistee population and is important as it is commonly associated with mitral valve prolapse. A study performed in the Medical Classification Centre in 1984,[11] showed that in 33 subjects with mitral valve prolapse, 21% had the straight back syndrome. In addition, it was found that 45% had sternal abnormalities and 27% had scoliosis. Although the incidence of mitral valve prolapse in those with straight back syndrome is unknown, these findings indicate that special care must be taken to exclude MVPs in such instances. More importantly, perhaps, the straight back syndrome is associated with clinical and radiographic features that may cause a mistaken diagnosis of organic heart disease to be made. The murmur in the straight back syndrome may sometimes be associated with a thrill.[12] Furthermore, the second heart sound is often widely split and may not become single in expiration. The pulmonary component of the second heart sound is also often accentuated and may be palpable, stimulating pulmonary hypertension.[1] In addition, the PA chest X-ray may show leftward displacement of the heart shadow, a prominent pulmonary artery and a "squashed", enlarged heart.[13]

Our study did not reveal any particular distinguishing features between the SBS and non-SBS group although there was a tendency for the murmurs in the former group to be louder and maximal in the pulmonary area. None of the cases with the straight back syndrome in our series had a second sound which remained split during expiration and the pulmonary component was not accentuated in any of the cases.

The radiographic features we obtained were characteristic. The lateral film showed marked loss of the normal dorsal kyphosis in the SBS group with a narrowed P-A diameter (mean 9.8 cm) and consequently, a reduced ratio of PA diameter to transthoracic diameter (mean: 0.36). The P-A chest X-ray also showed typical changes.

A final point of note, is that in 4 cases in the study population, there was ECG voltage criterion of left ventricular hypertrophy ie SV1 + RV5 greater them 40 mm. In all of these cases, the blood pressure readings were normal as were the echocardiograms.

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