ROLE OF LEFT VENTRICULAR FUNCTION EVALUATION IN NON SPECIFIC ECG ABNORMALITY

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ABSTRACT

A total of 373 subjects (367 service persons and 6 civilians) with ECG abnormality were evaluated with maximal TMT exercise, 86 (23%) of them showing positivity. Subsequent assessment including radionuclide ventriculography and coronary arteriography wherever necessary revealed coronary artery disease in 31 (8.3%). The remaining 55 were further evaluated by 2D and M-Mode echocardiography for exclusion of any other cardiac disease responsible for the ECG abnormality as well as for assessment of LV performance. Seven subjects showed minor structural cardiac anomalies - MVP in 5 and HOCM in 2. The remaining 48 showed no significant difference in the measurements of LV posterior wall and IV septal wall thickness, mitral septal separation, mitral valve excursion velocities, LV end-systolic/end-diastolic internal diameters and calculated percent fractional shortening, LV end-diastolic, end-systolic and stroke volumes as well as ejection fraction, on comparison with 20 age matched controls. These 48 service persons, thus evaluated were considered to have no organic heart disease or cardiac function impairment and were cleared for all strenuous duties including flying of sophisticated aircrafts or posting to high altitudes.

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KEY WORDS : LV systolic function; Non-specific ECG abnormality.

Introduction

Service personnel are subjected to periodic ECG recordings as part of their annual medical evaluation. Instances of asymptomatic ECG abnormality detected during such evaluations are not uncommon. Several investigations including Holter monitoring, stress tests, and in selected cases radionuclide as well as coronary arteriography (CART) are carried out to exclude coronary artery disease (CAD) in them. Needless to say, there are numerous causes producing ECG abnormality other than CAD, and therefore efforts must be made to exclude such causes before clearing the service personnel with ECG abnormality for strenuous duties including flying fighter aircraft or postings to high altitude terrains. We have studied all such personnel with 2D and M-mode echocardiography to assess LV regional wall as well as global performance and to establish normal cardiac anatomy and physiology which are

the prime requirements for men in services to be optimally fit for any eventualities during peace and war, under adverse conditions on land, in deep sea or over the limitless sky.

Material and Methods

Subjects with asymptomatic ECG abnormality (Table 1) reporting to us for further evaluation and disposal were included in this study. A detailed clinical evaluation, relevant laboratory and radiological investigations were done in all. Maximal treadmill exercise test (TMT) was done in all using a computerised multichannel viagraph equipment [1,2]. Continuous Holter monitoring was done where-ever indicated. Service personnel found to have positive TMT were then further evaluated with radionuclide or CART studies in selected cases, and those found free of CAD were subsequently subjected to echocardiographic evaluation using a computerised Sonolayer (Toshiba) equipment.

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TABLE 1
Types of ECG abnormality (n=373)

Abnormality	No of cases	%
T inversion in III, IIIR avF, avF (R)	74	19.8%
T inversion V1 V2 V3	24	06.4%
Infrequent extrasystole (SV)*	15	04.1%
Infrequent extrasystole (V)**	09	02.4%
Abnormality detected following Double Master two step exercise (ST-T changes in post-exercise records)	251	67.3%
Total	373	100%

* Supra ventricular extrasystole;

** Ventricular extrasystole

The 2 D cardiac imaging was done in left parasternal long and short axes and apical four chamber view and cardiac shape, size, pulsations, regional and global wall motions were carefully observed. LV posterior wall and IV septal wall thicknesses, mitral-E-point intraventricular septal separation (EPSS), mitral valve anterior and posterior cusps opening as well closing velocities, internal diameters of the left ventricle, left atrium and root of aorta during end-systole and end-diastole were measured for five consecutive M-mode cycles and mean values were obtained. Percent fractional shortening, LV end-diastolic volume (LVEDV), end-systolic volume (LVESV) stroke volume (SV) and ejection fraction were then calculated from the above mean values using the inbuilt computer [3-5].

Twenty age matched normal healthy controls were also similarly evaluated including echographic studies. The results were compared statistically

Results

Out of the 373 subjects studied, majority were male services personnel - 367 (98.4%), consisting of 253 officers and 114 other ranks - only 6 (1.6%) including 4 females were civilians. Their age varied between 26 years to 58 years. Clinical evaluation revealed 42 (11.3%) to be obese and 17 (4.5%) to have hypertension. Laboratory investigations

showed hypercholesterolaemia in 37 (9.9%) and diabetes mellitus in 23 (6.2%). ECG evaluations including Holter monitoring and TMT showed ST-T changes (horizontal/downsloping ST depression > 1.0 mm) suggestive of CAD in 86 (23%), 31 out of which were subsequently confirmed to have CAD by further studies including radionuclide and CART wherever indicated. Thus only 8.3% of the 373 studied had CAD.

The remaining 55, all male service personnel 37 officers and 18 other ranks - were then subjected to 2D and M-mode echocardiography. Seven of them showed anatomical abnormality - MVP in 5 and abnormal systolic anterior motion of the mitral valve in 2. They were excluded from the LV function study.

LV function evaluations in remaining 48 service personnel are given in details in Table 2 and Table 3. The mean values of LV posterior wall and IV septal wall thicknesses in ECG abnormality cases and controls were 10.89 ± 1.53 mm, 8.93 ± 1.26 mm and 10.56 ± 1.61 mm, 8.87 ± 1.26 mm respectively, the difference recorded being insignificant. The mean values of various parameters of mitral valve excursion velocities as well as the internal dimensions of left ventricle, left atrium, root of aorta both in systole and diastole were also within normal limits in both groups (ECG abnormality and controls) with mild insignificant differences between the two.

The mean LVEDV, LVESV and SV in ECG abnormality cases and controls were 136.8 ± 12.5 ml, 44.3 ± 8.7 ml, 84.1 ± 8.4 ml and 130.54 ± 11.3 ml, 46.4 ± 7.9 ml, 85.04 ± 9.3 ml respectively. The differences were insignificant statistically. Mean ejection fractions in the two groups also were within normal limits.

These 48 subjects were cleared to their respective optimum medical categories and permitted to fly service aircrafts or posted to high altitudes.

Discussion

LV function evaluation by echocardiography is a simple, repetitive bedside technique,

TABLE 2
Echocardiographic measurements

Parameters	Mean values $\pm$ SD		Statistical significance (p value)
	Controls	ECG Abn.	
LV post wall thickness (mm)	10.56 $\pm$ 1.61	10.89 $\pm$ 1.53	NS
IV septal wall thickness (mm)	8.87 $\pm$ 1.21	8.93 $\pm$ 1.26	NS
Mitral septal separation (mm)	5.48 $\pm$ 1.43	5.71 $\pm$ 1.29	NS
Opening velocity - ant cusp mitral valve (mm/sec)	156 $\pm$ 9.36	153 $\pm$ 10.5	NS
Opening velocity post cusp mitral valve (mm/sec)	68.3 $\pm$ 7.6	66.4 $\pm$ 9.12	NS
Diastolic mitral valve closure (mm/sec)	125.2 $\pm$ 9.36	123.8 $\pm$ 9.8	NS
Deceleration phase of mitral valve ant cusp closure (mm/sec)	66.82 $\pm$ 2.3	64.9 $\pm$ 3.7	NS
LV diastolic dimension (mm)	47.36 $\pm$ 4.6	48.1 $\pm$ 3.9	NS
LV systolic dimension (mm)	34.3 $\pm$ 3.92	35.4 $\pm$ 2.85	NS
Left atrial end-systolic dimension (mm)	33.4 $\pm$ 4.5	33.6 $\pm$ 3.9	NS
Aortic root dimension (mm)			
Systolic	25.89 $\pm$ 4.3	26.3 $\pm$ 3.2	NS
Diastolic	23.91 $\pm$ 2.6	24.1 $\pm$ 2.5	NS

NS : Not significant

TABLE 3
Echocardiographic evaluations

Parameters	Mean values $\pm$ SD		Statistical significance (p value)
	Controls	ECG Abn.	
Percent fractional shortening (%)	39.32 $\pm$ 4.1	38.75 $\pm$ 3.3	NS
LVEDV (ml)	130.54 $\pm$ 11.3	136.8 $\pm$ 12.5	NS
LVESV (ml)	46.4 $\pm$ 7.9	44.3 $\pm$ 8.7	NS
SV (ml)	85.04 $\pm$ 9.3	84.1 $\pm$ 8.4	NS
EF (%)	67.4 $\pm$ 4.12	64.3 $\pm$ 3.2	NS

NS : Not significant

very reliable and accurate in experienced hands. In fact this non-invasive technique in all its modalities (2D, M-mode, colour doppler) has revolutionised cardiac investigation [5-7]. Some of the dynamic estimations like percent fractional shortening, mitral septal separation and ejection fraction are considered to be valid and effective especially in normal hearts without regional synergy [8-10]. Other measurements like aortic root dimensions and mitral valve excursion velocities are also well correlated with LV function in normal hearts [8]. Ejection fraction, however, is the most useful single index of LV function because it correlates best with pa-

tients clinical state and outcome [8]. It can be calculated from EPSS measurements as well as from LV volume determinations [3,5,10]. The estimations of LV end-diastolic, end-systolic and stroke volumes by various methods used in both M-mode and 2D techniques are very accurate and simulate values obtained by angiographic studies [11,12].

Exclusion of CAD in cases of ECG abnormality, as done in our of 56 service persons, does not always indicate that all these subjects with ECG abnormality have structurally and functionally normal heart. This has amply been proved in our study where 7 cases were detected to have minor anatomical car-

diac anomalies. These 7 cases are being followed up in lower medical category. The remaining 48 cases when subjected to LV function studies did show a slight difference in the mean values of various parameters as compared to controls but all these values were within the range of normalcy. All these 48 cases have been cleared to their optimum medical category and declared fit to fly service aircrafts including fighter-bombers or proceed on duty to high altitude terrains wherever applicable. Thus exclusion of CAD in cases with ECG abnormality should not be the only criterion for labelling them innocent or nonspecific and clearing them for strenuous duties in Armed Forces. An echocardiographic evaluation with LV function determination should be done to detect occasional abnormality of heart missed so far and thus prevent a catastrophe either in mid air or at high altitude.

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