

# Echocardiography in Assessment of Cardiovascular Problems of Air Force Personnel

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*Seventy one Air Force personnel, including 14 aircrew, with cardiovascular problems were evaluated with various non-invasive tests including echocardiography. 29 cases (including 5 aircrew) had stabilised ischaemic heart disease (IHD), 12 cases (including 7 aircrew) had non-specific ECG abnormalities, 5 cases had arrhythmias and 25 cases (including 2 aircrew) had undiagnosed systolic murmur. 27.58% of cases with IHD, 16.6% of cases with non-specific ECG abnormality and 20% of cases with arrhythmias showed echocardiographic evidence of left ventricular dysfunction. 28% of the cases with undiagnosed systolic murmur showed definite diagnostic pattern by echocardiography in contrast to 12% having suggestive features in graphical recordings by indirect carotid tracings and apex cardiography. Thus echocardiography is found to be a very useful technique of evaluation of cardiovascular problems, in addition to other non-invasive tests.*

AIR Force personnel with stabilised ischaemic heart disease, non-specific ECG abnormalities, cardiac arrhythmias and undiagnosed systolic murmurs are evaluated with various non-invasive techniques including stress tests, impedance cardiograph, telemetry, Holter monitoring and systolic time interval studies prior to final disposal. Echocardiography is a relatively newer technique added to this battery of tests and has been found to be very handy and useful in evaluation of cardiovascular problems.

## Material and Methods

Seventy one Air Force personnel including 14 aircrew, with old stabilised un-complicated ischaemic heart disease, non-specific ECG abnormalities, arrhythmias and undiagnosed systolic murmurs formed the material of this study. All were subjected to detailed clinical evaluation and relevant biochemical and radiological investigations. A 14 lead resting electrocardiogram followed by master double two step exercise was recorded in each.

Subjects with stabilised ischaemic heart disease, non-specific ECG abnormalities and arrhythmias were evaluated by stress tests by graded multistage treadmill exercise or bicycle ergometer exercise. Bipolar lead system (CM5)<sup>2</sup> of electrocardiogram was recorded during the stress tests and ST segment and heart rates were analysed by on-line computers (Avionics-2900). Subjects with ischaemic heart disease were given submaximal exercise (85% of the age-determined maximal heart rate) whereas all others were subjected to maximal exercise<sup>3</sup>. Cases of undiagnosed systolic murmurs were evaluated with electrocardiogram, phonocardiogram, indirect carotid pulse tracings and apex cardiogram. The indirect carotid pulse tracings and apex cardiogram were recorded along with lead II of electrocardiogram and phonocardiogram in a multichannel recorder and at least 10 successive complexes were recorded in each case. Echocardiographic studies were done in all by Unirad Cardiosone Echocardiograph with moni-

toring facilities for 'A' and 'M' modes, the recordings being obtained on a Honeywell Strip chart recorder for permanent storage. Subjects were studied both in supine and standing positions. All the four valves were recorded. Special care was taken in recording both cusps of the mitral valve, especially their pattern of closure or any abnormal systolic anterior motion of anterior mitral leaflet. Pattern of motion of interventricular septum and posterior left ventricular wall (which normally move towards each other in systole and in opposite direction in diastole) was noted. The internal dimensions of left atrium, aortic root and the ventricles were measured in each case. Thicknesses of the interventricular septum and posterior wall of the left ventricle were also measured.

### Observations

Majority of the subjects belonged to the 4th and 5th decades of age (Table I). 29 cases, including 5 aircrew, had stabilised ischaemic heart disease. None of the five aircrew officers had transmural infarction. 12 cases, including 7 aircrew, had nonspecific ECG abnormalities. 5 subjects had frequent supraventricular/ventricular ectopics. 23 cases, including 2 aircrew, had undiagnosed systolic murmurs varying between grade II-III/VI heard in left parasternal areas.

None of the cases had any symptoms or cardiovascular complications. ECG at rest and after double Master two step exercise did not show any significant deterioration. Relevant biochemical and radiological parameters were normal in all. Treadmill exercises done in cases with ischaemic heart disease, non-specific ECG abnormalities and arrhythmias showed diagnostic evidences of effort ischaemia at peak of exercise in four cases with IHD (13.79%), in one case with non-specific ECG abnormality (8.3%) and in none with arrhythmias. Systolic time interval studies, indirect carotid tracings and apex cardiogram showed evidences suggestive of idiopathic hypertrophic subaortic stenosis in three cases (12%)—the carotid tracings showing rapid upstroke, mid systolic retraction and late systolic bulge.

Echocardiographic studies in the group with ischaemic heart disease showed evidence of left

ventricular dysfunction in 8 out of 29 subjects (27.58%). Two of them were aircrew. The features noted were consistent decrease in the mean velocity of circumferential fibre contraction in all, dilatation of the left ventricular cavity in 5, thickening of the interventricular septum in 3 subjects (with antero-septal ischaemia), diminished asynchronous movement of the posterior left ventricular wall and interventricular septum in 4 subjects. None had ventricular aneurysm. Two subjects (one aircrew) out of 12 (16.6%) with non-specific ECG abnormalities and one out of 5 (20%) with multiple ventricular ectopics also showed features of left ventricular dysfunction.

Evaluation of undiagnosed systolic murmurs by echocardiography was most rewarding, 7 cases out of 25 (28%) showing definite diagnostic patterns. Five cases had mitral valve prolapse (MVPS): one showed prolapse of both anterior and posterior mitral leaflets, while the other 4 had lone posterior mitral valve prolapse. The subject with both anterior and posterior leaflet prolapse had holosystolic prolapse while the rest 4 showed mid and late systolic prolapse. The degree of prolapse was seen to increase in all cases during standing position. Two subjects showed abnormal systolic anterior motion of anterior cusp touching the septum in diastole—a diagnostic finding of Idiopathic hypertrophic subaortic stenosis (IHSS). These two cases had earlier shown evidence of IHSS by indirect carotid tracings and apex cardiography. A third case who had similar finding during the carotid recordings was found to have echocardiographic evidence of MVPS.

### Discussion

Echocardiography owes its birth to the pioneering work of Elder and Hertz<sup>3</sup> who recorded the first echocardiographic signal using a sonar device borrowed from the local shipyard. The principle involved in echocardiography is as follows: a short pulse of ultra high frequency sound (1 to 8 MHz) is transmitted by a Piezo electric crystal in a beam into the tissues of chest. Part of this sound is reflected back to the transducer at each interface of tissues while the rest gets transmitted for further reflection by deeper cardiac structures. The time delay between sound transmission and the reception of each sequential sound allows calculation of the distance between the transducer and each reflecting

interface during this one pulse cycle. Most equipment transmit a pulse of 1 per sec duration and receive the reflection for 999 M sec., thus obtaining 1000 depth sampling per second<sup>4</sup>. If the transducer is moved from one direction to other to encompass several areas of the heart sequentially, the record will show an anatomical relation between one intracardiac structure to another. As the transducer is swept from left ventricle towards aortic root (infero-superiorly), the following echo patterns are recorded: (a) anterior chest wall (ACW), right ventricle (RV), right ventricular anterior wall (RVAW), echo free space of right ventricle (RV) echo from interventricular septum (S), echo free space of left ventricle (LV), echo from anterior chordae tendinae (AC), posterior chordae tendinae (PC), left ventricular posterior wall (LVPW) and pericardium (P) (b) ACW, RVAW, RV, S, anterior mitral valve leaflet (AMV) in a characteristic 'M' shape, posterior mitral valve leaflet (PMV) in reciprocal 'W' shape during diastole and merging into one oblique line in systole LV, LVPW and P; (c) ACW, RV (out flow tract) anterior aortic root with echo from septum (S) and posterior aortic root continuous with echo from mitral valve and left atrium (LA).

Echocardiography is useful for diagnosis and left ventricular function assessment in large number of clinical cardiovascular diseases<sup>4</sup>. It is extremely useful in diagnosis of left atrial growths (myxoma)<sup>6</sup>, mitral valve prolapse syndrome<sup>6,7</sup> pericardial effusion<sup>8</sup> and idiopathic hypertrophic subaortic stenosis<sup>9</sup>.

Systolic murmurs with or without click which are not typical of acquired or congenital valvular heart disease are often considered as 'innocent' or 'functional' in recruits, candidates for commissioning to services including flying branch of Air Force and in absence of cardiac catheterisation studies are considered 'no bar' for selection. Such murmurs may be due to mitral valve prolapse syndrome—a condition which is being more commonly detected in recent times and is known to produce atypical chest pains, electrocardiographic abnormalities mimicking ischaemic heart disease and acute infarction, various arrhythmias and cardiac decompensation<sup>10</sup>. Candidates for flying duties and serving air crews with such a finding may be assessed wrongly to have ischaemic heart disease and myocardial infarction or

may be overlooked altogether to precipitate problems during flying jeopardising their own life and property of the state. Echocardiography helps in establishing the diagnosis of MVPS unequivocally<sup>6,7</sup>. Five cases out of 25 subjects with systolic murmur (20%), all labelled to have functional murmur, were found to have MVPS by echocardiography in this study. They are under observation in lower medical category and being reviewed periodically. Two cases, in addition were found to have definite diagnostic evidence of IHSS—thus amounting to 7 cases (28%) who could be provided with definite diagnosis and disposal.

Table I  
Diagnosis and age distribution

Diagnosis	age in years				Total
	20-29	30-39	40-49	50-59	
IHD	2	10	15	2	29
(echo+ve)	(—)	(2)	(4)	(2)	(8)
ECG Abnormality	—	11	1	—	12
(echo+ve)	—	(1)	(1)	—	(2)
Arrhythmia	1	4	—	—	5
(echo+ve)	(—)	(1)	—	—	(1)
Undiagnosed	3	10	10	2	25
systolic murmur	(1)	(4)	(2)	(—)	(7)
TOTAL	6	35	26	4	71
(echo+ve)	(1)	(8)	(7)	(2)	(18)

To evaluate stabilised cases of ischaemic heart disease, their rehabilitation and return to near normal or normal duties in the Armed Forces and to upgrade service personnel with IHD to full medical category including flying categories to aircrews in Air Force and Civil, extensive studies are undertaken with various non-invasive techniques including stress tests, impedance cardiography, Holter monitoring, systolic time interval studies and echocardiography to ensure that the individual has achieved the maximum possible cardiovascular fitness. Echocardiography outlines

the left ventricular function in these cases of IHD, much more accurately than any other non-invasive technique and almost similar to cardiac catheterisation results.<sup>11,12</sup> Out of the 29 Air Force personnel with IHD studied by us though 13.79% showed abnormality in stress test evaluation, a larger percentage (27.58%) had echocardiographic evidence of left ventricular dysfunction—enabling us to review their treatment and disposal. Cases of non-specific ECG abnormalities and arrhythmias have also been similarly benefitted by this technique of evaluation—3 cases out of 17 (17.65%) being provided with adequate diagnosis and disposal and rest all cleared for full duties.

Thus, echocardiography is a useful, handy and repeatable non-invasive technique for assessment of cardiovascular problems like ischaemic heart disease and ECG abnormalities among service personnel including aircrews, and for screening certain cardiac lesions like MVPS and IHSS among recruits and candidates for commissioning into services.

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