Original Research Article Journal of College of Medical Sciences-Nepal, Vol-14, No 2, Apr-Jun 2018

ISSN: 2091-0657 (Print); 2091-0673 (Online) **Open Access**

Echocardiographic Assessment of Suspicious Clinical and Electrocardiogram Findings of Healthy Young Male Military Aspirants

Navaraj Paudel,[1] Vijay Madhav Alurkar[1]

[1]Department of Cardiology, Manipal Teaching Hospital, Pokhara, Kaski, Nepal.

ABSTRACT

Background: Heavy exercise is associated with multiple physiological changes in cardiovascular system. Individuals who otherwise are healthy and asymptomatic are also found to have cardiac abnormalities. The aim of study is to find prevalance of structural abnormalities in apparently healthy males who are found to have abnormal/ suspicious clinical/electrogram findings during routine screening. **Materials and Methods:** A cross-sectional study was done in the department of cardiology within Manipal Teaching Hospital, Pokhara over a period of 3 years (December 2013 to December 2016). The study population included all the participants who were apparently healthy young males competing for military recruitment. After the initial screening, those who had abnormal/suspicious findings in the physical examination or in ECG were subjected for trans-thoracic echocardiogram to assess for any structural abnormality **Results:** Out of 1950 individuals, who underwent physical examination and ECG, 165 had abnormal physical findings and 261 had abnormal ECG findings (21.84% of total had any form of abnormality). 72 (43%) had grade 2 short systolic murmur in the pulmonary area followed by pansystolic murmur in apex. Only 1.8% had diastolic murmur in aortic area. Most common ECG abnormality found was LVH followed by sinus bradycardia and T-inversion in III . Almost 7% of individuals with abnormal ECG findings. Only 16 (0.82% of the total screened/ 4.38% of suspicious findings) had structural abnormalities in echocardiography: 12 had RHD (MR-7, AR-3, AR+AS+MR=2); 1 had ASD, 1 had VSD, 1 had Ebstein's anomaly and 1 had mild valvular pulmonary stenosis (congenital). **Conclusion:** Individuals who are otherwise healthy and asymptomatic were found to have cardiac abnormality (almost 1.7% had serious electrical or structural abnormality). Cardiovascular screening of all the individuals seeking jobs requiring intense physical exertion is essential to prevent serious cardiovascular outcomes.

Keywords: echocardiography; electrocardiography; intense exercise; physical cardiac findings.

INTRODUCTION

Heavy exercise has lots of impact in the cardiovascular system. Because the exercising muscle requires more energy, this requirement is fulfilled by the body by increasing cardiac output. Cardiac output increases as much as 4-6 times the normal while heart rate increases by 2-3 fold from resting state, thus stroke volume increases to a maximum of 18 times the normal.[1] Although there are great changes in cardiac output, blood pressure remains within smaller increment as the pulmonary as well as systemic vascular resistance (SVR) to blood flow is reduced substantially. Not only this, there is great contribution of redistribution of blood flow to the working skeletal muscles during exercise for the efficient delivery of oxygen to sites of greatest need.[1,2]

Isotonic exercises such as running, cycling, swimming results in sustained elevations in cardiac output (CO) with normal or reduced peripheral vascular resistance while isometric exercises such as weight lifting results in increased peripheral vascular resistance with normal or slightly elevated CO.[3] Increased flow across the cardiac valves sometimes produces functional systolic murmurs such as the ejection systolic murmur at pulmonary area.4 Physiological adaptations like increase in LV cavity, wall thickness, aortic root dilation along with decrease in resting heart rate are also seen that may contribute to electrical (ECG) and mechanical (functional murmur) alterations.[5-7] There is high concern in athletes and army recruits regarding sudden cardiac death (SCD). Cardiac screening of

Correspondence: Dr. Navaraj Paudel, Department of Cardiology, Manipal Teaching Hospital, Pokhara, Nepal. Email: drnavarajdm@gmail.com. **DOI:** http://dx.doi.org/10.3126/jcmsn.v14i2.19964. **Orcid ID:** http://orcid.org/0000-0003-4551-0808. **Article received:** 2018-05-21. **Article accepted:** 2018-06-29.

individuals who are participating in excessive stress/exercise is mandatory now-a-days. The incidence of SCD was as high as 1-3/100,000 while after screening this risk has dramatically reduced by 90%.[8] These are primarily due to either structural heart diseases such as hypertrophic obstructive cardiomyopathy (HOCM), arrhythmogenic right ventricular dysplasia (ARVD), dilated cardiomyopathy (DCM) etc or electrical abnormalities such as brugada syndrome, long or short QT syndrome etc.[9] This study aims to find the prevalence of structural defects in apparently healthy recruits undergoing strenuous training who have been found to have suspicious clinical or electrocardiogram abnormality on routine screening.

MATERIALS AND METHODS

A cross-sectional study was done in the department of cardiology within Manipal Teaching Hospital, Pokhara over a period of 3 years (December 2013 to December 2016). The study population included all the participants who were apparently healthy young males aged 18 to 21 years; competing for military recruitment from a selection camp. All of them were on heavy training since 6 months (Each day they were asked to carry 25 kilograms of sand bag on their back and run a distance of 5000 meters to be completed in 40-45 minutes. Following this, other strenuous exercises were done for about 2 hours). All had tolerated the given exercise very well. They then underwent physical examination of the cardiovascular system and ECG screening along with other tests as per the standard protocol laid for selection process. ECG was done by MAC 1200 ST of GE systems. After the initial screening, those who had abnormal/suspicious findings in the physical examination or in ECG were subjected for trans-thoracic echocardiogram to assess for any structural abnormality. 2D echo was performed by Siemens ACUSON SC 2000 machine and results were confirmed by 2 cardiologists.

RHD was defined according to the World Heart Federation (WHF) criteria for individuals 21 years or younger and categorized RHD as definite or borderline. In brief, definite RHD requires the combination of at least 2 morphologic criteria with pathologic regurgitation or mitral stenosis or borderline disease of the aortic and mitral valves. Borderline RHD is defined by at least 2 morphologic features or the presence of pathologic mitral or aortic regurgitation.[10] Data were collected in a preformed proforma and analyzed in SPSS software version 16. Percentage, mean value were calculated and Pearson's correlation coefficient, chi -square test, t-tests, odds ratio etc were calculated wherever required and p values were considered significant at a predetermined ∞ level of 5%.

RESULTS

Total of 1950 individuals were screened. Out of those individuals with abnormal/suspicious cardiac abnormality (physical findings and ECG abnormality) were 426 (21.8%).Abnormal physical findings were found in 165 (8.46%) individuals. A total of 72 (43%) had grade 2 short systolic murmur in the pulmonary area followed by pansystolic murmur in apex (24%). Only 1.8% had diastolic murmur in aortic area (Table 1).

Abnormal ECG findings were found in 261(13.38%) individuals. Most common ECG abnormality found was LVH (15.7%) followed by sinus bradycardia (14.5%) and T-inversion in III (17%).Almost 18 (6.9%) of individuals with abnormal ECG findings, (0.92% of total screened) had significant ECG abnormality (WPW pattern, LBBB, Long QT, ST elevation V1,V2,V3) that warranted treatment/ further investigations (Table 2). 2D echocardiography was performed in all the individuals with abnormal physical or ECG findings. Only 16 (0.82% of the total screened/ 3.75% of suspicious findings) had structural abnormalities in echocardiography: 12 had RHD (MR-7, AR-3, AR+AS+MR=2); 1 had ASD, 1 had

Table 1. Abnormal physical findings.

Abnormal physical findings		Number affected	% (out of 165)
Murmur	Grade 2 Pansystolic murmur at apex	40	24.24
	Grade 3 Pansystolic murmur at apex	20	12.12
	Grade 2 ejection systolic in pulmonary area	72	43.63
	Grade 3 ejection systolic in pulmonary area	10	6.06
	Grade 2 systolic murmur in aortic area	5	3.03
	Diastolic murmur in aortic area	3	1.82
	Systolic murmur in tricuspid area	9	5.46
Second heart sound	Wide but variable splitting	5	3.03
	Wide and fixed splitting	1	0.60

Table 2. Abnormal physical findings.

SN	ECG abnormalities	Number affected	% (out of 261)
1	Sinus bradycardia	38	14.5
2	Right bundle branch block (incomplete)	25	9.57
3	Right bundle branch block (complete)	15	5.74
4	Left bundle branch block	03	1.14
5	T inversion in lead III only	35	13.4
6	Early repolarization (inferolateral)	15	5.74
7	Early repolarization (anterior)	31	11.8
8	Q in III, aVF	20	7.66
9	T inversion V1-V4	10	3.83
10	ST elevation in V1, V2, V3	8	3.06
11	Long QT	4	1.53
12	Left ventricular hypertrophy (voltage criteria)	41	15.7
13	First degree AV block	4	1.53
14	Pre-excitation syndrome	3	1.14
15	Right ventricular hypertrophy with right axis deviation	9	3.42

Table 3. Abnormal physical findings.

SN	ECHO diagnosis		Number affected	% (out of 16)	% (out of 426)	% (out of 1950)
1	Rheumatic Heart disease	Mitral Regurgitation	7	43.75	3.75	0.82
		Aortic Regurgitation	3	18.75		
		Mixed (AS+AR+MR)	2	12.50		
2	Congenital valvular Pulmonic stenosis (PS)		1	06.25		
3	Ventricular Septal Defect (VSD)- Perimembranous		1	06.25		
4	Atrial Septal Defect (ASD)- Ostium Secondum		1	06.25		
5	Ebstein's anomaly of the tricuspid valve		1	06.25		

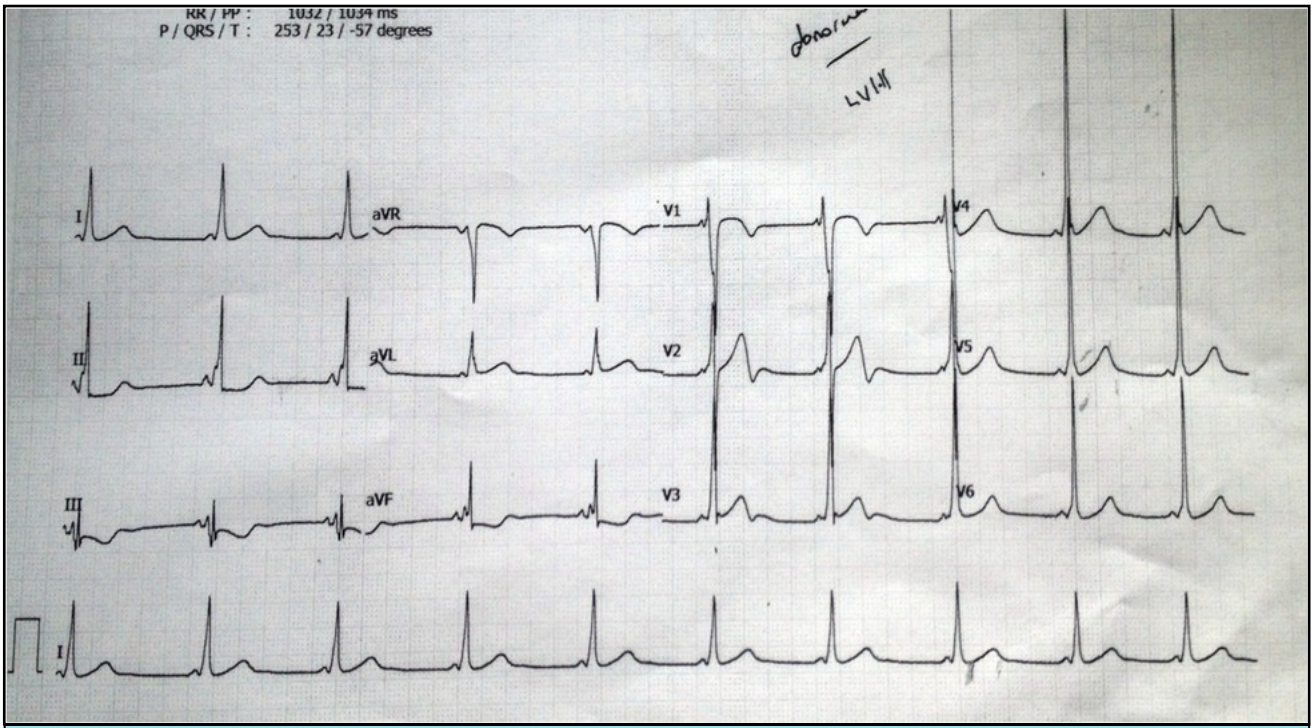

Figure 1. ECG showing Pre-excitation syndrome along with ST/T abnormality in V1-V3.

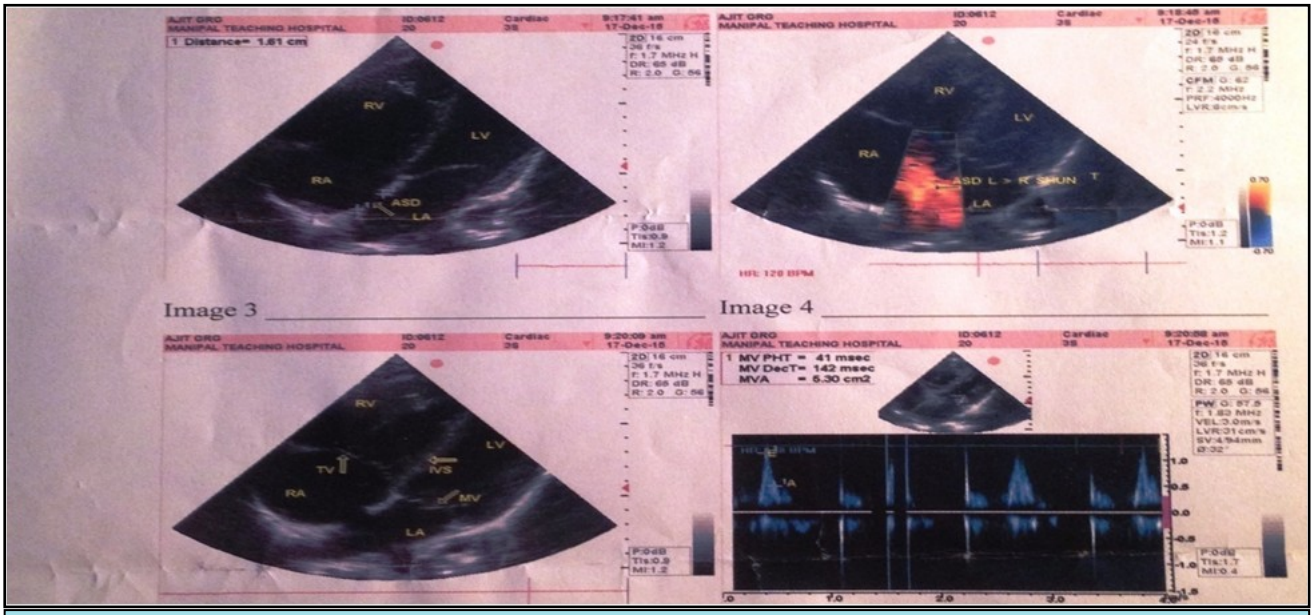

Figure 2. Shows Ostium secondum ASD.

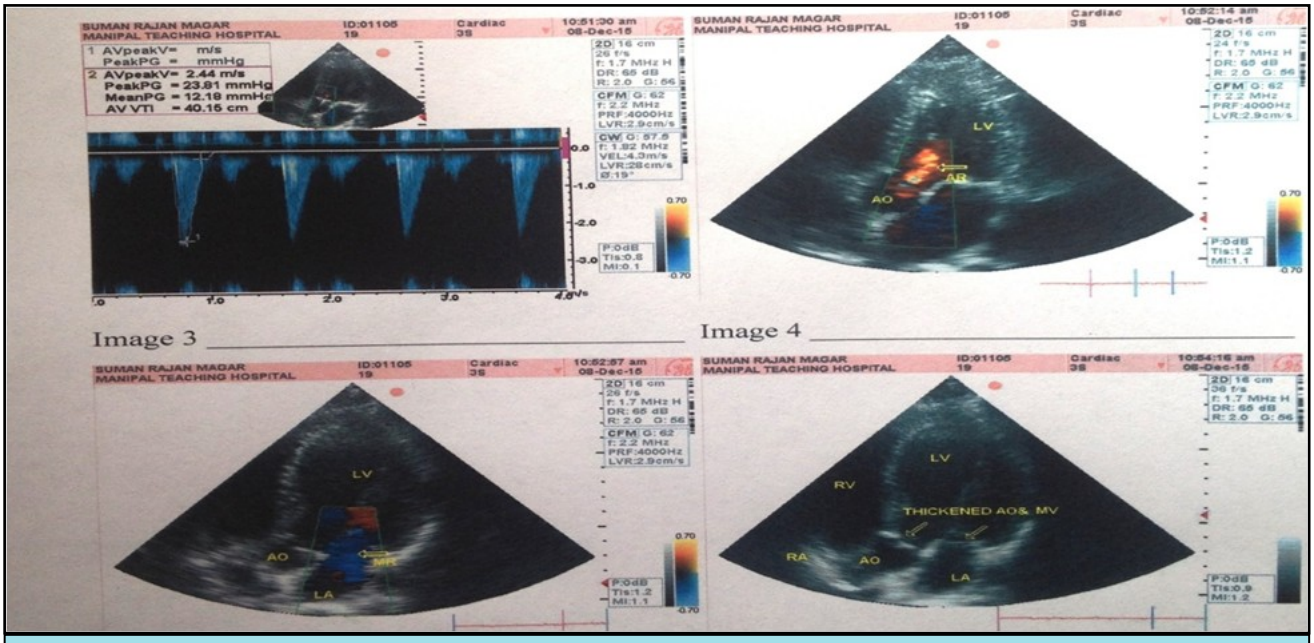

Figure 3. Shows RHD (AS+AR+MR).

VSD, 1 had Ebstein's anomaly and 1 had mild valvular pulmonary stenosis (table 3). Total RHD: 12 (75% of total structural abnormalities), RHD was defined as WHF criteria.[10] Total 34 (1.7%) individuals (18 with ECG abnormality and 16 with structural abnormalities) were having serious cardiac disease warranting treatment/further investigations.

DISCUSSION

This study was conducted to assess any cardiac abnormalities (both conductional and structural) in otherwise healthy persons who could perform strenuous exercise. This study shows that almost 1 out of 5 (18.7%) individuals were having some form of abnormal cardiac findings (both physical and ECG). Few studies done prior mention that physiological adaptations like increase in LV cavity, wall thickness, aortic root dilation along with decrease in resting heart rate are also seen that may contribute to electrical (ECG) and mechanical (functional murmur) alterations.[5-7]

In this study, Almost 92% individuals with abnormal physical findings were having innocent murmurs. Systolic murmurs are mostly due to increased flow across the cardiac valves and the commonest is an ejection systolic murmur at

pulmonary area which is also the commonest functional murmur.[4] Diastolic murmurs are usually pathological. In our study three individuals with diastolic murmurs at aortic area were found to have pathological (rheumatic) aortic regurgitation.

Differentiation between adaptive and pathological ECG changes in athletes is not always easy. Recommendations have been published by a group of US experts and the ESC5.[11] For example: Sinus bradycardia is normal in exercising individuals but heart rates less than 30 bpm and pauses >3secs during awake suggests a possibility of sick sinus syndrome; First and second degree type 1 (Wenckebach) blocks are benign in these individuals and usually resolve with hyperventilation or exercise. Incomplete RBBB is common but complete RBBB needs further evaluation. An elevated ST segment with upward concavity and positive T wave is seen in Caucasians and an elevated ST segment with upward convexity and negative T wave in African-Caribbean athletes. This may be a dynamic phenomenon caused by exercise.[12] In our study various ECG abnormalities along with both types of ST elevation and early repolarization were seen (See table 2).

In our study, few pre-excitation syndromes were seen and these individuals were considered for electrophysiological study and radio frequency ablation because these individuals are at risk of sudden death upon developing atrial fibrillation. In one individual it was associated with ebstein's anomaly of tricuspid valve (Table 2 and 3). Risk of sudden death is also associated with long QT syndrome and pathological early repolarisations.[13]All individuals with suspected congenital long QT syndrome, pre-excitation syndrome, pathological early repolarizations and brugada like pattern were counseled to seek early medical help upon symptoms like palpitations, and also for familial screening and confirmatory genetic analysis whenever possible.

In this study we have found sixteen individuals with structural abnormalities. Twelve out of 16 (75%) of individuals were having some form of rheumatic heart disease (commonly involving mitral and aortic valves). Secondary antibiotic prophylaxis was recommended in individuals with definite RHD. Nepal and few other developing countries are considered as high endemic area for rheumatic heart disease.[14] Silent rheumatic heart disease is five times more prevalent than manifest RHD as shown in a study done in eastern part of Nepal.[15]Early detection of silent disease may help prevent progression to severe valvular damage in future.

Approximately 0.8% of the population is born with congenital heart disease, up to 40% of them are cured spontaneously (mainly small VSDs) and with current surgical and interventional techniques, 85% survive into adults.[16-17]In adults VSD and ASD are the most common defects followed by PDA and pulmonary valve stenosis.[18] In this study, congenital structural abnormalities found were: One perimembranous VSD, one with ostium secondum type ASD, one with Ebstein's anomaly of tricuspid valve and one with mild valvular pulmonic stenosis (congenital). Serious structural abnormalities like hypertrophic Cardiomyopathy, Dilated Cardiomyopathy and Pulmonary hypertension were not seen.

Limitations: Current study has included apparently healthy young males who could perform strenuous exercise. Hence, the prevalence of structural heart disease may not be generalized to the general population. Current study reports findings of male patients only and conclusion about prevalence of structural heart disease cannot be drawn in general combined population.

CONCLUSION

Individuals who are otherwise healthy and asymptomatic are also found to have cardiac abnormality. In a country like Nepal where RHD/ Rheumatic fever is still highly endemic, screening programs with minimum: physical examination and ECG should be performed individuals with suspicious findings should undergo echocardiographic study for early diagnosis and treatment of the needed ones. Applicants for jobs requiring strenuous exercise should ideally undergone cardiac screening at intake. Screening program for both asymptomatic males and females from general population must be needed to estimate the prevalence of abnormal electrical and underlying structural heart diseases in asymptomatic people.

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Citation: Paudel N, Alurkar VM. Echocardiographic Assessment of Suspicious Clinical and Electrocardiogram Findings of Healthy Young Male Military Aspirants. JCMS Nepal. 2018;14(2):92-7.