



## Problems In Aeromedical Evaluation-III :\*

### @'Non-Specific' Repolarisation ECG Abnormalities

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A retrospective study of the routine ECGs carried out on 8922 males (age 20 - 55 yr.) during 1973 - 83 was undertaken. Out of them, 274 (3.0%) asymptomatic subjects (mean age 37 yr) were detected to have repolarisation (S-T, T and S-T/T) abnormalities. However, they did not fulfill the criteria for Coronary Artery Disease (CAD) even after stress-testing and therefore considered 'Non-Specific' Repolarisation ECG Abnormalities (Test Group). When followed-up (mean period 4.2 yr), 66/274 (24%) were found to subsequently develop changes specific for CAD, as against 177 (2.0%) in the rest of 8648 (Control Group). This is statistically highly significant. Within the Test Group, presence of one or more coronary risk factors amongst 60% (40/66) of them was also significant in subsequent development of CAD.

#### Introduction

Detection of Coronary Artery Disease (CAD) by ECG evidence of myocardial ischaemia (at rest or exercise-induced), in terms of repolarisation changes, is well established. Nevertheless, generally, S-T segment and T-wave may be unstable due to yet poorly understood dynamic biochemical flux following myocardial depolarisation.<sup>1</sup> Thus, when asymptomatic individuals are routinely screened with ECG, as in aeromedical practice, S-T and/or T deviations from the strictly normal pattern are observed, but not fulfilling the criteria for the diagnosis of CAD on stress-testing. These changes have, therefore, been considered 'Non-Specific' Abnormalities.

Howsoever, they do pose a diagnostic and prognostic dilemma and are of far-reaching implications in the cardiovascular evaluation of aerospace crew: whether these non-specific abnormalities warrant regular surveillance and special emphasis on primary prevention as a risk-group? or, these non-specific abnormalities are to be ignored? What are the prognostic considerations in terms of immediate and remote aerospace medical fitness?

There is paucity of definitive information in literature on these aspects. There is no uniformity

in defining the non-specific abnormalities or their significance vis-a-vis heart disease. Whilst there is general agreement that non-specific S-T/T changes "are a disquieting hint of latent disease which the physician can neither confirm or dismiss"<sup>10</sup>, other opinions vary between two extremes. 'Non-Specific' S-T/T changes have been considered associated with increased mortality in people with angiographic CAD<sup>(6)</sup> and overt CAD reported to develop in larger number of persons with non-diagnostic S-T/T abnormalities<sup>(2)</sup>; they have been stated to carry 3 to 10 times the risk of developing CAD than in those without. (2) At the same time, authors<sup>(1)</sup><sup>(9)</sup> have warned against overdiagnosis of heart disease based on non-specific ECG abnormalities.

Therefore, more exclusive data is required to be gathered and analysed on the subject. A preliminary report based on a study and follow-up of 274 cases of 'Non-Specific' Repolarisation ECG Abnormalities is presented.

#### AIM

- (1) To define 'Non-Specific' Repolarisation ECG Abnormalities ;
- (2) To analyse the spectrum of these abnormalities .
- (3) To delineate their natural history ;
- (4) To elucidate their prognostic value for CAD ;
- (5) To find any relationship to coronary risk factors.

#### DEFINITION

For the purpose of this study, 'Non-Specific' Repolarisation ECG Abnormality was defined as S-T segment/T wave deviations from strictly normal pattern in 12-Lead Scalar Electrocardiogram of asymptomatic individuals, which even after stress-testing, did not fulfil the criteria<sup>14</sup> of stress-test positivity for CAD ; this defined group excludes all instances with (a) coexisting cardiovascular/respiratory disease screened out by PA chest X-Ray and Echocardiogram where necessary, (b) drug effects,

(c) presence of pathological 'Q' wave, and (d) when such abnormalities may be explainable by frontal plane QRS axis, conduction defect, preexcitation syndrome, arrhythmia or features strongly suggestive of the so called Vaso-Regulatory Abnormality.

#### Material And Method

ECG records/reports carried out during 1973 to 1983 on 8922 Air Force Officers provided material for the study. ECG at rest, after Masters Double Two-Step Test and in case of abnormality, stress-testing on Bicycle Ergometer/Standard Treadmill/Vlagraph, as per applicable protocol had been performed. Hypoxia had been employed as an additional stress in selected cases. Manoeuvres like upright posture, valsalva, hyperventilation and beta-blockade had been utilised whenever indicated, Besides complete physical examination, PA skiagram of chest and evaluation of coronary risk factors inclusive of biochemical parameters had been done in all cases detected to have had ECG changes Echocardiogram had been done when considered necessary based on cardiac auscultatory findings. All instances of abnormal ECG pattern were subjected to follow-up graphs with regular periodicity.

Comprehensive serial data on each subject was collected from individual medical dossier on a pro-forma and filed in ICL-2958 Computer and processed. Retrieval of data was in response to pre-programmed questionnaire.

#### Result

*Prevalence of 'Non-Specific' Repolarisation ECG Abnormalities.* During the period from 1973 to 1983, 8922 Air Force Officers had undergone ECG examination as a routine procedure. The prevalence of 'Non-Specific' 'S-T' and/or 'T' changes was found to be 3.0% and these 274 subjects (mean age 37.0 yrs) formed the Test Group followed-up over a mean period of 4.2 years. The rest 8648 subjects (mean age 40.3 yrs) formed the Control Group. Both groups were derived from whole, all-male, homogenous population of Air Force Officers and were thus

comparable. In the Test Group, out of 274, 'Non-Specific' S-T segment changes were present in 35.7%, T-wave changes in 61.3% and both 'S-T' and 'T' changes in 3.0%.

*Progression of 'Non-Specific' Repolarisation ECG Abnormalities.* During the course of follow-up, the 'Non-Specific' 'S-T'/'T' Abnormalities reverted back to normal tracings in 10.2% (28/274). They progressed to changes diagnostic of CAD in 24.1% (66/274), In the rest 65.7% (180/274) the changes remained non-specific without any significant alteration of pattern or exercise response.

TABLE 1

**Development of CAD Diagnosed by Stress-Test Positivity or Clinical Manifestations During Follow-up of Test and Control Groups**

	Test Group (n=274)	Control Group (n=8648)
		(Highly Significant)
Total	66 (24%)	177 (2.0%)
Asymptomatic Cad	39	36
Symptomatic Cad	27	132
Silent M I	—	9
Predominant Age 35—40 yr (34.8%)		40—45 yr (345%)

*CAD Risk in 'Non-Specific' Repolarisation ECG Abnormalities.* From Table 1 it is seen that the risk of developing CAD is ten times more amongst subjects with 'Non-Specific' Repolarisation ECG Abnormalities than those who do not show these changes. No significance, however, is attached to the predominance of Asymptomatic CAD or younger age in the risk group since regular and frequent reviews were enforced on them which naturally led to earlier diagnosis and recognition of stress-test positivity.

TABLE 2

**Relationship of Coronary Risk Factors to the Later Diagnosis of CAD in Test Group 'Non-Specific' S-T/T Abnormalities - 274**

	Diagnosed CAD	Remained 'Non-Sp'/ Reverted To Normal
	66	208
Risk Factors Present	40 (60%) (S-p < 0.05)	95 (45%)
One	28	68
Two	11	22
More	1	5

*Relationship of Coronary Risk Factors to 'Non-Specific' Repolarisation ECG Abnormalities.* From Table 2 it is seen that within the Test Group, 60% of those who were later to be identified to have progressed to specific ECG changes of CAD, carried one or more coronary risk factors, as against 45% in those whose abnormalities disappeared or persisted unchanged (statistically significant at 0.05 level). However, individual risk factor association was not significant.

**Discussion**

Atherosclerotic Heart Disease is a major public health problem. Early detection of CAD is especially relevant in certain selected occupations, like aero-space operations, where in-flight incapacitation would be hazardous.

ECG monitoring is an universal standardised procedure for detection of occult CAD. When asymptomatic personnel are thus routinely screened with ECG, abnormalities in the repolarisation phase ('S-T' segment and/or 'T' wave) are observed, but which do not fulfil the diagnostic criteria for CAD even after stress-testing. These abnormalities have generally been considered 'non-specific' in nature.

There is as yet no uniformity in the identification of what constitutes such 'non-specific' ECG abnormalities. A restrictive definition for the non-

specificity of repolarisation abnormalities was adopted in this survey to make the results meaningful for interpretation and comparison.

In this study of 8922 males, the prevalence of such 'Non-Specific' Repolarisation ECG Abnormalities was found to be 3.0% in asymptomatic individuals. 'T' wave changes comprised the bulk (61.3%) of these non-specific abnormalities. Ostrander<sup>(1)</sup> cited 1.0% prevalence of non-specific 'T' wave abnormality with equal sex incidence in 4678 persons.

As for the natural history of 'Non Specific' Repolarisation ECG Abnormalities, it was observed that 75.9% either reverted to normal tracing (40.2%) or remained non-specific (65.7%) when followed-up. Packard<sup>(11)</sup> classified 90 ECGs as 'border-line'. He observed that in 59 of them the border-line abnormalities disappeared and in the 31 none of the abnormality deteriorated, suggesting that majority of border-line abnormalities are innocent. In this study, 24.1% of 'Non-Specific' 'S-T' and/or 'T' abnormalities were noted to progress eventually to a diagnosis of CAD.

The significance of 'Non-Specific' Repolarisation ECG Abnormalities vis-a-vis CAD remains uncertain in literature. Warning against overdiagnosis of heart disease in asymptomatic individuals based on non-specific ECG changes has been rightly made by authors. This is very valid when considered in the context of high false positive rate and low predictive value of ECG in this group<sup>(12)</sup>. However, Caris<sup>(3)</sup> noted that those with certain non-specific abnormalities have from 3 to 10 times the risk of developing CAD than those with normal results. In this study, the risk of future diagnosis of CAD was 10 times in the group who manifested 'Non-Specific' Repolarisation ECG Abnormalities. Froelischer<sup>(6)</sup> included non-specific S-T and T wave changes as one of the conditions associated with increased mortality in people with angiographic coronary disease. Angiographic findings in 111 aircrewmembers revealed<sup>(6)</sup> that in the subjects (n=32) with persisting S-T segment depression or straightening on resting ECG, 46.9% had significant CAD:

but not in those with previous tracings showing repolarisation changes and current tracing normal, or showing repolarisation changes with persistent low amplitude T-waves.

The multifactorial influence of coronary risk factors relating to atherosclerotic heart disease is well known. It was seen that individuals manifesting 'Non-Specific' Repolarisation ECG Abnormality who have also one or more coexisting coronary risk factor are statistically at a higher risk of developing CAD. In persons with an unfavourable cardiovascular profile (and a presumed propensity to accelerated atherogenesis), the development, without explanation, of certain electro-cardiographic abnormalities or cardiac enlargement on X-Ray study, herald the onset of ischaemic cardiomyopathy<sup>(13)</sup>. It cannot be determined whether 'non-specific' 'S-T'/'T' abnormalities themselves should be deemed to constitute a reckonable risk factor or they modulate the adversity of other known risk factors. But, no significant association of any one individual risk factor was notable.

The aetiology of resting ECG repolarisation abnormalities (non-specific S-T/T changes) in the group without CAD is unestablished. In their study of one of the commonest problems in Electrocardiography, namely, the interpretation of S-T/T deviations, Freidberg and Zager found that 209 cases showed non-specific S-T segment depression or T wave inversion or both in resting tracings and out of them, 29% could not be ascribed any apparent cause for the changes. It is speculative whether these may be due to previous episode of subclinical pericarditis or myocarditis or a present existing but subclinical cardiomyopathy<sup>(14)</sup>.

### Conclusion

'Non-Specific' abnormalities observed in ECGs of asymptomatic individuals are not to be considered benign on every occasion. About 25% of them may be harbouring occult CAD even though stress-testing does not elicit the accepted diagnostic criteria. In view of the unpredictability and potential for sudden incapacitation in air arising

out of undetected progression, 'non-specific' repolarisation ECG abnormalities do indeed pose a problem in aeromedical evaluation as to immediate disposal and longterm prognosis. Epidemiologically, 'Non-Specific' Repolarisation ECG Abnormalities merit consideration as a marker for high-risk of CAD and needs addition to the existing list of coronary risk factors. While precipitation of iatrogenic (electro-cardiographenic) illness in these cases is to be scrupulously avoided, 'Non-Specific' ECG Repolarisation Abnormalities require long-term surveillance. Since association of other coronary risk factors enhances the statistical chance of future occurrence of CAD, emphasis on primary prevention is warranted in such instances. An universal definition as to the non-specificity of the observed ECG abnormalities should be drawn and adopted for more studies in large scale.

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