

Influence of Beta-Blockade on Asymptomatic ST-T Wave Changes: A Follow up Study

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Abstract

ELECTROCARDIOGRAMS of 30 cases of T wave abnormalities among apparently healthy subjects in the age group 21-54 years were studied before and after administration of Beta Blockers (Propranolol 40 mgm). These cases were followed up for 3 years. The study shows that propranolol has a limited value in distinguishing between ECG changes of ischaemia and other causes. It has a definite role in cases showing evidence of beta adrenergic stimulation with cardiac reactivity.

Introduction

Electrocardiogram was made a mandatory requirement in 1967 for entry into all branches of Indian Air Force and a part of routine periodic physical examination. During recording of ECGs in a large number of cases repolarisation changes in the form of minor ST-T wave alterations were among the most frequent findings in apparently healthy subjects. These changes in the absence of any clinical correlation are termed Non-specific. Hiss⁷ found 581 cases of non-specific T wave changes in a electrocardiographic survey of 67,375 healthy males on flying status with USAF. Evaluation of 22,000 applicants for aircrew training with the Canadian Armed Forces revealed 611 cases with T wave variations¹². The incidence of ST-T abnormalities detected amongst aircrew in Indian Air Force is around 1%.

It is well known that extreme T wave changes may occur in susceptible individuals under benign conditions such as ingestion of glucose, hyperventilation, breath holding, valsalva manoeuvre, vasoregulatory abnormality and anxiety^{1, 6, 8, 11}. Opinions by

various authorities on the genesis and significance of minor ST-T wave alternations in asymptomatic individuals differ. On one hand Blackburn et al² have regarded horizontal or downward sloping depression of ST segment of between 0.25 and 0.5 mm and T wave inversion of less than 1 mm to be too slight and insignificant to merit inclusion in the Minnesota code. Freidburg⁵ states that ST depression of less than 0.5 mm and T wave inversion of less than 1 mm are not significant or at least not due to myocardial ischaemia. On the other hand, Evans et al⁴ emphasise the importance of such pattern as evidence of coronary heart disease. Aircrew certification for flying fitness in such cases poses problems and the responsibility of proving their benign nature or otherwise rests with the examining physician. The risk of incapacitating episodes compromising flight safety in these cases necessitates grounding and periodic observations. At the same time attaching ominous significance to these changes regardless of circumstances may lead to unwarranted cardiac invalidism and neurosis besides impeding the career prospects of the individual and loss of trained manpower to the State.

Stress induced catecholamine liberation could result in physical and electrocardiographic changes comparable to those associated with organic cardiovascular disease and as such ST-T changes have frequently been attributed to sympathetic overdrive due to situational stress of the examination per se. Abolition of these changes with beta blockade according to some authorities helps in differentiating between the functional and organic groups.

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The present study was undertaken to assess the influence of propranolol on ST-T wave changes in apparently normal subjects, detected during routine examination.

Material and Methods

30 subjects whose electrocardiograms revealed repolarisation abnormalities consisting of flattening, variable or negative T waves or ST depression with no significant deterioration after Double Master's exercise (Double Master's criteria not satisfied) comprise the material of present study. All the subjects were asymptomatic and had no clinical evidence of organic heart disease. 10 subjects with firm evidence of established infarction or hypertension showing the abnormal R-ST and T wave changes served as controls.

Evaluation included a detailed history to exclude any evidence of ischaemia or other associated abnormality. Past, family history of hypertension, diabetes mellitus or I.H.D. was enquired for. History of smoking and alcohol consumption was also recorded. Complete and thorough clinical examination was carried out. Height and weight were recorded. Special emphasis was laid to exclude hypertension, any chamber enlargement, overt thyrotoxicosis or any other abnormality. Signs of acute anxiety or stress such as tachycardia, tremors, facial pallor, sweating over palms were especially looked for and recorded. Investigations included a routine 100 gm standard G.T.T., estimation of serum cholesterol, uric acid and X-ray chest. Serum PBI estimation or I^{131} uptake studies were carried out to exclude latent or subclinical thyrotoxicosis, where indicated.

Electrocardiograms were repeated in the fasting state to ensure that electrolyte and metabolic changes associated with digestion were not the cause of the observed changes. The effect of respiration and hyperventilation were studied in some cases.

(Inderal (Propranolol) 40mgm was given orally and electrocardiograms (resting and after Double Master's 2 step exercise) repeated an hour later. Normalisation of ST segment changes and reversal of T wave changes with improvement in T wave amplitude were looked for and recorded. Subjects remained under periodic review and constant medical surveillance and have been followed up for an approximate period of 3.5 years.

Results and Observations

The subjects were divided into three groups as follows:

Group (i): Those manifesting overt signs of anxiety during examination with ST-T changes in ECG completely normalising with Inderal.

Group (ii): Subjects below 30 years of age showing minor T wave changes like flattening or less than 1 mm inversion or 0.5 mm ST depression with no evidence of stress, anxiety or any coronary risk factors, normalising ECGs after Inderal.

Group (iii): Subjects above 35 years of age showing well defined T wave changes with or without associated ST segment alterations or presence of coronary risk factors like obesity, smoking, raised serum cholesterol, borderline diastolic blood pressure records. Response to Inderal in these cases was complete normalisation, partial reversal or the ECG changes unaffected with betablockade.

Group (i): There were 3 cases who showed signs of situational stress and marked cardiac reactivity during the medical examination. Marked apprehension, facial pallor, tremors, moist palms and marked tachycardia as evidence of stress were noticed. Two subjects were aircrew from civil airlines and one Officer of the ground duty branch. Age ranged between 21 and 36 years with mean of 33 years. Heart rate ranged between 120 and 126/min (mean 116/min). None of them manifested any clinical or biochemical abnormality and I^{131} uptake done in 2 cases was within normal limits. ECG abnormalities consisted of flattening of T waves in limb leads with minor inversion in the precordial leads, with no deterioration after Double Master's 2 step exercise. After administration of Inderal, T wave became upright and well formed with reduction in heart rate which ranged between 70-80/min (mean 75/min). Catecholamine estimations were not feasible for lack of facilities.

These cases have been followed for approximately 3 years with no deterioration. The civil aircrew are engaged in active flying.

Group (ii): There were 7 subjects in this group. All were in excellent health and peak physical effici-

ency. Age ranged from 22 to 30 years (mean 25 years). 3 subjects were detected to have the ECG abnormality during evaluation to fly high performance aircraft. Two officers were volunteers for Naval aircrew duties, one was a civil pilot and the other was a candidate for commissioning in flying branch. No clinical or biochemical abnormality was detected in any subject. Majority of the subjects were vagotonic with heart rates ranging from 62-80/min (mean 68/min). ECG normalised in all except one subject where the T wave inversion became more pronounced (Fig 3 & 4). After Inderal, heart rate ranged between 54-75/min with a mean of 60/min.

The ECG abnormalities at subsequent reviews normalised in 3 subjects (high performance aircrew). Except 2, all are engaged in active flying, with no deterioration in their physical state for over 3 years.

Group (iii) : Comprised of 20 subjects. 7 were aircrew and 13 from ground duty branches. The ranges and means of age, weight and height are given in Table 1.

	Mean	Range
Age (Yrs)	46. 3	38-54
Wt (Kgs)	66. 6	59-89
Ht (Cms)	167. 6	156-178

All the subjects were asymptomatic with no significant abnormality on clinical examination. 10 cases were of normal body weight 3 cases were obese (20% overweight) and 7 were overweight (between 10-15% > ideal body weight). 3 cases gave a history of moderately heavy smoking (15 cigarettes a day). History of regular alcohol consumption was present in half the number of cases. 6 cases (30%) gave a positive family history of IHD. Two had manifested carbohydrate intolerance in the past which had remitted at the time of detection of ECG abnormality.

Heart rate (pre-drug) ranged between 68-84/min with a mean of 70/min. Borderline diastolic blood pressure records ranging around 94-96 mm Hg were detected in 2 subjects. After Inderal, ECG showed definite improvement in 13 cases (65%); partially restoring in 5 cases (25%) and remained unchanged in remaining 2 cases (10%). Serum cholesterol levels were mildly raised in 8 cases. None of them exhibited any carbohydrate intolerance or any other associated ab-

normality. During the period of follow up (2-3 years), two cases (10%) developed symptomatic myocardial infarction.

All the control cases of old established hypertension and myocardial infarction with ST-T changes in the ECG did not reveal any change after Inderal.

Discussion

The significance of improvement of ECG changes after beta blockade is still uncertain. Some authorities notably Noskowiec et al¹⁴, Moll et al¹⁵ and Smith and his associates¹³ reported the value of differentiating functional (non-ischaemic) changes from organic or ischaemic changes by beta receptor blockade with propranolol. Khanna et al¹⁶ in a recent study postulated that normalisation of these changes under propranolol is limited to resting records or under mild degrees of exercise. Propranolol according to them cannot distinguish the functional group from ischaemic heart disease when exercise is extended to sub-maximal level.

The present study also brings out the pronounced effects of propranolol in improving the non-specific T and ST changes in the ECG in approx 73% of cases. None of the cases with established hypertension or old healed myocardial infarction showed any improvement after exhibiting propranolol.

The genesis of ECG changes under stress is explained by the increased catecholamine secretion producing beta adrenergic stimulation of the heart. This produces positive chronotropic and inotropic effects. The resultant increase in cardiac output is associated with tachycardia and variable changes in stroke volume. The increased contractility and tachycardia produce increase in myocardial oxygen consumption and coronary blood flow. Thus, the net effect of catecholamine on the myocardium is one of "Oxygen wastage". This may result in electrocardiographic changes in T-ST segment of ECG simulating myocardial ischaemia. Blocking the effects of beta adrenergic stimulation with propranolol will therefore be of definite value in differentiating the ECG changes under these circumstances. In group (i) cases, showing non-specific T wave changes with evidence of stress and reversal with beta blockade, reflect their benign nature, mainly due to sympathetic overdrive.

Cases showing vagotonia also normalised their ECG under propranolol excepting one case. This

case in whom the heart rate further reduced to around 44/min after Inderal showed deterioration in the T waves. In 3 cases of high performance aircrew, detailed evaluation was carried out on treadmill (maximal exercise) and in the decompression chamber under hypoxia at 15000 ft¹⁰. No evidence of deterioration has been noticed in the follow-up of over 3 years. In fact, the ECG abnormalities have ameliorated in 3 of the 7 subjects, further signifying absence of any coronary artery disease in these subjects. It appears that changes in autonomic tone, both sympathetic and para-sympathetic may be responsible for the benign T wave changes.

The majority of subjects in this study (approx. 66%) were of the mean age 46.3 years with evidence of associated coronary risk factors. All were asymptomatic with no overt clinically discernible abnormality. 65% of the cases in this group showed normalisation of ECG changes with Inderal. During the period of follow up, however, 2 such cases, who were ground duty officers, developed symptomatic myocardial infarction. The value of propranolol in separating functional from organic groups is therefore doubtful in such cases. Probably these cases are suffering from asymptomatic or latent coronary artery disease, more so as coronary atherosclerosis in this age group is widely prevalent.

In conclusion, this study has shown that propranolol has limited value in distinguishing between ECG changes of ischaemic origin and those of non-ischaemic or functional type. It has a definite value in cases showing evidence of beta adrenergic stimulation with associated cardiac reactivity.

ECG changes noticed in subjects above 40 years should be evaluated critically including maximal exercise test on treadmill and if possible by coronary arteriography.

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