STRESS ECG-TESTING IN ASYMPTOMATIC MALE DIABETICS

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Summary

Twenty recently detected male diabetics with normal resting ECG in whom other known risk factors for CHD such as hypertension, smoking, family history of coronary artery heart disease (CHD) and obesity had been excluded were exercised on a treadmill using Chung's protocol. Thirty age-matched non-diabetic males were also included in the study as controls. Occult ischaemia was uncovered in a significantly higher proportion of diabetics ($P<0.01$). A positive correlation between fasting blood glucose level and occult coronary ischaemia was noted ($P<0.05$). While there was no significant correlation between total cholesterol (TC) LDL-Cholesterol, HDL-Cholesterol, LDL/HDL ratio and TC/HDL ratio on the one hand and occult ischaemia on the other; a highly significant positive correlation between hypertriglyceridaemia and occult ischaemia was observed ($P<0.001$). It is concluded that the incidence of occult CHD is significantly high among diabetics necessitating the need for routine exercise electrocardiography in them. Further, in diabetics, hypertriglyceridaemia, even in the absence of other known coronary risk factors, increases the risk for CHD.

Introduction

After insulin and antibiotics have virtually eliminated ketoacidosis and infections as the principal fatal complications of Diabetes, vascular complications such as cardiovascular, cerebrovascular and peripheral vascular diseases rank high as causes of morbidity and mortality among diabetics[1]. It is well known that CHD is commoner in a diabetic. It is also more frequent in younger patients as well as females. Its severity is also greater in the diabetic. The mortality rate in diabetics who develop myocardial infarction is twice that of non-diabetics. Hence early detection of coronary artery heart disease (CHD) in diabetics in the asymptomatic state and institution of preventive measures might help reduce the cardiovascular morbidity and mortality. A pilot study was therefore undertaken to uncover occult CHD in diabetics.

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Materials and Methods

Twenty male diabetics (Age 41.45 ± 7.03) at initial detection of diabetes, who had no symptoms suggestive of CHD and whose routine 12-lead resting ECGs were normal were taken up for the study. Females were not included because of practical difficulties, and the possible high incidence of false positive results known to occur in them[2]. Thirty age-matched non-diabetic males were also included in the study as controls.

Each patient was exercised on a Treadmill atleast 2 hours after the last meal using Chung's protocol. The end-point of the exercise test was :

1. Symptoms : Pain, inability to continue due to fatigue, dyspnoea or faintness.

2. Heart rate/rhythm : reaching 90% of target heart rate or progressive fall of the heart rate or the development of arrhythmias or conduction defects.

3. Blood Pressure : Progressive fall of systolic blood pressure or significant elevation of systolic and diastolic blood pressure associated with headache or blurred vision.

4. ECG : Ischaemic ST-T changes. ST depression of 1 mm or more for atleast 0.08 sec. (Table 1).

TABLE 1
Recommended Criteria for ST-depression

Exercise or post-exercise configuration	ST depression in mm and point of measurement
Horizontal	1.0 mm at 60 m. sec. from J point
Upsloping	1.5 mm at 80 m. sec. from J point
Downslopping	1.0 mm or more depression than at rest.

Results

Incidence of occult Ischaemia :

Occult ischaemia was uncovered in 12 of the 20 diabetics as compared to 6 of the 30 controls, a significantly higher ($P < 0.01$) incidence (Table 2). Those who developed ischaemic changes on exercise are referred to as positive responders while the others as negative responders.

TABLE-2
ECG Response to exercise in diabetics (n==20) versus controls (n = 30)

	Diabetics		Controls		Statistical
EGG Response	No.	%	No.	%	Significance
Positive	12	60	6	20	$P < 0.01$
Negative	8	40	24	80	

Response to exercise in diabetics

None of the subjects developed angina or hypotension. Significant ST depression was noted in 12 out of the 20 diabetics studied. Two had arrhythmias in addition one occasional premature ventricular contractions and the other junctional ectopics (Table 3).

TABLE 3

Response to exercise in diabetics
n=20

Response	Number	Percentage
Symptoms	Nil	0
ST-T-changes	12	60
Arrhythmias	2*	10

* In addition to significant ST depression

Age Distribution

The age distribution of the subjects studied is shown in Table 4. The mean age of the subjects studied was 41.45 ± 7.03 (Range 31 to 55) while that of the positive and negative responders was 42.25 ± 6.87 (Range 34-52) and 46.13 ± 7.73 (Range 31-55) respectively, which was not significantly different.

TABLE 4

Age Distribution
n=20

Age group	Number	Percentage
31-40	10	50
41-50	7	35
51-60	3	15

Fasting blood glucose levels in the positive responders (211.33 mg % ± 35.51) was significantly higher ($P < 0.05$) than that in the negative responders (157.00mg % ± 38.13) (Table 4)

TABLE 5

Fasting blood glucose in positive and negative responders compared

Group of Diabetics.	No.	Fasting Blood Glucose in mgm%	Statistical Significance
Positive responders	12	211.33 ± 35.51	P < 0.05
Negative responders.	8	157.00 ± 38.13	

There was no significant difference between the positive and negative responders in the levels of total Cholesterol (TC), HDL Cholesterol, LDL-Cholesterol, HDL/LDL ratio and TC/HDL ratio. But the level of triglyceride was significantly (P < 0.001) higher in the positive responders (Table 5)

TABLE-6

Lipid Profile in the positive and negative responders compared

Lipids	Positive Responders (n=12)	Negative Responders (n=8)	Statistical significance
Total Cholesterol.	219.66 ± 66.21	222.12 ± 30.01	N.S.
LDL cholesterol	129.51 ± 51.61	150.29 ± 37.49	N. S.
HDL cholesterol	41.62±17.43	44.41±30.99	N.S.
Triglyceride	215.08 ± 39.87	105.13 + 38.90	P < 0.001
HDL/LDL	0.42 ± 0.34	0.36 + 0.13	N. S.
* TC/HDL	0.02± 2.93	4.93± 2.39	N.S.

N.S. - Not significant.

The lipoprotein pattern observed in the 20 diabetics studied is shown in Table-7. Type IV was the commonest hyperlipoproteinaemic seen.

TABLE-7

Lipoprotein pattern in 20 diabetics

Lipoprotein pattern	Number
Normal	11
Type-IIa	2
Type-IIb	1
Type IV	6

Further analysis showed that while only one negative responder had hyperlipoproteinaemia, two-thirds of the positive responders were hyperlipoproteinaemic (Table-8)

TABLE 8

Lipoprotein pattern in the positive and negative responders compared

Group	Number	Lipoprotein pattern			
		Normal		Abnormal	
		No.	%	No.	%
Positive Responders	12	4	33.33	8	66.67
Negative responders.	8	7	87.50	1	12.50

Cardiovascular Response to Exercise

The heart rate and blood pressure responses to exercise were studied. Both the basal heart rate and the immediate post-exercise recovery heart rate were not significantly different between the positive and negative responders (Table-9). However, it was significant that the maximum achieved heart rate was lower in the positive responders ($P < 0.001$) Table 10)

TABLE 9
Heart rate response to exercise

Exercise period.	Positive Responders	Negative Responders	Statistical Significance
	n=12	n=8	
Resting heart rate.	88.33 ± 36.07	78.5 ± 6.72	N.S.
Maximum achieved H.R	126.75 ± 11.38	154.12 ± 15.33	$P < 0.001$
Post-exercise heart rate	96.38 ± 13.27	96.00 ± 4.28	N.S.

TABLE 10
Change in heart rate during exercise

Exercise Period	Positive Responders N=12	Negative Responders N=8	Statistical Significance
Rise in heart rate during exercise	37.58 ± 12.68	75.63 ± 17.57	P<<0.001

Blood Pressure

There was no significant difference between the positive and negative responders in the level of basal, exercise and post-exercise systolic and diastolic blood pressure (Table 11 and 12).

TABLE 11

Systolic blood pressure in the subjects

Exercise period	Positive Responders n=12	Negative Responders n=8	Statistical Significance
Basal	123.00 ± 12.24	113.75 ± 11.88	N.S.
Maximum during exercise	150.00 ± 20.00	146.00 ± 16.85	N.S.
Post-exercise	137.50 ± 16.02	126.25 ± 10.60	N.S.

TABLE 12
Diastolic blood Pressure in the subjects

Exercise period	Positive Responders (n = 12)	Negative Responders (n = 8)	Statistical significance
Basal	80.00 ± 7.39	76.00 ± 7.78	N.S.
Maximum during exercise	91.33 ± 7.60	89.00 ± 7.96	N.S.
Post-exercise	84.16 ± 5.15	85.50 ± 7.31	N.S.

Discussion

The incidence of occult coronary ischaemia in 60% of asymptomatic male diabetics studied is comparable to that of Bellet[3], Persson[4] and Karlefors[5]. A number of studies have indicated that a positive exercise test frequently precedes clinically overt CHD. Therefore,

stress-ECG testing can be an effective non-invasive method of screening a large number of diabetics for CHD that is not clinically apparent.

A positive correlation between fasting blood glucose level and occult CHD observed in this study that excluded subjects with other known coronary risk factors except lipid abnormalities is significant and implicates hyperglycaemia as an independent coronary risk factor.

Similarly, highly significant correlation between triglyceride and occult CHD stands testimony to Santen and Co-workers[6] observation that 'hypertriglyceridaemia may have a greater impact on vascular disease in diabetic than in non-diabetic patients and that diabetic patients with atherosclerosis could be distinguished from those without atherosclerosis more reliably by triglyceride levels than by cholesterol levels'. The cardio-vascular response to exercise in the positive responders was no different from that of the negative responders except for the fact that the maximum achieved heart rate during exercise in them was significantly lower.

It is concluded that the incidence of occult CHD is significantly high among diabetics necessiating the need for routine exercise electrocardiography in them. Further, in diabetics, hypertriglyceridaemia even in the absence of other known risk factors, increases the risk of CHD.

Acknowledgement

The authors acknowledge the help rendered by Prof. G. Anantha Subramaniam, Dr. C. Janakiram and Dr. Thomas George in this study.

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