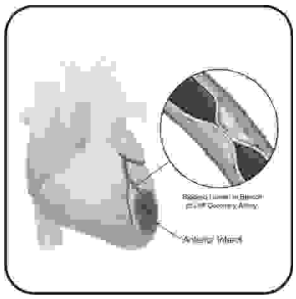
ORIGINAL PROF-1014

CORONARY HEART DISEASE;

PREDICTIVE VALUE CHANGES IN R-WAVE AMPLITUDE AFTER EXERCISE



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ABSTRACT… drmsgilani@yahoo.com. **Objective:** To assess the value of coronary events reflected by changes in R-wave amplitude after exercise. **Setting:** Nishtar Hospital, Multan. **Duration.** One year. **Study Design:** comparative study. **Material and Methods:** Sample size 146 patients. **Sampling Technique:** Convenient probability sampling done. **Results:** All patients were followed up for 6 months, during which time myocardial infarction and death of cardiovascular origin were considered endpoints. The incidence of events in patients in whom R-wave amplitude decreased (normal response) and in those in whom R-wave amplitude did not change or increase (abnormal response) was compared. The incidence of coronary events in patients with a normal response was 23% and in those with an abnormal response, 45.8% ($p<0.01$). Correlating the results with several non invasive and angiographic variables, an abnormal R-wave response showed a significantly higher rate of events in the subsets of patients with prior myocardial infarction, absence of cardiomegaly, maximal functional capacity lower than 4 METs, maximal heart rate higher than 140 beats/min and abnormal left ventricular function. **Conclusion:** The changes in R-wave amplitude after exercise is a variable that should be taken into account when assessing the risk of future events in patients with coronary heart disease.

Key words: Value coronary events, R-wave changes amplitude, exercise, coronary heart disease.

INTRODUCTION

The pathophysiologic characteristics and clinical value of the changes in R-wave amplitude after exercise are controversial[1]. The normal response is a decrease of R-wave voltage after exercise, but some investigators reported a correlation between its increase and the presence of coronary heart disease (CHD), especially in its more severe forms, such as 2- and 3-vessel CHD and abnormalities in left ventricular function[1,2]. This finding was not confirmed in other studies[3,4,5,6]. The present investigation assesses the predictive value of coronary events reflected by changes in R-Wave amplitude after exercise in patients with CHD followed up for 2 years.

PURPOSE OF STUDY

To assess the value of coronary events reflected by changes in R-wave amplitude after exercise.

MATERIAL AND METHODS

Setting: Nishtar Hospital, Multan.
Sample size 146 patients.
Duration Two years.
Study design

Sampling Technique

We studied 146 patients with CHD diagnosed by clinical history, physical examination, electrocardiogram at rest, exercise stress test and cinecoronary arteriography. Patients ranged in age from 27 to 72 years (mean ± standard deviation 51 ± 9). Seven patients were female; 96 had healed myocardial infarction and 103 had angina when they entered the study.

The exercise test was performed on a Quinton model-609 treadmill, or on a Godard electro mechanically braked bicycle ergometer according to the Nauhton protocol[7]. Pedaling began without resistance and the work load increased by 150 kpm/min every 3 minutes. The work load was expressed in METs (multiples of the oxygen consumption at rest or basal metabolic rate). In patients who exercised on the bicycle ergometer, the work load (kpm/min) was converted into METs using the formula: 300 + (2.W)/K.3.5, where W= the work load on the bicycle (expressed in kpm/min), K= the weight of he patients (expressed in kilograms) and 3.5 = the oxygen consumption per kilogram of body weight per minute at rest. Medication was discontinued during an adequate washout period, whenever it was possible according to the individual clinical situation. Three bipolar electro cardiographic leads were used, with their positive poles on V_2, V_5 and left lumbar area[8], respectively. Electro cardiographic tracing was continuously mentioned on a Hewlett-Packard 780=3 Viso Scope. A paper recording of the 3 leads, heart rate and systolic and diastolic blood pressure were obtained at rest, at the end of every stage, at minutes 1, 3 and 6 during the recovery or whenever it was necessary. The exercise was terminated when the patient reached exhaustion or if 1 of the following situations occurred: chest pain or dyspnea of two thirds intensity, decrease in systolic blood pressure, dizziness or ataxic gait, elevation of he systolic blood pressure above 250 mg Hg or of diastolic blood pressure above 130 mm Hg, paroxysmal tachy- or Brady arrhythmia, ST – segment depression of more than 5 mm or ST – segment elevation more than 3 mm.

R-wave amplitude was measured on the lead with the positive pole on V_5. Readings were done with the patient sitting on a chair or on the bicycle, immediately before and after the exercise. The average of 10 consecutive beats was considered in all patients to minimize the respiratory variations. The difference between the values before and after exercise was calculated (dR). Patients were classified into 2 groups according to dR: those with a negative dR value (normal response) and the others with a positive dR value (abnormal response). The patients with dR = 0 were included in the abnormal response group.

Cinecoronary and left ventricular angiography were performed in all patients using the Sones method. Patients were classified into groups with 1,2- and 3-vessel CHD according to the number of principal arteries obstructed in at least 75% of their lumen. Left ventriculography was analyzed in the 2 anterior oblique positions and patients were classified into 2 groups (normal or abnormal function), according to the presence or absence of akinesia or dyskinesia in at least 1 of the wall segments.

All patients were medically treated and controlled during 2 years after their inclusion in the study. Coronary events considered as endpoints for this investigation were acute myocardial infarction and death of cardiovascular origin. The predictive value of the R-value amplitude augmentation was calculated as the quotient between the number of patients with a positive dR who had a coronary event and the total number of patients with a positive dR., expressed as a percentage. The predictive value of R-wave decrease was calculated in a similar fashion. The statistical significance of the difference was evaluate by the chi-square test with the Yates correction.

RESULTS

Table-I shows the correlations between the R-wave responses and 4 non-invasive variables that had high predictive value of coronary events prior myocardial infarction, cardiomegaly, maximal functional capacity of 4 METs and maximal heart rate of 140 beats/min. In all subgroups, a positive dR had a higher predictive value than a negative dR. IN some of the events (prior myocardial infarction, absence of cardiomegaly, maximal functional capacity lower than 4 METs and maximal heart rate higher than 140 beats/min), the differences were

statistically significant (P<0.04).

Table-I. Incidence of coronary events in patients with r-wave decrease or increase and its correlation with non-invasive variables

		R-Waves decrease			R-Waves increase			
		Non coronary events	Coronary events	T	Non coronary events	Coronary events	T	P value
PMI	0	27 (84.4%)	05 (15.6%)	32	11 (61.1%)	07 (38.9%)	18	<0.06
	+	40 (72.7%)	15 (27.3%)	55	21 (61.2%)	20 (48.8%)	41	<0.06
CM	0	54 (84.4%)	10 (15.6%)	64	28 (58.3%)	20 (41.7%)	48	<0.01
	+	13 (56.6%)	10 (43.5%)	23	04 (36.4%)	07 (63.6%)	11	NS
MFC (METs)	>4	40 (80.0%)	10 (20.0%)	50	21 (70.0%)	09 (30.0%)	30	NS
	<4	27 (73.0%)	10 (27.0%)	37	11 (37.9%)	18 (62.1%)	29	<0.01
MHR (beats/min)	>140	36 (87.8%)	05 (12.2%)	41	11 (61.1%)	07 (38.9%)	18	<0.02
	<140	31 (67.4%)	15 (32.6%)	46	21 (61.2%)	20 (48.8%)	41	NS

PMI = Prior myocardial infarction CM = Cardiomegaly METs = Basal metabolic units
MFC= Maximal functional capacity MHR= Maximal heart rate NS = Non-significant
T = Total 0 = No + = Yes

Table-II shows the correlation between the R-waves responses and the presence of 1-, 2- or 3-vessel CHD. It also presents the results according to the existence of normal or abnormal left ventricular function. In all subgroups the incidence of coronary events was higher if there was an increase in the R-wave voltage. Among the patients with abnormal left ventricular function, the difference was statistically significant (P<0.04).

Table-II. Incidence of coronary events in patients with r-wave decrease or increase And its correlation with angiographic variables

	R-waves decrease			R-waves increase			
No. Of diseases vessels *	Non-coronary events	Coronary events	T	Non-coronary events	Coronary events	T	P value
-1	25 (89.3%)	03 (10.7%)	28	10 (66.7%)	05 (33.3%)	15	<0.07
-2	17 (77.3%)	05 (22.7%)	22	08 (50.0%)	08 (50.0%)	16	<0.08
-3	25 (67.6%)	12 (32.4%)	37	14 (50.0%)	14 (50.0%)	28	NS
LVG							
NI	34 (89.5%)	04 (10.5%)	38	14 (70.0%)	06 (30.0%)	20	<0.06
Abn	33 (67.4%)	16 (32.6%)	49	18 (46.2%)	21 (53.8%)	39	<0.04

Number of vessels with 75% stenosis
LVG = Left ventriculogram NI = Normal Abn = Abnormal

DISCUSSION

The increase of the R-wave amplitude after exercise has been advocated as a useful tool for diagnosing CHD, particularly when there is poor left ventricular function[1,2]. Some investigators have found that it is also sensitive and specific in special subsets of patients (i.e. young female patients[9], patients with left bundle branch block[10] and asymptomatic men with electro cardiographic ST-T changes at rest[11]. Kannel et al reported a relation between the increase of R-wave amplitude after exercise and in impairment of the ejection fraction as assessed by gated blood pool left ventricular imaging[12]. Furthermore, Ashley et al showed that the administration of nitrates could reverse an abnormal r-wave response[13]. Because other investigators could not find a correlation between the R-wave changes and the presence of CHD[3,4,5], Froelicher et al[14] suggested that R-wave voltage remains unchanged or increases during exercise up to a heart rate of approximately 140 beats/min in normal subjects and above this rate R-wave amplitude decreases. They speculated that all subjects have a similar R-wave response, and that the increase of R-wave amplitude observed in CHD really reflects only that patients with CHD have stopped the exercise at submaximal heart levels. Our results show that of the 59 patients that attained a heart rate higher than 140 beats/min, 18 had R-wave augmentation, and among them the incidence of events was significantly higher.

When the results obtained in the different subgroups of patients were analyzed according to the correlation with non-invasive and invasive variables, a positive dR showed a higher predictive value than a negative dR in all the subsets, but the differences were statistically significant in only some (prior myocardial infarction, absence of cardiomegaly, maximal functional capacity lower than 4 METs, maximal heart rate higher than 140 beast/min and abnormal left ventricular function). Presumably, the differences could also be significant in the other subgroups if the samples were larger.

The predictive value of R-wave response was previously evaluated by Blair et al[15], who found that among patients with a positive dR, 97% had angrigraphic coronary stenosis, and by O'Rourke et al[16], who reported a significantly higher rate of coronary events among asymptomatic men older than 40 years.

Exercise stress testing, along with several variables that contain a clear predictive value of coronary events, contribute to the prognostic value of R-wave changes[17,18,19,20,21,22]. According to the results presented in this study, an increase of R-wave amplitude after exercise should be included among the variables with prognostic value for future coronary events; twice the probability of having an event compared with the remaining patients.

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