

The Prevalence and Variability of Electrocardiographic Changes Indicating Ischemic Heart Disease: A Population Survey and Follow-up.

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Numerous studies have investigated the incidence of coronary heart disease in many populations. However, in a few studies only this disease has been investigated prospectively in the population in a representative sample (Keys et al., 1966, Keys et al. 1970, Kannel et al. 1970, Johnson et al. 1968, Gordon et al. 1971, Rosenman et al. 1970, Kozarevic et al. 1971); in none the dynamics of ECG changes were published: appearance and disappearance of ischemic ECG signs in every person, separately, and in relation to the general population.

We set ourselves the task of analysing the incidence of ECG findings indicating coronary disease in a representative sample from the general population. The changes were analysed after a three-year interval with the stress on the appearance of new cases and the disappearance of changes in the course of the three-year period, in every person separately. The task of the study was to analyse incidence and prevalence of ECG signs of ischemic heart disease in a population, and to show variability of the ECG signs.

Sample and Methods of Investigation

In the course of 1969 a population group consisting of 4210 persons i.e. 2049 men and 2161 women, born between 1915 and 1934 was investigated in six regions of Croatia, Yugoslavia. The sample is taken from the electoral register of the region comprising three municipalities in the interior of the country i.e. the centre of a big town, a suburb of a big town and a mainly rural community and subsequently three littoral regions were taken, i.e. the centre of a big town, and littoral rural communities. The investigation represents part of the study on chronic diseases in adults.

Electrocardiogram was recorded at rest and after exercise, using 12 leads: I, II, III, aVR, aVL, aVF, VI-V6. Changes in the Q and QS wave, the S-T segment and the T wave in the electrocardiogram at rest were noted according to the Minnesota code (Rose & Blackburn, 1968). An analysis was made of the Q wave in cases of a certain (code 1-1), likely (code 1-2) and possible

Q wave (code 1-3). Horizontal or descending depression of the S-T segment was recorded according to the degree: up to 0.5 mm (code 3-4), 0.5-0.9mm (code 4-2) and 1 mm or more (code 4-1). Inversion of the T wave was equally recorded according to the degree: 0-0.9 mm (code 5-3), 1-5 mm (code 5-2) and over 5 mm (code 5-1).

In 81.2 per cent of them the exercise test was performed. The mechanical cyclo-ergometer was used over a duration of 5 minutes, 900 kpm/kilopondmeters/for men and 600 kpm for women, per minute. It was not submaximal exercise test. The load remained the same throughout the test. No exercise test was performed in 19.8 per cent of the test subjects in view of the well known contraindications to effort. The electrocardiogram was recorded before and directly after the exercise test. The following changes seen after exercise were chosen: without S-T segment depression at rest and some depression after exercise (code 11-1 to 11-3), deeper S-T segment changes than at rest (code 11-5) and an analysis was made of the changes in the sense of improvement of the finding (code 11-6) and the same finding as the one at rest (code 11-7), and the disappearance of the finding after exercise (code 11-8). The following changes of T wave were analysed: inversion of the T wave after exercise (code 12-1 to 12-3), changes lower than at rest (code 12-4), improvement of the finding (code

12-5), the same finding as the one at rest (code 12-6) and the disappearance of the finding after the exercise (code 12-7).

In the course of 1972 the same persons were examined once again and an analysis was made of the same ECG changes in the same manner as in 1969. Both findings were then compared for each person separately. 804 out of 4210 persons did not report for the second examination.

The electrocardiograms were recorded on a three-channel electrocardiograph after resting in the lying position for at least 3 minutes. Also blood pressure was recorded. The blood pressure was consider elevated in values of 160/96 mm Hg or higher.

Results

Table I shows Q, S-T, T distribution according to sex in 1969. The finding of Q wave was more frequent in men than in women (0.8:0.4 per cent). S-T segment depression 1 mm or more was twice as frequent in women than in men (0.6:0.3 per cent). Depression of 0.5-0.9 mm was more than three times as frequent in women than in men (2.7:0.8 per cent), and depression up to 0.5 mm was also more frequent in women (0.5-3.3 per cent). S-T segment depression was seen in a total of 4.4 per cent men and in 11.8 per cent of women.

Table 1: Changes in the Electrocardiogram According to Sex

ECG finding		SEX				Significance
		Men		Women		
		No	%	No	%	
Q and QS finding	certain	2	0.1	1	0.05	
	likely	4	0.2	3	0.1	
	possible	11	0.5	5	0.2	
S-T segment depression	≥ 1 mm	6	0.3	12	0.6	
	0.5-0.9 mm	17	0.8	58	2.7	P < 0.01
	0.5 mm	67	3.3	183	8.5	P < 0.01
T wave inversion	> 5 mm	4	0.2	1	0.05	
	1-5 mm	20	1.0	57	2.6	P < 0.01
	0-1 mm	157	7.6	325	15.0	P < 0.01

The finding of T wave inversion was seen more than twice as often in women than in men and the difference was significant.

Q wave was most frequent in urban district and in the interior of the country. There were no marked difference in the prevalence of the S-T segment depression with regard to the domicile. A tendency towards milder forms of the T wave inversion was found in urban districts (up to 1 mm), while a more marked form

of T wave inversion (1-5 mm) was frequently the finding in rural regions of the interior.

Table 2 shows S-T segment depression at rest compared to the finding after exercise. Exercise was made in 215 out of 273 persons with S-T segment depression. In the group with depression at rest 0.5-0.9 mm the finding deteriorated after the exercise test in one fourth. In subjects with S-T segment depression of up to 0.5 mm the finding deteriorated in 39.7 per cent, which is a considerably higher rate than in the previous group.

Table 2: S-T segment depression at rest according to changes after the exercise test

S-T segment depression after the exercise test	S-T segment depression at rest						Total	
	≥ 1 mm		0.5-0.9 mm		upto 0.5 mm			
	No	%	No	%	No	%	No	%
Deeper	0	—	12	25.0*	64	39.7*	76	35.3
Lower	0	—	2	4.1	9	5.6	11	5.1
The same	6	—	33	68.8	82	51.0	121	56.3
Normal finding	0	—	1	2.1	6	3.7	7	3.3
Total	6	—	48	100.0	161	100.0	215	100.0

*P < 0.05

Exercise test was performed in 383 out of 461 persons with T wave inversion. In subjects with inversion of T wave of 1-5 mm the finding did not change to over 5 mm in any of persons. In persons with inversion of the T wave of 0-0.9 mm the finding deteriorated after exercise in 18.9 per cent.

Frequency of high arterial blood pressure was in the group with S-T segment depression of frequency of 51.6 per cent and in the group with inverted T wave 47.5 per cent; in the total sample the frequency was 33.0 per cent.

There was no connection between ECG changes and smoking habits.

Table 3 shows data on Q, S-T, T changes at rest in the same subjects at two different periods of investigation, i.e. in 1969 and in 1972. In 0.6 per cent the Q wave was found, S-T segment depression in 4.8 per cent while an inverted T wave was found in 8.5 per cent in both examinations. In 0.1 per cent of the total population Q wave had disappeared after the 3-year interval. Depression of the S-T segment had disappeared in 3.2 per cent but was found in 5.8 per cent for the first time. The inverted T wave had disappeared in 5.0 per cent of the total sample but a new inversion of the T wave appeared in 8.5 per cent. In two subjects with a "likely" Q wave and in two with a "possible" Q wave the finding had disappeared whereas it had remained unchanged in all three test subjects who had the so-called "certain" Q wave.

Table 3: Electrocardiographic findings of Q wave, S-T segment depression and inverted T wave at two different periods of investigation

ECG finding N=3406	Has finding in 1969 and in 1972		Has finding in 1969 and has not in 1972		No finding in 1969, has finding in 1972	
	No	%	No	%	No	%
Q wave	19	0.6	4	0.1	5	0.1
S-T segment depression	165	4.8	108	3.2	198	5.8
Inverted T wave	291	8.5	170	5.0	289	8.5

According to the degree of ECG changes, S-T segment depression of 1 mm or more had remained constant after 3 years in half of persons, while in the other half the finding had improved or disappeared altogether. In those with depression of 0.5-0.9 mm the finding remained constant in only 29.5 per cent while in 45.9 per cent it had disappeared. In those with S-T segment depression of up to 0.5 mm the finding had remained the same in 49.2 per cent and had disappeared in 39.2 per cent. The finding of inverted T wave of 1-5 mm remained constant in 58.5 per cent after a period of 3 years, whereas in 24.6 per cent the finding had disappeared. Inversion of up to 1 mm remained constant in 56.6 per cent and had disappeared in 38.8 per cent.

Discussion

In this investigation of a representative sample aged 35-54 years a significant Q wave was seen in 0.6 per cent. It was twice as frequent in men than in women and was most often found in the 45-49 age group. After a 3-

year period 0.7 per cent presented with the same finding. In the study by Keas et al. (1966) a somewhat higher incidence was found, but the age limits were higher too, ie. 40-59 years and the subjects investigated were men only. The finding was most frequent in the 45-49 years age group, the same as in our study. In another investigation (Kozarevic et al. 1971), results similar to our were obtained.

The fact seems worth mentioning that in four of our test subjects this finding disappeared after a period of 3 years (17 per cent). This phenomenon has been registered earlier from Keys et al. (1970) in which a disappearance of 34.1 per cent had been registered. The percentage of disappearance of Q wave in selected populations fluctuated from 6.0 per cent (Kaplan et al. 1964), 6.7 per cent (Kalbfleisch et al. 1968) to 31.0 per cent (Andersen et al. 1964).

In both our investigations 4.8 per cent showed S-T segment depression while an inverted T wave was seen in 8.5 per cent.

The results obtained are higher than those in the seven countries study (Keys et al. 1966). S-T segment depression and inversion of T wave were significantly more frequently found in women than in men. One of the reasons lies perhaps in fact that arterial hypertension was more often seen in women than in men. The S-T, T changes were variable but the variation of the S-T segment depression was only very slightly higher than inversion of the T wave in the investigation after 3 year period. In more than one third of persons who, in the first investigation had a S-T segment depression, the finding had normalized three years later, while in one third T wave inversion also normalized. After a period of 3-years revealed an upward trend of both these findings.

Analysing the S-T segment depression it was noted that the finding after exercise frequently deteriorated in comparison with the finding at rest. This was most often seen in test subjects showing the least changes, that is depression of up to 0.5 mm. S-T segment depression of up to 0.5 mm is usually defined as "small non-specific S-T segment changes" in the clinical interpretation. This shows that the changes observed do not represent any more non-specific changes than are deeper S-T changes.

In subjects with an inverted T wave at rest, in the group of 0-0.9 mm the finding showed deterioration after the exercise test in 18.9 per cent. It was moreover observed that the finding remained the same before and after exercise in a fairly high percentage of persons with S-T, T changes. One of the reason lies perhaps in fact that we used load reaching the sub-minimal in most of the persons.

In this investigation we noticed that twice as many of our test subjects (35.3 per cent) had a deeper depression of the S-T segment than those that showed a lower inversion of the T wave (16.5 per cent) following exercise, which agrees with Robb et al. (1967).

Summary

In a representative sample of 4210 men and women, aged 35-54 years, an electrocardiogram was recorded at rest and in 81.2% after exercise. The examination was repeated after a period of three years.

At both examinations significant Q waves were seen in 0.6 per cent, S-T segment depression in 4.8 per cent and inverted T wave in 8.5 per cent.

Over the three year period the Q wave had disappeared in 17 per cent and S-T segment depression disappeared in 40 per cent. The most variable of these was the S-T segment depression of 0.5-0.9 mm. Inversion of T wave disappeared in 37 per cent.

Q wave was twice as frequent in men than in women. Depression of the S-T segment and inversion of T wave were two and a half times as frequent in women as in men. S-T segment depression of up to 0.5 mm at rest showed a deterioration in 39.6 per cent after exercise; T wave inversion of 0-0.9 mm at rest deteriorated in 18.9 per cent.

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