Electrocardiograms and 13 year cardiovascular mortality in Busselton study

KEVIN CULLEN, N S STENHOUSE, K L WEARNE, G N CUMPSTON

From Busselton Health Centre, Mill Road, Busselton; Raine Medical Statistics Unit, University of Western Australia, Nedlands; and Department of Cardiology, Royal Perth Hospital, Perth, Western Australia

SUMMARY In 2119 unselected Busselton subjects 40 to 79 years of age, the 13 year mortality from cardiovascular disease was significantly higher in those whose initial electrocardiogram showed Q and QS patterns, left axis deviation, ST depression, T wave depression, flat or biphasic T waves, atrial fibrillation or flutter, and ventricular extrasystoles.

In angina-free subjects whose electrocardiographic codes occurred in isolation from any other electrocardiographic abnormality, ventricular extrasystoles were associated with significantly higher mortality from cardiovascular disease compared with controls.

Since 1966, the Busselton population has been the subject of a longitudinal study of cardiovascular mortality.1 Resting electrocardiograms were associated with significantly increased six year mortality in those with suspected ischaemic heart disease, and in those with probable ischaemic heart disease to factors of seven to nine times and 20 times, respectively.2 The present paper outlines the 13 year cardiovascular mortality in 2119 unselected subjects 40 to 79 years of age, related to their electrocardiograms recorded in 1966.

Methods

Resting electrocardiograms were recorded on Nihon Kohden machines, model MC-11 and Model MC-3, with a paper speed of 25 mm per second. These machines fulfilled the performance recommendations of the AHA Committee on Electrocardiography 19673 except in the high frequency range, where constant amplitude sinusoidal input signals of 100 Hz were reduced to 50%. The maximum reduction should be no more than 30%. Such a defect could in part affect the prevalence of tall R waves. There were no specific intervals between the time of the meal and recording of the electrocardiograms, but approximately 10% of subjects had their electrocardiograms recorded about one and a quarter hours after a 50 g glucose drink. For the remaining subjects, there was a longer interval.

All electrocardiograms have been classified according to the Minnesota Code4 by five trained observers working independently under the guidance of a consultant cardiologist (GNC). All subjects answered the chest pain questionnaire of Rose.5

One thousand and fifty-six men and 1063 women were studied. Mortality in this group between January 1967 to December 1979 was confirmed by the Registrar of Deaths in Perth, Western Australia. Survivor status was established by local contact and by checking all compulsory electoral rolls in Western Australia. Twenty-one men and 18 women could not be traced. All missing subjects were checked against the Registrar's files for possible deaths. The ICD 8th revision (1968) codes used to determine mortality resulting from cardiovascular disease were 390-458 and 746-747. The 13 year cardiovascular disease mortality in control subjects with a normal electrocardiogram was compared in each instance with the cardiovascular disease mortality of those found with the specified abnormality.

Using the total 40 to 79 year population as a basis, standardised mortality rates for specific electrocardiographic codes and for the "normal electrocardiogram" population were calculated by the direct method.6 The standardised mortality rate for the "normal electrocardiogram" population was compared with that for the population with a specific electrocardiographic code, expressed first as a difference and second as a ratio. The difference was used to calculate an approximate standardised normal deviate, and the appropriate test of significance performed.

Initially, all populations were divided into eight five-year age groups, for each sex. It was decided to standardise using only those age-groups where the
specific electrocardiographic code population had at least five people at risk. In this data set all eight age groups were used in calculating rates and ratios on only four occasions, and then only when the sexes were combined.

Finally, two different methods of determining the specific electrocardiographic code populations were used—firstly, where the particular code existed without regard to any other code that may have been present: these results are presented in the Table for the 2119 unselected subjects aged 40 to 79 years. The second method analysed the mortality in 1497 subjects free of angina for each electrocardiographic code in isolation from any other code.

Results

The Table outlines the findings in the 2119 unselected subjects aged 40 to 79 years. Mortality from cardiovascular disease was significantly higher in those whose initial electrocardiogram showed Q-QS patterns, left axis deviation, ST junction and ST segment depression, negative T waves, flat or biphasic T waves, atrial fibrillation or flutter, ventricular extrasystoles more than 10% of all complexes, and infrequent ventricular extrasystoles.

In 1497 subjects free of angina, the analysis of those electrocardiographic codes without any other coexisting electrocardiographic codes (not tabled with the results of the unselected subjects in the Table) has shown that infrequent ventricular extrasystoles were the only electrocardiographic code in isolation to be associated with a raised risk of cardiovascular disease. The mortality ratio was 2.1 for both sexes in six contributing age groups, with 11 deaths in 46 subjects with a Z value of 2.55 (p<0.05). The cardiovascular disease mortality ratio for all types of ventricular extrasystoles was 2.4 for both sexes, with a Z value of 3.44 (p<0.001) in seven contributing age groups, showing 15 deaths in 61 subjects.

Discussion

VENTRICULAR EXTRASYSTOLES
A recent review concluded that ventricular extrasystoles occurring in subjects without clinical evidence of cardiac disease appear not to be associated with an increased incidence of either sudden death or death. In contrast to these conclusions, Blackburn et al. reported an increased incidence of coronary heart disease in those with ventricular extrasystoles compared with carefully matched controls. The ratio of expected to observed was 1.9, the number being too small to reach levels of significance. These findings resembled those in Busselton where ventricular extrasystoles in angina-free individuals without coexisting electrocardiographic abnormalities were associated with a significant increase in mortality from cardiovascular disease.

Q AND QS, T WAVE CHANGES, AND ATRIAL FIBRILLATION
In Busselton unselected subjects, Q and QS changes, ST segment and T wave changes, atrial fibrillation, and left axis deviation were associated with significantly greater mortality from cardiovascular disease. The numbers showing these abnormalities in selected subjects were too small to be of significance.

In 18403 unselected civil servants 40 to 64 years, Rose et al. reported significantly increased coronary heart disease mortality in those with small Q waves, left axis deviation, flat or inverted T waves, and left
bundle-branch block. In symptomless normotensive subjects, only those with prominent Q waves and atrial fibrillation showed excess mortality from coronary heart disease.

In an international study of 12,770 men of 40 to 59 years, there was a significantly increased five year incidence of coronary heart disease in those with major Q and QS complexes, with negative T waves, and in those with atrial fibrillation compared with carefully matched control subjects. An increased risk of stroke from emboli was reported in Framingham subjects with atrial fibrillation.

LEFT VENTRICULAR HYPERTROPHY
An increased cardiovascular disease mortality has been described in those with left ventricular hypertrophy, compared with the population at large. In Busselton, left ventricular hypertrophy was not associated with significantly increased cardiovascular mortality.

LEFT BUNDLE-BRANCH BLOCK AND RIGHT BUNDLE-BRANCH BLOCK
Schneider et al. have recently reported that 50% of 55 Framingham subjects with left bundle-branch block had died within 10 years of its onset with only 11% remaining clinically free of cardiovascular abnormalities. The mean age of onset for left bundle-branch block was 62 years. Schneider et al. also reported on newly acquired right bundle-branch block in 70 Framingham subjects over a period of 18 years, mortality from cardiovascular disease being almost three times greater in these subjects than in an age matched sample of the population at large. Busselton subjects showed no significant increase in cardiovascular disease mortality for left and right bundle-branch block in the analysis of age specific mortality.

The Busselton Population Study has been supported by the University of Western Australia, the Arnold Yeldam and Mary Raine Medical Research Foundation, the National Heart Foundation, the Royal Perth Hospital, State Health Laboratories (WA), and the National Health and Medical Research Foundation, Telethon (WA).

References
4 Rose G, Blackburn H. Cardiovascular survey methods. WHO Monogr Ser 1968; No. 56.


Requests for reprints to Dr Kevin Cullen, Busselton Health Centre, Mill Road, Busselton, Western Australia 6280.