CHAPTER 3.5

ELECTROCARDIOGRAPHIC PREDICTORS OF CORONARY HEART DISEASE IN THE SEVEN COUNTRIES STUDY

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The electrocardiogram (ECG) displays information about the heart, whether there has been a heart attack or the muscle lacks oxygen, whether conduction of the heart beat is disturbed or its rate or rhythm altered. It is useful as a rapid indicator of the diagnosis and is easy, painless and inexpensive to record. Also used to monitor severely ill patients, the record made in healthy people at rest or undergoing an exercise test helps predict risk of future coronary disease.

The electrocardiograph was invented by Willem Einthoven in Leiden, the Netherlands, around 1900, when he displayed the deflections representing differences in electrical potential between the arms and legs, amplifying the tiny current passing through the body with each heart beat. Now data are recorded from the chest wall and the limbs and displayed on paper or TV screens. Tracings are interpreted by physicians or technicians and, in digital form, are analyzed automatically with computers.

The ECG was recorded in the Seven Countries Study from the outset in 1958 to identify such characteristics relevant to cardiovascular diseases as myocardial infarction, hypertrophy, arrhythmia and conduction defects. ECG findings were also used as predictors of future events, independent of the medical history and the physical examination. The advantage was a quantitative record that could be preserved, capable to characterize an individual objectively in central blinded coding.

The development of a coding system, known as the Minnesota Code (1,2), was the consequence of the need for a quantitative procedure to measure characteristics and severity of the ECG findings and to classify them following precise criteria and rules. The Minnesota Code was based on careful review of validated criteria at the time. Its procedure was to obtain uniform, precise and reproducible codes within and among observers, as required for population studies. The Minnesota Code provides a quantitative description of major relevant findings such as large Q waves, ST and T deviations, conduction defects and arrhythmias. The Minnesota Code and procedure diminishes observer disagreement and is widely used in population studies.

ECG recordings were systematically recorded at rest and after exercise at baseline and 5- and 10- year follow-up examinations. Resting ECGs were also taken at regular intervals in the cohorts of the FINE Study in elderly men of three countries. ECG findings, in the absence of clinical diagnoses of coronary disease of any type, were used to test their predictive power for CHD events.

ECG RECORDING AND CODING

The ECG coding followed strict rules as published in the WHO Cardiovascular Survey Methods Manual (2). Records were taken using 2- or 3-channel ink-jet machines, in 12 standard leads, following protocol for the preparation of skin, positioning of electrodes, number of beats to be recorded in each group of leads, their sequence and the freedom from baseline artifacts. The paper speed was 25 mm per second and the calibration 10 mm per mV. The simple field exercise test, after exclusion of subjects with clinical contra-indications, was based on a single-step test (step of 30 cm, 60 ascents and 60 descents in 3 minutes) or a bicycle ergometer at 150 W for 3 minutes. The post-exercise record was taken starting about 30 seconds after the end of exercise.

All records were centrally coded at the Laboratory of Physiological Hygiene, University of Minnesota, by a team led by Henry Blackburn, following standard rules and quality control. The up-dated version of the Code published in 1968 was used (2).