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WORLD HEALTH ORGANIZATION
TECHNICAL REPORT SERIES

No. 168

HYPERTENSION AND CORONARY HEART DISEASE: CLASSIFICATION AND CRITERIA FOR EPIDEMIOLOGICAL STUDIES

**First Report
of the Expert Committee on Cardiovascular
Diseases and Hypertension**

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WORLD HEALTH ORGANIZATION

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GENEVA

1959

**EXPERT COMMITTEE ON CARDIOVASCULAR DISEASES AND
HYPERTENSION**

Geneva, 13-18 October 1958

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This report was originally issued in mimeographed form as document WHO/CVD & H/14.

PRINTED IN SWITZERLAND

HYPERTENSION AND CORONARY HEART DISEASE: CLASSIFICATION AND CRITERIA FOR EPIDEMIOLOGICAL STUDIES

First Report*
**of the Expert Committee on Cardiovascular
Diseases and Hypertension**

1. INTRODUCTION

The WHO Expert Committee on Cardiovascular Diseases and Hypertension met in Geneva, Switzerland, from 13 to 18 October 1958 to discuss the public health problems created by cardiovascular disease and to consider the classification and criteria for diagnosis of hypertension and coronary heart disease, particularly for epidemiological purposes. Agreement regarding these matters appeared necessary in order that epidemiological studies can be planned in such a way that they produce comparable data.

The meeting was opened by Dr Candau, Director-General of the World Health Organization. Dr Candau indicated the importance of cardiovascular diseases as causes of mortality and morbidity and the interest of WHO in these diseases. He pointed out that in November 1955¹ a study group met to consider the problem of atherosclerosis and ischaemic heart disease and that in October 1957² another meeting was held to discuss the problem of the classification and grading of atherosclerotic lesions.

Dr J. J. Groen was elected Chairman, Dr H. E. Hilleboe and Dr J. Speransky, Vice-Chairmen, and Dr J. N. Morris, Rapporteur. The draft agenda was adopted.

* The Executive Board, at its twenty-third session, adopted the following resolution:
The Executive Board

1. NOTES the first report of the Expert Committee on Cardiovascular Diseases and Hypertension;
2. THANKS the members of the Committee for their work; and
3. AUTHORIZES publication of the report.

(Resolution EB23.R33, *Off. Rec. Wld Hlth Org.*, 1959, 91, 18)

¹ *Wld Hlth Org. techn. Rep. Ser.*, 1957, 117

² *Wld Hlth Org. techn. Rep. Ser.*, 1958, 143

2. PUBLIC HEALTH IMPORTANCE OF CARDIOVASCULAR DISEASES

The Committee began its deliberations by considering the present status of the various cardiovascular diseases, especially from a public health point of view. It was decided that hypertension and coronary heart disease are most in need of epidemiological study at the present time.

The Committee decided to give consideration to the other cardiovascular diseases of public health importance but not to discuss them in detail. It was recommended that WHO pay further attention to them at appropriate times.

2.1 Congenital heart disease

The lower the infant mortality, the greater is the comparative importance of congenital defects. The incidence of congenital heart disease as reported from many countries does not vary greatly. However, the incidence in many of the less developed countries is not known. It is in these areas that environmental factors affecting the mother are likely to show the greatest variation. The role of environment in the production of congenital defects needs further study and for this purpose adequate incidence figures would be very helpful.

Although great advances have been made in the surgical correction of some congenital defects of the heart, little progress has been made in their prevention. Except for the effect of maternal rubella, no good evidence concerning the role of either environment or heredity in the production of congenital defects has been produced. Therefore no effective preventive programme can be advanced. The Advisory Group on Cardiovascular Diseases convened by the WHO Regional Office for Europe¹ has made recommendations regarding the development of centres for diagnosis and treatment of patients with congenital heart disease. The wider adoption of such recommendations is encouraged by this Committee.

It was agreed that advantage be taken of current interests in radiological hazards to obtain better diagnosis and reporting of the incidence of congenital defects which may be associated with exposure to such hazards. Close co-operation with organizations working on this problem should be encouraged.

The problem should be studied both by cardiologists interested in congenital heart disease and by others concerned with the entire problem of congenital defects, as there is evidence that similar noxious factors to those that produce congenital heart disease also cause other congenital abnormalities.

¹ *Chron. Wld Hlth Org.*, 1958, 12, 395

2.2 Syphilitic cardiovascular disease

Although syphilis and its late manifestations, including syphilitic cardiovascular disease, are still problems in certain areas of the world, review of statistical data regarding the amount of syphilis of all kinds indicates that, in general, there has been a great decrease in deaths recorded as due to syphilis, including cardiovascular syphilis.¹ Even though syphilis is still prevalent among certain populations, from a public health point of view it would not be advisable at this time to concentrate attention on its cardiovascular aspects. The advent of penicillin therapy has entirely changed the problem of cardiovascular syphilis. The public health problem now relates to the prevention of syphilis and the detection and treatment of all persons with early syphilitic infection.

Cardiologists can aid in the prevention of syphilitic cardiovascular disease by supporting their public health colleagues in the prevention of venereal disease. It was also stressed that every effort should be made to ensure adequate supplies of penicillin in all areas of the world in order that prompt and adequate treatment of all cases can be carried out.

2.3 Pulmonary heart disease

Pulmonary heart disease (cor-pulmonale) is the result of long-standing increased resistance in the pulmonary vascular bed. This is usually due to severe pulmonary disease of which asthma, chronic bronchitis, and emphysema are the commonest causes. The prevention of this type of heart disease is dependent on the prevention of the underlying pulmonary disease. Cognizance is taken of the apparently wide variation in the occurrence of pulmonary heart disease in different geographic areas, for example, the United Kingdom on the one hand and Scandinavia and the USA on the other.

Those interested in the prevention of pulmonary heart disease can encourage further research into the prevention and cause of emphysema and its frequent precursors, chronic bronchitis and bronchial asthma. They can also lend their support toward efforts to eliminate air pollution and dust hazards responsible for so much chronic pulmonary disease. Effort should be concentrated on the prevention of silicosis, coal-workers' disease, byssinosis and beryllium poisoning. The prevention of deformities of the thorax is an additional important measure for preventing pulmonary heart disease.

2.4 Rheumatic heart disease

Rheumatic heart disease and its precursor, haemolytic streptococcal infection, is still a major public health problem throughout the world. In

¹ *Epidem. vital Statist. Rep.*, 1954, 7, 11

many countries, the extent of the problem has not yet been determined. However, the basic problem, i.e., the prevention of rheumatic fever has already been given consideration by WHO.¹ The degree to which previous recommendations regarding penicillin prophylaxis have been carried out is unknown, but it is apparent that the attention of all countries must again be directed to the value and importance of this public health measure.

Although it is well established that the decrease in the amount of rheumatic fever in some countries was accentuated in the last decade by the widespread use of penicillin, the extent to which this has prevented rheumatic heart disease is difficult to measure. Further studies aimed at clarifying this point may be indicated.

The recommendation of the Advisory Group on Cardiovascular Diseases² regarding the preparation of streptococcal typing sera is endorsed by this Committee.

2.5 Bacterial endocarditis

With the exception of a small number of acute infections involving the endocardium, almost all cases of bacterial endocarditis occur secondary to valvular heart disease or congenital heart defects. Many cases can be prevented by adequate penicillin prophylaxis. There has been some concern over the excessive and often unnecessary use of penicillin and the creation of strains of enterococci and staphylococci which are resistant to penicillin. These difficulties have occurred primarily when penicillin was administered to entire populations. The prevention of subacute bacterial endocarditis involves the administration of penicillin to a few susceptible individuals and creates no such difficulty.

The attention of all groups interested in preventing this disease should be called to the need for early diagnosis and treatment if cures are to be obtained and serious valvular damage prevented. Penicillin prophylaxis should be encouraged in persons with rheumatic and congenital heart disease during any procedures likely to cause invasion of the blood stream by haemolytic and non-haemolytic streptococci, e.g., dental extraction and repair, operations on the upper respiratory tract or the lower gastrointestinal tract, and obstetrical delivery.

2.6 Hypertension and coronary heart disease

The major problems requiring epidemiological study in the cardiovascular field today are hypertension and coronary heart disease. Since hypertension and coronary heart disease are frequently associated, it is difficult to indicate their relative importance. Considered together, they

¹ *Wld Hlth Org. techn. Rep. Ser.*, 1957, 126

² *Chron. Wld Hlth Org.*, 1958, 12, 395

are responsible for the major portion of the cardiovascular disease and death of adult life.

The extent to which either of these diseases is present in individual countries throughout the world cannot be stated accurately. Mortality data for both diseases as determined from vital statistics are subject to many errors.

2.6.1 *Hypertension*

Death certification data provide an extremely poor indication of the prevalence of hypertension. Morbidity data are very sketchy and are based to a great extent on subjective impressions. It is therefore recommended that studies be done throughout the world to determine possible differences in blood-pressure distribution in many populations. Studies on population groups which cannot be adequately described are not considered profitable, since interpretation of such data is almost impossible. Community studies in populations which can be adequately described should be encouraged. These can be either cross-sectional or longitudinal. To ensure comparability the same criteria should be used.

2.6.2 *Coronary heart disease*

2.6.2.1 *Value of available statistics*

The Committee noted that substantial differences were regularly to be found in the death rates from coronary heart disease reported from different countries. Thus the rate reported in the United States of America was greater than that of Finland, and the Finnish certified mortality was substantially greater than the Norwegian. The rate in Norway in turn was considerably higher than that in Japan. However, the Committee regretted the slow progress of studies to determine the comparability of these official death rates, studies that would: (a) analyse the practices of national offices of vital statistics in allocating causes of death—cardiovascular, renal and respiratory—to various code numbers in the International Classification of Diseases¹; (b) describe the national customs and nomenclature in completing death certificates, especially in the elderly; and (c) assess the levels of knowledge and interpretation of coronary heart disease among general practitioners and hospital clinicians in various countries. Until such studies have been carried out, international statistics of mortality from coronary heart disease, arteriosclerotic heart disease, and, *a fortiori*, from “myocardial degeneration” should be treated with caution and regarded only as first indicators with regard to the problems of coronary heart disease.

¹ World Health Organization (1957) *Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death*, 1955 Revision, Geneva

The Committee expressed the hope that it would soon become possible to institute the publication of mortality rates for large cities, as recommended by the Study Group on Atherosclerosis and Ischaemic Heart Disease¹.

2.6.2.2 *Morbidity rates*

These have proved of little value in the epidemiology of coronary heart disease. This is primarily due to the difficulties of diagnosis and to the inability to relate the reported data to the population at risk. However, morbidity rates in special groups subject to a high degree of medical supervision, e.g., among medical practitioners themselves, can provide valuable information on the incidence and prevalence of the disease in these special groups and on the individual's chances of developing it.

2.6.2.3 *Field studies*

The Committee believed that the only hope of rapid growth of knowledge in the epidemiology of coronary heart disease lies in field studies. The Committee stressed the value of prevalence studies and of direct incidence studies among different groups of persons—e.g., smokers and non-smokers, sedentary workers and physically active workers, people on different diets. In the search for clues to etiology, incidence studies of this type are the most likely to be fruitful. However, because of the long incubation period of coronary heart and other chronic diseases, such incidence studies may need to be conducted over many years. The Committee heard reports of field studies being carried out in several countries and it expressed the view that there is scope for considerable expansion of these studies both in developed and in less developed countries where there may be special situations and opportunities. Here, they believed, was an area of endeavour highly suitable for active support by WHO. The Committee laid stress on three matters to which they wish to draw the attention of all concerned with field studies:

(a) The necessity for uniformity in regard to minimal criteria for diagnosis, definitions of characteristics under study, and methods of reporting, so that studies in different situations can be compared. There was no wish among the Committee to impose more rigidity than was essential to achieve useful comparability of studies. Beyond this minimum, individual investigators and teams should be encouraged to work along lines which are most attractive to them.

(b) The necessity for choosing and describing populations and samples to be studied with the utmost care, having regard not only to "who is present", but to the biases of selective entrance into, and exits from, the groups under study.

(c) The need for a high degree of technical competence in carrying out field studies, not only in cardiology, but also in epidemiology.

¹ *Wld Hlth Org. techn. Rep. Ser.*, 1957, 117

2.6.2.4 *Clinical-pathological studies*

The Committee were impressed by the reports from different centres of both overdiagnosis and underdiagnosis of coronary heart disease. They expressed the hope that more clinical and pathological correlation studies will be carried out, not only on highly selected material, like the records of hospital patients, but also on more unselected material, like the causes of death of patients as regularly diagnosed by the practitioners of the region.

In view of the above considerations, the need for establishing uniform criteria for the diagnosis of hypertension and coronary heart disease is evident.

3. EPIDEMIOLOGICAL STUDIES ON HYPERTENSION

3.1 Methodology of blood-pressure determination

The Committee considered the various problems associated with determination of blood-pressure levels in population studies and made the following recommendations:

(1) *Type of apparatus to be used*

Either a mercury manometer or an aneroid instrument in good working order is satisfactory. If the latter is used, it should be standardized at frequent intervals.

The blood-pressure cuff should be at least 14 cm wide and should be sufficiently long that it can be wrapped completely around the arm. With obese arms, over-estimation of the blood-pressure may occur regardless of the cuff used. The wider the cuff, the less is the probability of error.

(2) *Selection of systolic and diastolic levels*

The systolic pressure should be recorded at the appearance of the first sound when the cuff is deflated slowly.

Difference of opinion was expressed with regard to the recording of the diastolic blood-pressure. It was agreed that either the point of disappearance of the sound or the point at which the sound becomes muffled may be used. In either case the point selected should be indicated in published data. It was believed that, in field studies, little difference would be introduced whichever point was selected. Some investigators may wish to record both points.

(3) *Number and method of recording blood-pressure determinations*

In many population studies it will be possible to make only one blood-pressure determination. Such measurements are comparable to the first of a series when more than one blood-pressure determination is

made. If a series of additional blood-pressure measurements is taken, the same number should be made on each subject, examined at specified time intervals. The mean systolic and mean diastolic levels of such a series are the most descriptive of the blood-pressure of the individual, although for some purposes the highest or lowest of such a series may be used. It is urged that, wherever possible, full distribution curves of blood-pressure measurements be presented in published data.

(4) *State of the subject at the time of examination*

For epidemiological purposes the only practicable determination of blood-pressure is that in which there has been no special preparation of the patient. This is often referred to as the "casual" blood-pressure. In the determination of blood-pressure, however, all attempts should be made to eliminate extraneous factors and stimuli which might alter the reading, attention being given to the following points:

- (a) the room should be as quiet as possible;
- (b) care should be taken to avoid chilling the subject;
- (c) emotional stimuli should be kept to a minimum.

Either arm may be used for the determination and the position of the subject—whether sitting or lying down—is not significant, unless he is under treatment with drugs which cause postural hypotension, when he should lie down while the measurement is made.

If nurses or technicians are employed to determine blood-pressure, their ability to do so should first be carefully checked by comparing their readings with simultaneous readings obtained by a physician.

3.2 Criteria of hypertension

Blood-pressure measurements of large population groups are distributed continuously. The curve is not a normal distribution curve but is skewed to the right. There is no sharp line of demarcation between normotensive and hypertensive persons. However, at the upper and lower ends of this distribution curve there are reasonably homogeneous groups which may be designated with some degree of assurance.

To define these groups for the study of hypertension, it is recommended that the following cut-off points be used:

- (1) below 140/90 mm Hg—normal range
- (2) 160/95 mm Hg and above—abnormal (hypertensive) range

The values given are for statistical application to population studies and no significance for the individual person is implied.

3.3 Classification of hypertension

Blood-pressure is measured during systole and diastole, and hypertension may be systolic, diastolic or both.

When hypertension is purely systolic, it is most often associated with the decreasing elasticity of the aging aorta and large blood vessels. Systolic hypertension alone also occurs in cases of aortic regurgitation, large arterio-venous shunts, and hyperthyroidism, as well as in severe chronic anaemia and other conditions associated with high cardiac output, and in complete heart block.

Diastolic hypertension is practically always accompanied by systolic hypertension and is found in association with a large group of diseases. This includes coarctation of the aorta, unilateral renal disease, endocrine syndromes such as Cushing's disease, pheochromocytoma, primary aldosteronism, and toxæmia of pregnancy, as well as a number of diffuse renal diseases, particularly chronic glomerulonephritis and pyelonephritis, and polyarteritis nodosa, lupus erythematosus disseminatus, and necrotizing angiitis.

There remains a much larger group of persons with a systolic and diastolic hypertension, or diastolic hypertension alone, in whom no specific cause for the hypertension has been found. The disease is then designated "essential hypertension." It may be classified into two sub-groups as follows:

(1) *Essential hypertension, uncomplicated*—when no cause for the hypertension has been found and clinical, ophthalmoscopic, X-ray, electrocardiographic or laboratory studies reveal no evidence of cardiac hypertrophy and/or vascular involvement of the brain, retinae, kidneys, or heart.

(2) *Essential hypertension, complicated*—when no cause for the hypertension has been found, but clinical, ophthalmoscopic, X-ray, electrocardiographic or laboratory studies present evidence of cardiac hypertrophy and/or vascular involvement of the brain, retinae, kidneys or heart.

Essential hypertension can take a severe and rapidly progressive form called "malignant hypertension". Such cases must be included and specified in surveys.

It is urged that all persons found to be hypertensive in a field survey be further studied to determine not only the presence of a specific etiological factor but also the presence or absence of vascular and/or cardiac disease. Surveys of populations without this further investigation are incomplete.

4. EPIDEMIOLOGICAL STUDIES ON CORONARY HEART DISEASE

4.1 Terminology

The term "atherosclerosis" was defined by the Study Group on Classification of Atherosclerotic Lesions in Washington¹ as "a variable com-

bination of changes of the intima of arteries (as distinguished from arterioles) consisting of the focal accumulation of lipids, complex carbohydrates, blood and blood products, fibrous tissue and calcium deposits, and associated with medial changes". The Committee endorses this definition.

The term "ischaemic heart disease" was defined by the Study Group on Atherosclerosis and Ischaemic Heart Disease² as "the cardiac disability, acute and chronic, arising from reduction or arrest of blood supply to the myocardium in association with disease processes in the coronary arterial system". The Committee found itself confronted with the fact that this term has since been accepted in some countries, whereas in others the term "coronary heart disease" is being used for the same condition. The Committee therefore decided to accept both terms for the disease as defined above, hoping that in the future one term will find general acceptance.

The two main pathological processes involving the coronary arteries are (a) atherosclerosis and (b) thrombosis in these vessels. While the processes concerned in atherosclerosis and in thrombosis are usually concurrent, they may nevertheless be independent and may have different etiologies. The exact relationship between atherosclerosis and thrombosis has not been elucidated.

4.2 Review of present status of knowledge of etiological factors

The Committee noted that since the meeting of the Study Group on Atherosclerosis and Ischaemic Heart Disease in 1955 studies have been carried out in some related fields. Although much additional information has been gained, the role which the factors discussed by the Study Group play in the production of coronary heart disease still remains controversial.

4.2.1 Diet

The role of saturated fatty acids in raising the blood lipids and of polyunsaturated fatty acids in lowering these has been clarified in a series of studies; and the findings may have an important bearing on the development and prevention of coronary heart disease in man. However, laboratory and population studies so far are inadequate to warrant any general recommendation for changes in diets or food habits with respect to fats. Moreover, other ingredients of the diet also need to be studied. Carefully controlled clinical trials of the effect of different diets on patients suffering from coronary heart disease are urgently needed.

Some field surveys, in addition to obtaining information on the prevalence and incidence of coronary heart disease, are also collecting data

¹ *Wld Hlth Org. techn. Rep. Ser.*, 1958, 143

² *Wld Hlth Org. techn. Rep. Ser.*, 1957, 117

about the individual food consumption in the population under study. These data, if carefully collected, would be of much greater value than those of *per capita* "consumption" of foodstuffs, as calculated from the national production, availability, or consumption statistics. Preliminary explorations, however, have shown again and again the great difficulties inherent in obtaining such seemingly simple information as a reliable dietary history, let alone objective data about the food actually consumed over a long period. The Committee recommended, therefore, that methods of ascertaining individual food intake which are at the same time simple, reasonably reliable, and comparable, should be made the subject of special study. The Committee suggested that in this connexion special attention be paid to foodstuffs commonly used in population groups where a low prevalence of coronary atherosclerosis and heart disease has been established.

4.2.2 *Blood cholesterol levels*

Attempts are now being made to correlate blood-cholesterol levels with food intake on the one hand and the occurrence of coronary heart disease on the other. The results of these studies can be expected to be highly important for decisions about possible preventive measures in the future.

Of all laboratory methods used in relation to coronary heart disease, the estimation of the blood cholesterol is most in need of standardization. It has been demonstrated that in the same adult age-groups the "normal" figures for blood cholesterol may vary widely in different countries and communities.

In view of the great importance of such correlation studies it is imperative that the methods used for blood cholesterol determinations in different surveys be standardized, reliable, and identical, or at least comparable within known limits. The Committee recommends that WHO should undertake the task of promoting measures for the standardization of blood cholesterol determinations and give this matter high priority.

4.2.3 *Physical activity*

Suggestive evidence in epidemiological and laboratory studies shows that physical activity affects blood lipid levels, blood-clotting and fibrinolysis, the collateral coronary circulation, and the occurrence of coronary atherosclerosis and coronary heart disease. However, the studies in man so far carried out have used occupational groups as indices of physical activity; no information is yet available on the direct relationship between physical activity and the development of coronary heart disease. Several studies in the United States of America have not shown the same relationship between occupation and coronary heart disease as those in the United Kingdom. Additional studies on the relationship of personal characteristics of

individuals selecting different occupations to the development of coronary heart disease are also needed.

4.2.4 *Smoking*

Recent evidence on the relation of smoking to coronary heart disease is contradictory. Several studies show a strong relationship, particularly in early middle age; whereas in other studies, including prospective ones, no connexion has been found.

4.2.5 *Psychosocial factors*

The Committee noted that very little work had been done on possible relationships between psychological and psychosocial factors and the occurrence of coronary heart disease.

4.2.6 *Hormones*

Much work is being carried out in both men and women, of various ages, on the relationship of hormones to blood lipid levels, atheroma formation, and coronary heart disease. So far these studies have not led to any definite conclusions on the role of hormones in the etiology of coronary heart disease or on the usefulness of hormones in the treatment of patients.

4.3 **Classification of coronary heart disease and criteria for diagnosis**

The principal manifestations and clinical syndromes of coronary heart disease are as follows:

- (1) angina pectoris;
- (2) myocardial (or cardiac) infarction;
- (3) sudden death (often the first clinical manifestation of coronary heart disease);
- (4) cardiac failure (mainly congestive in type).

The Committee tried to define these manifestations and to assess their usefulness as indicators of the occurrence of coronary heart disease in population groups. The Committee noted that the term "coronary insufficiency" has been subject to different interpretations by different workers. The Committee agreed that cases with severe angina and transient electrocardiographic changes which have been labelled "coronary insufficiency" or "intermediate syndrome" should be included under the heading "angina pectoris" in field surveys. Accordingly, the Committee recommended that the term "coronary insufficiency" commonly used in some countries should not be employed in population studies.

4.3.1 *Angina pectoris* (definitions for epidemiological studies)

It has been argued against the use of this symptom that it is entirely subjective and depends on the observed and the observer. However, it is felt that the manner in which the patient describes the anginal pain is often so characteristic that it cannot be considered only subjective. Moreover, the reliability and the validity of the symptom itself could be made the subject of special study.

4.3.1.1 "*Definite*" *angina of effort*

A pain, occurring centrally in the front of the chest at the mid- or upper-sternal level brought on by effort (e.g., exercise, emotional stress, ingestion of food, or exposure to cold). It may radiate to the left arm or both arms, round the chest, or into the neck or jaw. It is described as "tight", "heavy", "constricting", or "crushing", but it may also be described as "numbing" or "burning". It is relieved within a few minutes after cessation of effort or taking of sublingual nitroglycerine.

It is recognized that cases of *angina at rest* also occur. However, in field studies this condition is unlikely to present a problem.

4.3.1.2 "*Probable*" *angina of effort*

(a) Pain as described under 4.3.1.1 but beginning in any of the sites of radiation mentioned.

(b) Pain as described under 4.3.1.1 but commencing above the left nipple.

(c) Pain as described under 4.3.1.1 but the pain may pass with further effort.

4.3.1.3 *Differential diagnosis* (pain not acceptable for diagnosis of *angina pectoris*)

(a) Pain as described under 4.3.1.1 but occurring *after* cessation of effort (as opposed to *during*), e.g., in anxiety states.

(b) Pain as described under 4.3.1.1 but occurring only in relation to meals and posture, e.g., in hiatus hernia.

(c) Pain as described under 4.3.1.1 but related to special movements and positions only, e.g., in arthritis or fibrositis.

(d) "Stabbing" or "lancinating" pain below the left breast, e.g., in anxiety states.

4.3.1.4 *Some suggestions for obtaining comparable observations*

Satisfactory conditions of examination to allow good rapport between observer and subject are important. For instance, the observer should be of suitable temperament, should be able to speak the language of the subject and should understand his psychological make-up. The examination

should be conducted in a suitable room and the examiner and subject should be alone and undisturbed. Any fear of personal disadvantage from the examination should be removed as far as possible.

It is also important that the observer should accept the agreed criteria. Wherever possible observers from different surveys should obtain first-hand knowledge of each other's work, and should be checked against each other for "inter-observer variation," for example, by arranging for subjects to be interviewed by observers from different surveys. In this and kindred areas of research much trial and experiment are needed—more than is often realized by those who are new to the field of epidemiological research. In general, it may be said that when observers disagree, the area of disagreement can often be clarified by making it the subject of a special objective study.

Methods of eliciting a history of angina pectoris, including questionnaires completed by the subject himself, were also discussed. It was concluded that:

- (a) the best procedure is a history taken by an experienced physician;
- (b) failing this, populations may be screened by a trained interviewer;
- (c) questionnaires completed by the subject are, in general, unsatisfactory, except for highly selected populations.

When a diagnosis is made by an interviewer other than a physician, its accuracy should be checked by a physician. Methodological research should show the degree of error arising from the use of questionnaires by non-medical personnel as compared with history-taking by a physician.

4.3.2 *Myocardial infarction*

This disease is due to obstruction of the coronary circulation causing the necrosis of a macroscopic, circumscribed area of the myocardium. If death of the subject does not ensue, such an area will undergo fibrotic changes.

The symptoms and signs of the acute stage of myocardial infarction are well known, but in field studies it is not likely that persons in this acute stage will be encountered. Accordingly, the Committee felt that it was not necessary to enumerate or evaluate these symptoms and signs. However, it is most important that field studies should detect those individuals who have experienced a myocardial infarct and the Committee offers the following comments with regard to diagnosis:

A clear history of myocardial infarction may be given by the patient, consisting of a gradual or, more often, a sudden onset of severe chest pain, similar to that of "definite" angina of effort. The pain may have been associated with symptoms of collapse and/or other symptoms, often serious enough to require prolonged bed-rest at home or in a hospital. In this event, the hospital documents may furnish further, objective evidence, especially if a series of successive electrocardiograms is available. When

hospital or other specialized information is used, it must be recorded separately. This is important since information of this type may bias comparisons with results from areas where such information cannot be obtained.

The Committee emphasized that the most important signs of the presence of myocardial scars are furnished by the electrocardiogram.

4.3.3 *Sudden death*

Sudden death not due to medico-legal causes has been used as an index of the frequency of coronary heart disease. For this purpose the definition of sudden death has varied from instantaneous death, that is, death occurring within a few minutes, to all deaths occurring within three days of the onset of clinical manifestations.

Emphasis has also been placed on the "unexpected" character of such fatalities, whether they occur as the initial manifestation of disease or as an unexpected incident in an individual with known coronary or other disease. The problem has been further complicated by those unobserved deaths in which the body is found at an unknown interval of time after death has occurred.

At the present time, there is not enough quantitative evidence to justify the use of sudden death as an index of the frequency of coronary heart disease. However, this is a promising area of research, and a useful index should be obtainable if quantitative estimates are made, in unselected populations, of the proportion of sudden deaths which are due to coronary heart disease, and to other manifestations of cardiovascular disease, including cerebral accidents, pulmonary embolism and dissecting aneurism.

If sudden death is to be used as an index of coronary heart disease, the Committee recommends that, except in special studies, this term be used in the sense of instantaneous death as defined above. All such deaths should be included, whether they occur as an initial manifestation of disease or as an unexpected event during an illness, but the two types should be recorded separately.

4.3.4 *Cardiac failure*

Whereas there is general agreement that angina pectoris usually results from coronary artery disease and that myocardial infarction is due to obstruction of one of the larger coronary arteries, no uniformity of opinion exists as to whether the gradual development of cardiac failure consequent on diffuse myocardial damage is also a manifestation of coronary heart disease, the arterial disease being perhaps localized in small vessels. Many clinicians seem to be of this opinion and as a result are inclined to label all cases of congestive heart failure in elderly patients as "arteriosclerotic heart disease," unless other conditions such as beriberi heart or amyloid degeneration of the heart are evident, the assumption being that the multiple areas of

myocardial fibrosis found at necropsy can be considered as scarred areas due to microscopic infarcts.

The Committee felt that this view, although widespread, has not been substantiated, and that the assumption that all cases of heart failure from so-called diffuse myocardial degeneration are due to coronary heart disease is not warranted. For epidemiological studies, chronic heart failure is not a useful indicator of coronary heart disease.

4.3.5 *Methods for the diagnosis of coronary heart disease*

4.3.5.1 *Electrocardiography*

Electrocardiography is essential for the epidemiological study of coronary heart disease. It is an objective method, provides a permanent record and, properly used, is productive of more information about the damage to the myocardium than any other procedure. Moreover, it is readily applicable to the examination of a large number of people. However, like all other methods, it must be applied with proper precautions and with a full awareness of its limitations as well as of its possibilities.

In the first place, the technical conditions, including the choice of a reliable instrument, should be such as to secure good records. Electrocardiographic instruments of the direct-writing system with a minimum frequency response of 45 per second are recommended. The use of the conventional 12 leads, namely I, II, III, VR, VL, VF and V1 to V6 is recommended by the Committee. When less than 12 leads are used, at least 7 leads, namely, I, II, III, VI, V2, V4 and V6 should be employed. The standard of 1 mV = 1 cm should be respected unless very high voltages in the precordial leads make it necessary to reduce the scale to 0.5 cm for 1 mV. This reduction should be noted on the tracings. At least 3 consecutive complexes in each lead, free from artefacts and with horizontal T—P base lines, should be recorded, and the standardization recorded once in each lead. Height, weight, blood-pressure, and the use of drugs should be entered on the record.

The reading of the electrocardiogram is of more value from an epidemiological point of view when checked by several observers. It should be interpreted in two ways:

- (a) without reference to clinical data;
- (b) supplemented by specific clinical information.

Observers should bear in mind the possible effects of factors other than coronary artery disease (e.g., drugs, electrolyte disturbances, posture and body-build, infections) on the record. Field-study groups should be encouraged to exchange electrocardiographic records to ensure comparability of interpretation.

It is highly desirable to be able to compare the electrocardiogram recorded at the time of illness with one or more records made previously

when the subject was believed to be in good health. Similarly, during periods of illness in which the development of coronary heart disease is suspected, a series of electrocardiograms taken during the progression of the illness are of more value than a single tracing which, if taken very early in the illness, may show insignificant or inconclusive changes.

The determination and description of electrocardiographic changes diagnostic of coronary heart disease is a difficult task. It was the opinion of the Committee that only those electrocardiographic patterns indicating "very probable" or "possible" myocardial infarction should be taken into account in the diagnosis of coronary heart disease. A list of electrocardiographic criteria will be found in the Annex (p. 25). The clinical history may reinforce the meaning of "possible" patterns and give them as much value as "very probable" patterns.

Electrocardiographic abnormalities, indicating, for example, auricular fibrillation, bundle-branch block, T-wave changes, etc.—in which the relationship to coronary heart disease has not been established—should be recorded separately so that their diagnostic significance may be determined.

4.3.5.2 *Exercise tests*

In some surveys, these are being used at present in connexion with electrocardiography in suspected cases of angina pectoris. The Committee agreed that valuable information can be obtained from exercise tests in clinical practice and investigation, but considered that their value and feasibility for field studies remains to be determined.

The Committee felt that the reports of the field teams using these tests should be awaited before any routine application can be recommended.

Electrocardiographic criteria for positive exercise tests are included in the Annex.

4.3.5.3 *Roentgenography*

The Committee considered the place of X-ray examinations in surveys of coronary heart disease and hypertension. While there is no doubt of the great value of this method of examination for clinical practice and investigation, its place in field epidemiological work is not clear. Apart from the technical, financial, and safety problems, the exact measurement of small increases in heart size (such as are often met in field surveys) offers methodological difficulties which have not yet been solved. Since the value of roentgenography in the field study of hypertension remains to be proven, the Committee suggested that the results of current experiments be awaited before any recommendation for the general use of X-rays in field surveys is made. The Committee agreed that roentgenography of the heart has no place at present in field surveys of coronary heart disease. Whether X-ray of the aorta, e.g., for the measurement of aortic width or the recording

of calcifications, can be usefully employed in field surveys needs to be the subject of special study.

4.3.5.4 *Other clinical methods*

In addition to the methods mentioned above, the Committee recommended further investigation of other clinical methods adaptable to field studies, including retinoscopy, measurement of peripheral vascular narrowing or obstruction by palpation, oscillometry, and pulse-wave registration. The Committee emphasized that clinical usefulness of a method is not a sufficient recommendation for its use in epidemiological studies; its value must first be proved by actual experience in field trials.

5. IMPLICATIONS FOR THE INTERNATIONAL CLASSIFICATION OF DISEASES

The Committee reviewed the section of the International Classification of Diseases¹ relating to diseases of the circulatory system. The Committee was aware that this section of the Classification is complicated and difficult to apply; but it was realized that the inadequacy of the Classification does reflect the present lack of agreement regarding clinical concepts and terminology of cardiovascular diseases. Any clarification in the clinical classification of cardiovascular diseases will in time benefit a statistical classification, provided that it is periodically revised in an effort to keep abreast of established advances in medical knowledge and to take account of current clinical opinion.

It was emphasized that the application of uniform diagnostic criteria would improve the quality and homogeneity of diagnoses, and this in turn would facilitate the task of allocating cases and deaths among the categories of the International Classification of Diseases, thus increasing the precision of the resulting statistics. In spite of improvements in its structure, however, the Classification will have to provide categories for those vague and symptomatic terms which are still often found on death certificates, particularly in the case of the aged.

The Committee recommended that research should be done both on the classification of disease complexes and on multiple-cause tabulation. In the case of a disease complex, more than one disease would appear on the

¹ World Health Organization (1957) *Manual of the International Statistical Classification of Diseases, Injuries and Causes of Death*, 1955 Revision, Geneva

death certificate (e.g., coronary heart disease and hypertension) but only the one that has precedence (coronary heart disease) would appear in published statistics. An example of multiple-cause tabulation would be coronary heart disease and diabetes co-existing in the middle-aged.

The Committee also discussed the differences which exist between various countries in the habits of medical practitioners in certifying causes of death and in the practice of national administrations in classifying the diagnoses thus recorded. The Committee welcomed the initiative of the WHO Regional Office for Europe in starting a study of the practice in various European countries with regard to death certification in cases of cardiovascular disease and related conditions. It was realized that a long period of post-graduate education of the medical profession was required before improvement of certification could result in a substantial improvement of national statistics. Pending such improvement, the Committee recommended that comparative studies based on both clinical and post-mortem records be undertaken in various countries in order to ascertain, in so far as possible, the exactitude of certification and the real incidence of the morbid conditions responsible for cardiovascular disease and deaths. This would provide a check on the significance of the available nation-wide statistics, an estimate of the error of certification, and an effective method of obtaining the interest and co-operation of the medical profession.

Pending the availability of the results of such epidemiological studies, the Committee felt that existing international tabulations of mortality from cardiovascular diseases would gain in usefulness if they were accompanied by comments concerning their quality and the methods of collection and classification prevailing in different countries.

The Committee was informed of the steps envisaged by a recent Expert Committee on Health Statistics¹ for the Eighth Revision of the International Classification of Diseases; it endorsed the recommendation made by the latter committee to the effect that:

“(1) a group consisting of specialists in cardiovascular diseases familiar with the principles of classification for statistical purposes and of health statisticians be established soon to consider the revision of the classification of cardiovascular diseases in the light of current medical concepts and statistical requirements, and to formulate proposals for revision;

(2) in view of the complexity of the problem, such a group meet several times before 1963 to attend to the various stages of the preparatory work.”

¹ *Wld Hlth Org. techn. Rep. Ser.*, 1959, **164**, 14

6. CONCLUSIONS AND RECOMMENDATIONS

It has now been universally accepted that cardiovascular diseases form a major public health problem in many parts of the world and that the study of, and the struggle against, these diseases can take place fruitfully on an international scale. The World Health Organization, having as its objective the attainment by all peoples of the highest possible level of health, would be expected to mobilize its resources to promote research work and stimulate control programmes in this as well as in other important fields. The Committee therefore recommends that future activity of WHO be increasingly devoted to those tasks. It is realized, however, that careful planning is necessary.

In the light of these considerations the Expert Committee on Cardiovascular Diseases and Hypertension (concentrating its attention in its present meeting mainly on hypertension and coronary heart disease) agreed on the following:

1. The Committee noted that continuity has been ensured in the past for an orderly development of WHO activities in the field of cardiovascular diseases. In this connexion, the Committee reiterates the suggestions for further research given in the report of the Study Group on Atherosclerosis and Ischaemic Heart Disease¹, since it is of the opinion that many of the items mentioned are still deserving of the attention of research workers and agencies. The Committee stressed the fact that many of the researches recommended in the report for the study of ischaemic heart disease would also be of value for the elucidation of hypertension. Furthermore, the Committee endorses the recommendations of the Study Group on Classification of Atherosclerotic Lesions², especially in so far as they refer to the terminology and its implications for the International Classification of Diseases and to the establishment of international and regional centres. Finally, the Committee recommends that the proposals formulated by the Advisory Group on Cardiovascular Diseases convened by the WHO Regional Office for Europe at Copenhagen from 21-25 April 1958 should be brought to the attention of the other regional offices.

2. The Committee noted with satisfaction that there will be at WHO Headquarters an expert in cardiovascular diseases and epidemiology as a permanent staff member to collaborate with and provide for the exchange of information among research workers in this field in different parts of the world as well as to stimulate the formation of new research groups.

The Committee also noted that an Expert Advisory Panel is available to the Organization and to the headquarters expert so that continuity can be provided between expert committee meetings.

¹ *Wld Hlth Org. techn. Rep. Ser.*, 1957, 117

² *Wld Hlth Org. techn. Rep. Ser.*, 1958, 143

3. A meeting of representatives of some of the research groups and teams that are at present carrying out field work on hypertensive and coronary heart disease in different countries might be of value. The aim of such a meeting would be to give the leaders in these different countries an opportunity to discuss their experiences with one another and to compare them with the criteria suggested in this report. In this way the criteria set up by this Committee may best serve to further the accumulation of accurate knowledge about the distribution of cardiovascular diseases in different areas of the world.

4. In its capacity as directing and co-ordinating authority in international health WHO might develop activities to co-ordinate the work of the above-mentioned field projects so as to assure uniformity of methods and comparability of results in the different countries. In this connexion, WHO might also undertake to provide assistance and expert epidemiological advice to Member States who wish to start similar epidemiological field investigations. It is implicit, however, that a core of reliable and experienced research workers be available in the country concerned, who are willing and able to adhere to uniform criteria for studies used in the other countries. Pending this, opportunities should be provided for training such workers in other countries.

5. The Committee noted that insufficient effort and resources are devoted to the elucidation of the possible role of psychological and sociological factors in the etiology of the different forms of heart disease. The Committee was of the opinion that the present paucity of scientific data on the significance of these factors is due partly to the methodological difficulties, inherent in such research, and partly to the difficulties in bringing about co-operation between physicians, psychologists and sociologists who have training and experience in the specific epidemiological problems of this field. It is recommended, therefore, that WHO stimulate this co-operation by bringing together physicians, psychologists and sociologists to formulate methods and principles of research in the psychosociological aspects of the cardiovascular diseases. Once these methods have been elaborated, private foundations interested in heart disease, mental health, and social research might be called upon to co-operate in and support world-wide studies in this important field.

6. Non-governmental organizations, such as professional or scientific societies and private foundations which support research on an international level, may be invited to join efforts with WHO and devise how funds can be made available to support epidemiological studies of cardiovascular diseases on an international basis.

7. The Committee felt very strongly that one of the major obstacles in developing these studies is the lack of trained and experienced

epidemiologists who are so necessary for the study of chronic diseases. The implementation of a broad training programme is thus an urgent need and is recommended to WHO as one of the first priorities.

7. CONCLUDING REMARKS

As a result of its deliberations and after careful consideration of the three previous WHO reports relating to cardiovascular diseases, the Committee wishes to draw particular attention to the following matters:

1. There is an urgent necessity to establish the true frequency of coronary heart disease, hypertension, and related conditions in countries at various stages of development through the study of representative and comparable samples of their populations. Such studies would help to clarify the present confusion and might provide important leads for further research and prevention.

2. Minimal criteria for the diagnosis of coronary heart disease and hypertension for use in such epidemiological studies have been suggested by this Committee. The Committee invites careful review of these criteria by workers in the field so that their suggestions and criticisms may be embodied in further revised versions of these criteria.

3. Progress in the establishment of the true frequency of coronary heart disease and hypertension, and in the study of the many factors associated with these diseases, will also depend upon the standardization of clinical, laboratory, and electrocardiographic methods for field study, and the development of techniques for the assessment of individual diets, psycho-social factors, and physical activity.

4. There is a great dearth of workers who are experts in the field of cardiovascular epidemiology. The training of these workers is a matter of great urgency.

The Committee is gratified at the agreements reached on many controversial points and hopes that this report will provide assistance to workers in this important field of research.

Annex

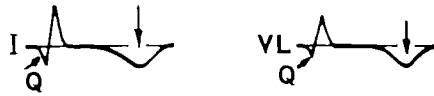
THE ELECTROCARDIOGRAM IN CORONARY HEART DISEASE

The electrocardiographic changes listed under A. below are those which are considered to be diagnostic of "very probable" myocardial infarction. Similarly, patterns consistent with "possible" myocardial infarction are depicted under B. The changes are shown graphically to clarify the written description.

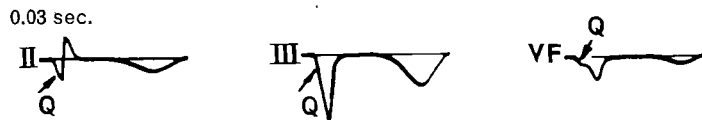
1. Criteria for the diagnosis of myocardial infarction

A. "Very probable" myocardial infarction

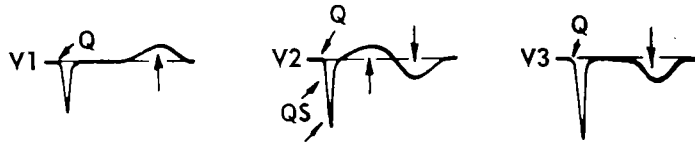
- (a) Association of **Q I** not less than 20% of **R I**, and negative **T I** (a sign of anterolateral infarction which has to be confirmed by precordial leads, as illustrated in (c) and (d) below). VL is much like lead I.



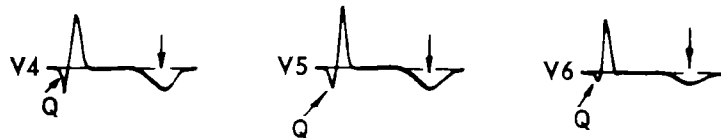
- (b) Association of **Q II** negative **T II**, **Q III** negative **T III** and **Q VF**. Q at least 25% of the largest standard R wave in III and not less than 0.03 sec. in II or III.



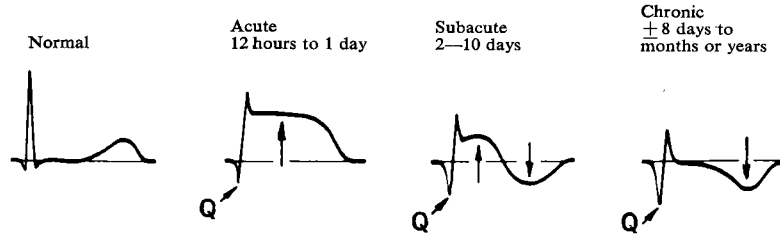
- (c) Q waves in precordial leads V1, V2, V3 and negative or diphasic T waves in V2 and V3 (QRS not exceeding 0.10 sec.). When no R present = QS configuration.



- (d) Q waves more than 0.4 mV deep in precordial leads V4 and V5, and 0.2 mV in V6, in association with negative T waves in those leads.

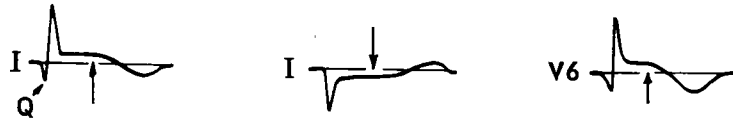


(e) **Injury current**—evolution and disappearance in three stages. Probability of myocardial infarction in any stage is almost 100%.



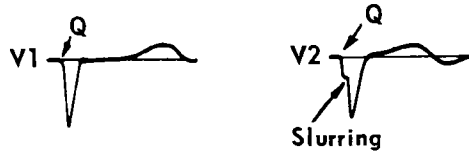
B. "Possible" myocardial infarction

(f) **Transient elevation or lowering of S-T**, more than 0.1 mV in I or V1 to V6. When persisting and more than 0.3 mV in I or V5, V6, suspicion of cardiac aneurysm. Typical QRS abnormalities should coexist.

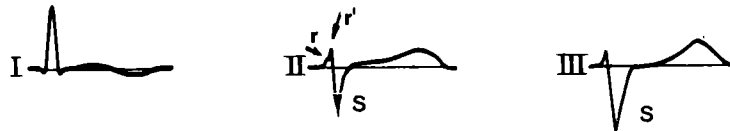


(g) Q II and Q III 25% of maximum R, trivial Q VF.

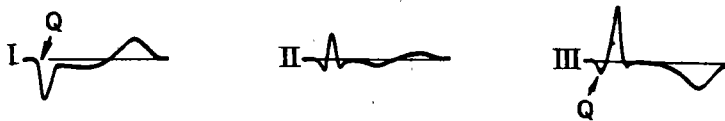
(h) Q or QS with slurred downstroke in V2 and/or V3.



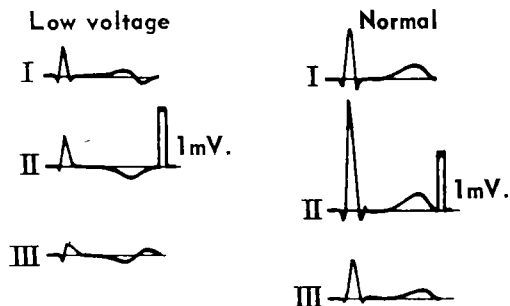
(i) **Marked left axis deviation** with deep SII, SIII and rr'II. a pattern found, for example, in anterior infarction. Confirmatory changes in chest leads also required.



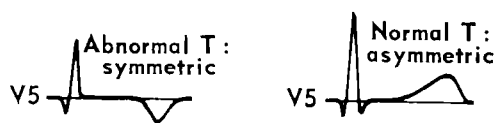
(j) **Right axis deviation** and hypertrophied left ventricle (sign of apical or lateral myocardial infarction).



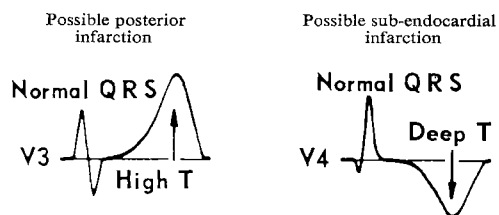
- (k) "Low voltage" in standard leads (<1 mV) and precordial leads (<2 mV) with hypertrophied heart or hypertension. Other, typical abnormalities of QRS and T should coexist.



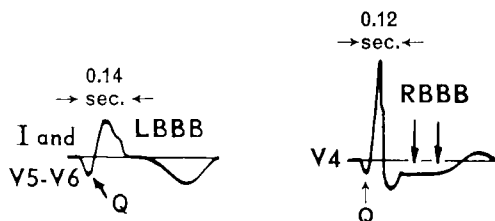
- (l) Symmetrical negative T waves in all or part of the leads from V3 to V6.



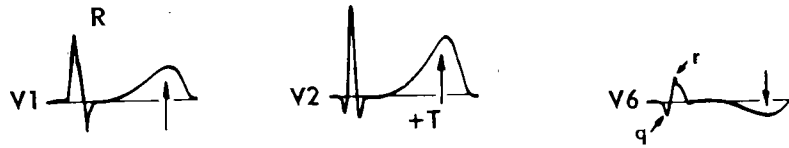
- (m) High or deep precordial T waves (1 mV or more) in two or more chest leads with normal QRS waves.



- (n) Bundle branch block right or left plus suspicion of myocardial infarction owing to presence of additional Q waves.



- (o) High early R waves in V1 without right hypertrophy or R.B.B.B. (a sign of postero-lateral myocardial infarction). In addition qr and negative T in V6 and tall T waves in V1 and V2.



- (p) $T_{III} > T_I$ can be a sign of former anterior infarction.

2. Criteria for the diagnosis of angina pectoris

Positive effort tests = depressed S-T segments in one or several leads. Sometimes lowering of R waves. S-T depression is flat or curved in form.

