The Care of the Patient with Coronary Heart Disease

REPORT OF A JOINT WORKING PARTY OF THE ROYAL COLLEGE OF PHYSICIANS OF LONDON AND THE BRITISH CARDIAC SOCIETY

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FOREWORD

This working party was set up at the same time as the one on rehabilitation after cardiac illness. The object was to review the present position of coronary care in its widest aspects, with particular reference to the United Kingdom. Some overlap

with the report of the Working Party on Cardiac Rehabilitation (and with that on Primary Prevention of Coronary Heart Disease which was set up later) has been encouraged in order to emphasise important aspects.

An important objective of the report on Coronary Care was to analyse and comment on specific problems, such as unexpected sudden death, prehospital care, early diagnosis and the place of both the hospital and mobile coronary care units, and the contribution of home care for myocardial infarction.

The section of the report that deals with the management of the patient after the disease has become established embodies the views and experience of experts in the United Kingdom, continental Europe, North America, Southern Africa and Australasia. Every attempt has been made to evaluate the current situation and to indicate areas where further work needs to be done. In considering particularly coronary care units and early diagnosis and treatment, the report emphasises the unacceptably high death rate in the first three hours after cardiac infarction and concludes that the facilities for attempting to reduce it are, in general, inadequate. The report suggests in general terms ways in which the problems could be tackled.

By contrast, definitive proposals for the improvement of licensing requirements for drivers of public vehicles have been made and considerable attention has been paid to the problems of detection of heart disease in airline pilots.

Details of treatment and of diagnosis have been omitted as the Report deals essentially with matters of principle and major policy.

We are most grateful to all the members of the Working Party who have given so much of their time, thought and expertise to the Report and we are particularly indebted to the Chairman, Dr Lawson McDonald and to the Secretary, Professor Desmond Julian.

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To fulfil the brief of the Working Party nine aspects of coronary care were defined and considered—

1. Epidemiology
2. Notification of coronary heart disease
3. The diagnosis and management of presymptomatic coronary heart disease
4. The management of the patient after symptoms have developed
5. Coronary care outside hospital
6. The Coronary Care Unit
7. Management after cardiac infarction
8. The surgical management of coronary heart disease
9. The future

1. EPIDEMIOLOGY

Most of this aspect was considered more appropriate to the Working Party on Primary Prevention of Coronary Heart Disease. It was unanimously accepted that in the care of the coronary patient geographical factors were of the greatest importance and that what might apply in London was likely to be different from smaller cities and rural areas. The number of beds in Coronary Care Units in relation to needs appears to be less in the United Kingdom than in other European countries.

2. NOTIFICATION OF CORONARY HEART DISEASE

A national register for coronary heart disease would add useful knowledge only if it were based on accurate and comprehensive data. Not only are diagnostic criteria difficult to establish but many patients die suddenly before medical aid is available, and many others are treated without reference to hospital and without investigation. It would be a very expensive exercise because of the numbers involved and the many possible routes of notification. For these reasons it was concluded that the case for a national register of coronary heart disease remained weak, and that its establishment was unjustifiable at the present time. Much valuable information could be collected on a local basis by well-planned epidemiological studies.

3. THE DIAGNOSIS AND MANAGEMENT OF PRESYMPTOMATIC CORONARY HEART DISEASE

Most of the adult male population of Britain (in common with the rest of Western Europe and the United States) have atheromatous deposits within their coronary arteries. Symptoms do not usually arise until the lumen of one or more of the larger arteries is seriously compromised, but about one man in five develops overt myocardial ischaemia by the time he is approximately 65.[1]

One cannot be sure how many people in the United Kingdom die of the disease. The Registrar General's figures (1971)[2] suggest that approximately 25 per cent of all deaths are due to myocardial ischaemia, but certification at time of death does not provide an accurate source for these statistics. Reliable overall mortality data are sparse, for they depend upon scrupulous population studies which are difficult and expensive to conduct. Moreover, the few published studies have been in areas with a high coronary mortality and none can be considered representative for the population of Britain, which itself shows marked regional variations.[3] With this important reservation it is worth considering the example of Rochester, Minnesota, where necropsies were performed in 73 per cent of all deaths of residents over a five year period: coronary artery disease was the cause of death in four of every 10 men.[4]

By no means all of those who die are aware of the significance of preceding symptoms; Armstrong *et al.*[5] reported that 25 per cent of first episodes of acute heart attacks presented as medically unattended deaths. Coronary heart attacks

can also be unapparent in those who survive, for the Framingham study[6] has shown that 23 per cent of subjects with electrocardiographic evidence of infarction did not report relevant symptoms to their medical advisers and, as far as can be ascertained, 12 per cent had no suggestive symptoms at all.

Presymptomatic, undiagnosed, and undisclosed coronary heart disease is therefore common, but its assessment is beset with many difficulties. First, the underlying pathological process is present to a greater or lesser degree in many apparently healthy people, but there is no way of predicting accurately its rate of progress in any individual case, nor indeed whether it will ever become manifest. Secondly, the non-invasive techniques for diagnosis are at best imperfect. In particular, electrocardiograms (ECGs) recorded at rest may, on the one hand, show changes falsely suggestive of myocardial ischaemia yet, on the other hand, may commonly be equivocal even in the presence of myocardial infarction.[7] Tracings recorded during effort may also be unreliable and difficult to interpret. Thirdly, symptoms do not correlate well with the seriousness of the disease, and indeed may not occur until shortly before death.

Despite these inherent difficulties, diagnosis in the presymptomatic or unrecognised phase of the disease is attempted in air crews and drivers of public service vehicles in order to protect the public from risks that might arise if these individuals were suddenly to have incapacitating symptoms from an acute coronary occlusion or serious arrhythmia.

Recently, the tendency has grown to investigate subjects who are thought to have occupational risks and who have special responsibilities, and also the families of patients with diagnosed premature coronary heart disease. The purpose here is to combat the disease in an early phase, to delay, reduce, or prevent its clinical manifestations. This aspect of prediagnosis is not considered in this report because it is within the terms of reference of the Working Party on Primary Prevention.

Fitness to Fly and to Drive

A. *Pilots and Air Crew.* The prediagnosis of coronary heart disease has received more consideration in pilots than in any other group of the population, and extensive experience has been gained since the United States Air Force first demanded an ECG at entry in 1957. Thus, the methods, value and limitations of available techniques for the detection of presymptomatic coronary heart disease can profitably be considered in relation to the practices evolved by the licensing authorities for air crew.

The requirements for professional fliers, which have progressively become more stringent, are governed largely by the International Civil Aviation Organisation, which last revised its standards in December 1972. Pilots, engineers, navigators, and air controllers are required to submit to a full medical examination by authorised medical officers and to have base-line ECGs at entry to training. Clinical examinations are repeated at frequent intervals, with an ECG every five years to the age of 30, every two years to the age of 40, and every year to the age

of 50. Thereafter pilots have ECGs recorded at six-monthly intervals, while the other groups continue to have yearly checks. Private fliers are not required to have an ECG until they reach the age of 40.

Some organisations require even more frequent examinations. For example, the United States Air Force demands an ECG annually for all flying personnel from the age of 35, and any who develop possible repolarisation abnormalities are requested to have repeat ECGs and a double Master's exercise test[8] if the changes are persistent; if the double Master's test is borderline or abnormal, the individual is referred for full assessment, including maximal treadmill exercise tests, and in selected cases cardiac catheterisation and coronary angiography.[9] Also, in the United States, the Federal Aviation Administration proposed the compulsory addition of a post-exercise ECG to the currently required medical examination for airline pilots, but the proposal has recently been withdrawn.

Most experience has been gained with the 12-lead ECG recorded at rest. This test has the outstanding advantages of being readily standardised, simple, rapid to perform, safe, and inexpensive. It does provide a useful yield of diagnostic information in presymptomatic coronary heart disease. In 1972, Lancaster and Ord[10] reported from the Aerospace Medical Association on the findings in 661,488 ECGs recorded since 1957 from 236,114 individuals of the U.S.A.F. flying population. Of the initial ECGs recorded in asymptomatic healthy adult men, 82.6 per cent were considered normal. Some of the others showed changes of doubtful importance, but the incidence per thousand was 5.24 for all degrees of A-V block, 4.43 for pre-excitation, 8.09 for ventricular extrasystoles, 1.67 for right bundle branch block, 0.28 for left bundle branch block, 0.43 for previous myocardial damage, and 24.72 for low amplitude T waves and non-specific repolarisation changes. Of greater importance, the incidence of previously unrecognised cardiac infarction detected solely by the annual review ECG in U.S.A.F. fliers has ranged from one to two per thousand each year for men from 40 to 50 years of age (Caris, 1970).[11] Most of these episodes have been completely asymptomatic judged by detailed retrospective history-taking. Caris's figures thus show the value of the annual ECG in the diagnosis of serious coronary heart disease in apparently healthy men, but also underline the need for more sensitive detectors, since both fatal and non-fatal coronary episodes can be incapacitating for air crew.

An ECG showing changes characteristic of infarction must disqualify a flier, except under exceptional circumstances. Unfortunately, most abnormal electrical patterns are not specific for coronary disease. Difficulties are most frequently encountered in the repolarisation forces (ST and T waves). The problem is highlighted by the many studies that revealed variations between different observers even in the classification of ECGs in the normal and abnormal categories.[12-14] Moreover, a single skilled observer cannot be completely consistent with doubtful tracings. Higgins *et al.*[15] reported on the interpretation by one of the authors on two occasions of 440 ECGs from the Framingham study,

using the standardised coding system that has become known as the Minnesota code.[16] No discrepancy of the classification into normal or abnormal occurred in 408 instances, though 22 were called normal on the first occasion but abnormal on the second, and 10 were called abnormal on the first but normal on the second.

Unfortunately, non-specific or doubtful abnormalities on the ECG cannot be dismissed as having no possible relevance. Higgins *et al.*[15] showed from an eight-year follow-up of the Framingham cohort that persons with isolated Q waves that had not been considered diagnostic had about twice the average risk of developing overt coronary disease. Isolated T inversion carried a five-fold increased risk of death and three-fold increased risk of an incident of coronary heart disease. Also in the Framingham study, normotensive subjects having non-specific ECG patterns suggestive of left ventricular hypertrophy had a morbidity ratio from coronary heart disease increased more than two-and-a-half-fold.[17] Minor T wave abnormalities, such as notching or low amplitude in V5 and V6, are often associated with organic heart disease and with an increased fatality rate over the follow-up period.[18] On the other hand, Hiss *et al.*[19] who studied 226 U.S.A.F. personnel with non-specific T wave changes, have cautioned against making a firm diagnosis of heart disease on this basis alone.

Electrocardiograms recorded during exercise stress have been widely used both in an attempt to resolve some of the difficulties in the interpretation of the non-specific changes in tracings recorded at rest, and also to provide a diagnostic test of greater sensitivity in the diagnosis of suspected coronary heart disease. The use of exercise tests in the evaluation of patients with myocardial ischaemia has been reviewed by Bruce and Hornsten.[20] The varying techniques that have been described fall into two broad categories: those involving submaximal levels of exercise, and those conducted during maximal oxygen uptake. Either may utilise steps, bicycle ergometer, treadmill, or any other device for dynamic exercise. During submaximal tests one or more workloads may be used, with an arbitrary end-point that may be related to the work performed or to the patient's response, e.g. changes in heart rate or ECG pattern, or the development of symptoms. Maximal tests, which imply a demonstration that oxygen uptake cannot be further increased, are more time-consuming to perform, require the presence of a medically qualified person, are potentially more dangerous, and therefore less suitable for routine diagnostic use.

The simplest test procedure in common use is the Master two-step test,[8] which was originally used to observe pulse and blood pressure responses to exercise. The treadmill and bicycle ensure more reproducible energy expenditure. Some degree of ST segment shift is taken as an abnormal response, the recommended criteria ranging from 0.5 to 2 mm (0.05 to 0.2 mV) in any lead, the PR segment providing the reference voltage. The interpretation of ST responses during exercise may be difficult because of baseline shifts, muscle potentials, artefacts, and respiratory variations. Some abnormal responses are very transient and may last only for

seconds after exertion has stopped. Tracings must therefore be taken during exercise if the technical problems can be overcome, or at least started immediately afterwards. Recordings should be continued intermittently for several minutes because in a few individuals the appearance of abnormality may be delayed.[21]

It is necessary to examine critically the value of effort ECGs in the diagnosis of presymptomatic coronary disease. They do have a predictive value. Blackburn *et al.*[22] reported the results of an international study comprising 12,770 men aged 40 to 59 years who had post-exercise ECGs. After a five-year follow-up, subjects with 'Ischaemic' ST depression had a three-fold excess in the incidence of manifest coronary disease even when allowance was made for other known risk factors. From Britain, Rumball and Acheson[23] took a standard ECG and performed an effort test on 660 male R.A.F. volunteers without clinical or radiological evidence of heart disease and diastolic pressures below 100 mmHg. The ECGs of 149 men (22.6 per cent) showed minor conduction disturbances or non-specific abnormalities, either at rest or after exercise. After a period of four to seven years, a postal enquiry disclosed that 10 definite episodes of heart disease had occurred, involving seven of the group with 'anomalous' ECGs (4.8 per cent) compared with three of 500 initially adjudged normal (0.6 per cent). Clinical examination of 177 subjects revealed 14 additional cases of coronary heart disease, 11 of which came from the 'anomalous' group; all 11 had had ST depression of 0.5 mm or more after exercise in their initial tests. However, the limitation of accurate diagnosis in individuals was underlined by the fact that of 20 men with the grossest post-exercise changes initially, 13 remained free from cardiac symptoms, and four had normal exercise tests at the end of the follow-up period. More disturbing are data from Seattle[24] where 186 apparently healthy men had three annual effort tests: 31 men had one or more positive tests, but no less than 14 showed a change from positive to negative in the period reviewed. That factors other than myocardial ischaemia can affect repolarisation forces in resting or exercise ECGs is, of course, well recognised. Roitman *et al.*[25] have demonstrated that effort tests can be especially misleading in individuals with pre-existing repolarisation abnormalities. This is not always well appreciated, and indeed is unfortunate when effort tests are frequently performed in an attempt to confirm or deny myocardial ischaemia in patients with non-specific abnormalities in tracings recorded at rest.

The specificity of effort ECGs is thus unsatisfactory. Moreover, the sensitivity is also poor, especially when submaximal exercise is used. This is illustrated by data from Doyle and Kinch,[26] who included an annual (or rarely biennial) treadmill test as part of a prospective epidemiological survey of 2,437 men. Follow-up was maintained in 1,970 of those initially free of the stigmata of coronary heart disease and exercised two or more times in the study period. Seventy-five men developed an abnormal response to exercise, and 34 of these went on to develop further evidence of coronary heart disease in the period covered by their report. However, 189 men developed other manifestations of coronary heart disease without first showing positive effort tests. Thus, of 223

subjects developing clinical manifestations of coronary heart disease, only 18 per cent were detected by the development of positive effort tests, even though these were conducted annually in most cases. Garrison and Gullen[27] argue from these and other data that in order to prevent one pilot jeopardising his aeroplane 1,000 pilots must be retired prematurely following positive ECGs; moreover, the predictive value of effort tests is so poor that only a very small minority of dangerous disabilities could be prevented, even at so great a cost.

The criteria for an abnormal response to effort ECGs are not generally agreed. If 2 mm depression of the ST segment is demanded, specificity is improved, but the sensitivity is such that the test was positive only in 28 per cent of patients with prominent angina pectoris.[28] It would be of little value in identifying asymptomatic pilots. A 1 mm response was obtained in only 58 per cent of the same patients. The sensitivity is enhanced at 0.5 mm, but the specificity is then unacceptable. ST depression of 1 mm is probably the best compromise to indicate a presumed abnormal response in the submaximal tests currently employed.

The limitations of the exercise ECG as presently employed can be summarised. The methods used for submaximal effort tests have not been standardised, and there is no general agreement on the criteria for an abnormal response. Even among experienced cardiologists, inter-observer variation is great; intra-observer variation is also considerable, so that the use of the same observer for all exercise readings would not necessarily provide acceptable reliability.[29] The reproducibility of tests is unsatisfactory, the specificity of abnormal responses incomplete and the sensitivity is poor. This catalogue of problems reinforced the opposition from the Airline Pilots' Association of the United States to the Federal Aviation Administration's proposals to include a post-exercise ECG in the currently required regular examination of airline pilots.[27] It is not felt that the exercise test should be condemned as being of no value. A standardised test performed by an experienced observer may have a place in the initial examination for entry before training for commercial flying service begins. It should certainly be useful in the investigation of doubtful symptoms in subjects with normal ECGs at rest. Furthermore, the whole place of exercise tests is now under active consideration by a working party of the Committee of the Royal College of Physicians and may possibly be more widely introduced in the future. Coronary angiography could also be of value. Froelicher *et al.*[9] recently presented the results of coronary angiography in 76 asymptomatic air crews with responses to exercise testing that suggested coronary heart disease. Although 53 per cent had angiographically confirmed coronary arterial disease, 47 per cent did not, and were recommended for return to flying duties. The indications for this invasive test must obviously be restricted, for it is not free from risk; but a good arbiter can be welcome when balance has to be kept between concern for public safety, on the one hand, and, on the other, justice to an individual who has made flying his career.

At the present time, lipid analysis is not required for professional fliers and

there is no guarantee that the inclusion of this investigation would improve safety standards. However, severe lipid disorders (for instance Fredrickson Type II) are such important predictors of coronary heart disease that screening at entry should be recommended. This would have economic advantages to airlines and might reduce for individuals the social problems caused by enforced premature retirement.

It is considered that no currently acceptable test or combination of tests is 100 per cent accurate in differentiating individuals with potentially dangerous coronary heart disease from those who do not have this condition. Despite the limitations of our diagnostic procedures, only a few serious cardiovascular incidents are known to have occurred to air crews while flying. The Civil Aviation Authority is aware of one or two acute coronary episodes during international flights each year in the decade ending 1972; during this period of approximately 18 million flying hours there were eight accidents to large transport aircraft in which an acute coronary episode was considered a possible contributory cause of the accident.[30] The figures do not include the Eastern Block countries, in respect of which little data are available. Heart disease in air crews remains a minor but important public hazard, as well as the commonest cause of loss of flying licences after the age of 35 years.

B. *Drivers of Public Service and Heavy Goods Vehicles.* The possible public hazard from drivers in these categories with presymptomatic or undiagnosed coronary heart disease must receive careful consideration, since sudden collapse at the wheel is likely to have more serious consequences than would follow from similar illnesses in drivers of private motor cars. Moreover, professional drivers spend a greater proportion of their lives on the road than the private motorist, and are therefore more likely to develop their first symptom in potentially dangerous situations. They are also less likely to stop their vehicles for what might seem only a trivial disability, because of their responsibility for maintaining public services or following tight schedules.

For this reason the law requires higher standards of medical fitness in applicants for vocational licences to drive public service vehicles (PSV) and heavy goods vehicles (HGV) than are mandatory for private motorists. A medical report must be submitted with the first application. Medical certificates are also required on the first renewal of a PSV licence after the ages of 50, 56, 59 and 62 and annually from 65; for HGV licences a certificate must accompany every renewal application after the age of 60. Conditions that debar applicants are set out in *Medical Aspects of Fitness to Drive.*[31] They include angina pectoris, a history of cardiac infarction, syncope or arrhythmias, casual blood pressure readings of 200/110 mmHg or over, ECG evidence of myocardial ischaemia, or radiological evidence of significant cardiomegaly.

The London Transport Executive has made a close study of disability rates in drivers, and much useful information has been published. They require medical examination not only at the ages set out above, but also after 21 days' absence

from work attributed to sickness or accident, after failure to complete a shift due to illness, and after absence from work attributed to certain defined conditions. During a five-year period, 1967-71, 670 drivers aged between 50 and 64 were recommended for retirement or transfer to alternative work on health grounds.[32] Of these, only 15 per cent were the result of age-related medical examinations whereas 85 per cent resulted from post-sickness assessments. Since 86 per cent of all spells of sickness ended in under 21 days, only a small minority of men absent from work required examination and contributed to the high yield of significant disabilities. Forty-two per cent of these were disorders of the cardiovascular system, in particular, hypertension.

The importance of hypertension as a predictor of coronary heart disease is well known. For example, Morris[1] has recently published the results of a ten-year follow-up of London busmen who were free from recognisable cardiovascular disease when first examined in 1957-60. The incidence of subsequent diagnosed coronary heart disease ranged from 9 per cent in those with casual systolic blood pressures below 130 mmHg through successive increments to 35 per cent with pressures over 190 mmHg. The incidence of cerebrovascular disease and of overall mortality showed similar trends, and no less than 54 per cent of the initial group with pressures over 190 mmHg died during the follow-up period. The value of blood pressure recordings in symptomless drivers relates not only to public safety but also to the prognosis in the individuals concerned. The trial conducted by the Veterans' Administration[33] and Poblete *et al.*[34] has demonstrated that treatment of even mild hypertension reduces substantially the incidence of cerebrovascular accidents, heart failure, and renal failure. Unfortunately, the increased incidence of cardiac infarction is not markedly altered.[35] The importance of excluding subjects with serious hypertension from holding PSV and HGV licences is not doubted.

The importance of disease as a causal factor in road accidents has been reviewed by Ysander.[36] In Britain, disease in motorists was considered to contribute only two per 1,000 of all road accidents involving personal injury reported in 1958.[37] Very similar figures have been collected from the United States, West Germany, Norway, Denmark and Sweden. Although too much reliance should not be placed on these statistics, they do suggest that disease plays only a minor part in road accidents.

Some information is available on sudden death or incapacitating illness from cardiovascular disease in drivers of heavy vehicles and public service vehicles. Myerburg and Davis[38] investigated 1,348 instances of sudden and unexpected death due to heart disease (with autopsy confirmation) in subjects aged 65 and under. Their data show that 66 of these deaths were in drivers of trucks, taxis, or buses. In 28 instances symptoms had occurred previously, but coronary heart disease had not been diagnosed, and, as far as can be ascertained, 21 individuals had had no previous symptoms at all. Only a minority of these subjects were at work when they died, and no serious accidents occurred as a result of their deaths. Raffle[39] has recently reported the experience of London Transport over 20 years

to 1972, involving a total of 343,600 driver-years. There were 108 incidents of acute illness in which a bus driver had to stop driving suddenly or actually collapsed at the wheel. Fifty-four of these incidents led to accidents, of which only eight involved acute myocardial ischaemia. This experience amounts to one crash resulting from coronary heart disease in every 782,000,000 miles travelled. The risk to railway passengers from unsuspected coronary heart disease in train drivers is also small. Drivers are under medical surveillance similar to that employed by London Transport. One, or possibly two accidents have occurred in 10 years as a result of sudden incapacity of a driver from coronary heart disease.[40]

The public hazard from episodes of coronary heart disease in PSV and HGV drivers is therefore small in comparison with the risks from crashes due to other causes.

However, we do recognise that several aspects of the present licensing requirements are unsatisfactory.

(*a*) Medical certificates for an HGV licence must be submitted on first application: it could be over 30 years before another examination is required (over 20 years for a PSV licence).

(*b*) Up to the present time there has been no statutory obligation for a licence holder to declare any new disability during the three-year tenure of a licence; when a renewal application is submitted, he has only to declare that he has not 'suffered from epilepsy, or from sudden attacks of disabling giddiness or fainting, or from any disease, mental or physical, or disability likely to interfere with the efficient discharge of (his) duties as a driver or to cause the driving by (him) of a heavy goods vehicle to be a source of danger to the public'. This declaration could be signed in good faith by many drivers with serious cardiovascular disease.

(*c*) The questionnaire on the medical certificate for an HGV licence (part of form DLG 1A) does not detail those cardiovascular conditions that should debar a driver. The applicant is asked only if he 'suffers from any heart or lung disorder likely to interfere with the efficient discharge of his duties as a driver of a heavy goods vehicle'.

It is true that the medical officer is asked to have regard to the recommendations by the Medical Commission for Accident Prevention *Medical Aspects of Fitness to Drive*[31] which lists 10 items that should prohibit the holding of an HGV licence. Our enquiries suggest that some examiners do not remember these detailed recommendations.

(*d*) The examinations are usually conducted by the applicant's own medical practitioner, who might be reluctant to take any steps that could threaten the livelihood of his patient.

We do not consider that any practicable scheme could overcome all these problems in an entirely satisfactory manner. One important improvement has already been made: when the provisions of the recent Road Traffic Act of 1974[41]

are brought into operation, every driver will have a duty to report any new disability that is, or might be expected to become, relevant to his safety as a driver. Having regard to the very serious consequences that can follow from even one crash involving a heavy goods or public service vehicle, we recommend that consideration be given to the following additional proposals—

1. That the present statutory examinations should not be carried out by the applicant's ordinary medical adviser.
2. That a medical certificate from the applicant's usual medical practitioner should accompany every application for renewal of an HGV or PSV licence that did not involve a fresh examination. The certificate should state that no disqualifying illness had occurred since the initial licence had been granted.
3. That details of disqualifying conditions for HGV or PSV licences be included in notes that form part of the medical certificate that is signed by the medical practitioner either at the time of examination or routine certification of applicants.
4. That medical examination should be mandatory for any HGV or PSV driver who is considered to be at fault in an accident that results in a crash.
5. That an appropriate medical certificate of continued fitness to drive be required of any HGV or PSV driver who is absent due to sickness for longer than 21 consecutive days.

C. *Drivers of Motor Cars.* The high incidence of latent or symptomatic heart disease in the adult population of Britain inevitably implies that many car drivers are at risk of developing sudden incapacitating illness. Unlike PSV and HGV drivers, special risk groups have not been excluded by medical examination. Taggart *et al.*[42] recorded electrocardiograms in 78 people who were driving their own cars along familiar but busy city routes. The majority increased their heart rates, about 40 per cent attaining a peak of more than 115 beats per minute. ST changes developed in three of 32 drivers who had no clinical or conventional electrocardiographic evidence of heart disease Abnormalities became more pronounced in 13 of 24 drivers who were known to have coronary heart disease; the changes were gross in 6, 5 developed multiple ventricular extrasystoles, 2 developed anginal pain, and 2 left ventricular failure. It cannot be doubted, therefore, that driving is a potent cause of stress though, not unexpectedly, the cardiovascular responses are less in experienced drivers than in the inexperienced.[43]

Although coronary heart disease is responsible for only about one-sixth or one-seventh of all cases of sudden illness that cause accidents,[44] it is the most common cause of death from natural causes while at the wheel. Peterson and Petty[45] reported the outcome of 81 such cases. More than half were apparently able to stop their cars before an accident occurred; the crashes that did result were minor, producing relatively little damage to property and no serious injury to

other people. The matter can be put into better perspective by considering data collected by Herner *et al.*[46] Only 41 of 44,255 road accidents reported to the police in one region of Sweden from 1959 to 1963 were thought to have been caused by sudden illness in drivers. Although 8 drivers died from their disease, no other person was killed in the 41 accidents.

Supported by these and similar data, the report on *Medical Aspects of Fitness to Drive*[31] by the Medical Commission for Accident Prevention advised that diagnosed coronary heart disease was not regarded as a bar to driving private vehicles, except within two months of an episode of cardiac infarction, and 'when angina pectoris is easily provoked during driving, either by the mechanical act of driving or by the annoyance caused by other drivers, or by everyday city conditions'. The Working Party concurred with their conclusions. Because medical examination plays no part in the routine licensing of private drivers, it remains the responsibility of the individual to seek medical advice if he has any reason to doubt his ability to use the road safely by reason of possible illness. This responsibility may soon become more onerous, for the Secretary of State for the Environment has proposed that private-car driving licences should remain valid from the date of issue to the age of 70. In this new situation it must be stressed that all doctors must become accustomed to thinking of their adult patients as drivers, and must always be prepared to offer advice about fitness to drive even when this advice is not solicited. Medical examinations are desirable for drivers who are thought to be at fault in causing any accident resulting in serious injury. Under the Road Traffic Act 1974 the courts will have the power to notify the Secretary of State if it appears that an accused person may be suffering from 'any relevant disability or prospective disability within the meaning of section 87 of this act . . . .' It is hoped that the courts will be alert to the need to exercise their power whenever they are in doubt about the present or future medical fitness of an accused person to hold a licence. However, it is not considered that coronary heart disease will be a common cause of disqualification.

The European Economic Community[47] has published a draft directive on the Harmonisation of Driving Licence Procedures which proposes a routine medical examination and psycho-technical tests before the initial issue of a private driving licence, as well as medical examinations at increasing frequency with advancing age. It seems unlikely that these proposals will be adopted in Britain in the forseeable future.

4. THE MANAGEMENT OF THE PATIENT AFTER SYMPTOMS HAVE DEVELOPED

The data and conclusions in this section are based upon replies to a survey covering cardiologists and general physicians with an interest in cardiology in the United Kingdom, United States, Scandinavia, France, Germany, Italy, Holland, Canada, Australia and South Africa. Approximately 100 replies have been received but the great majority of these (75) are from Britain. Wide differences of

opinion were reported from different centres but the main guide lines are now fairly clear.

Investigation of the Patient

Electrocardiography (*see* pp. 8 to 12)

Metabolic Studies. When a clinical diagnosis of coronary heart disease has been made it is normal practice, certainly in patients up to middle age, for the serum cholesterol to be investigated routinely, preferably on at least two occasions, and it is strongly recommended that fasting triglyceride levels are also estimated. The difficulties in obtaining satisfactory blood samples are not insuperable and it appears that the routine investigation is increasing. Again, at least two samples on different occasions should be taken. Fredrickson's classification of beta lipoproteins is highly advisable.[48-50]

The routine measurement of uric acid does not have adequate clinical importance to justify routine measurement at the present time, but a modified glucose tolerance test should be carried out in every patient; random spot tests of blood glucose are of no value unless, by chance, they are unduly high. This is such an inefficient way of screening for diabetes mellitus or abnormal glucose metabolism that it cannot be recommended. The importance of age and body weight in determining whether these levels are abnormal is discussed further under the heading of treatment.

Coronary Arteriography. The indications for coronary arteriography remain under constant review. Specific groups of patients in whom the investigation is indicated include—

1. Patients whose angina has not responded to medical treatment and in whom coronary arterial by-pass grafting is considered.
2. Crescendo or unstable angina pectoris in which the pain has not settled with medical treatment.
3. Patients with atypical histories or ECG findings in whom the diagnosis of coronary heart disease cannot be established or refuted by other means.

In skilled hands coronary arteriography carries only a small risk. The investigation should not be carried out in centres where the case load would lead to less than 100 per year;[51] also it is highly desirable that facilities for coronary arterial surgery are available within the same building at all times.[52] With these precautions the mortality risk from the investigation is of the order of 0.1 per cent.[53] Although there is no upper age limit for coronary arteriography in a patient considered for by-pass grafting, it is unlikely that the indications will be strong enough to justify arteriography in many patients above the age of 65.

Treatment

General Measures (These matters are dealt with in the report on Cardiac Rehabilitation[54] and also in the report on Primary Prevention to be published in April 1976).

There is no proof that reduction of weight alone, even in obese patients, improves the prognosis of coronary heart disease but it is universal practice to advise patients to attain the normal body weight for their age and height or, preferably, slightly less. This should be recommended, even for patients who have no lipoprotein abnormality, on the grounds that it reduces the work of the heart and is likely to improve the overall exercise tolerance. The psychological benefit following weight loss is usually impressive.

Exercise is important in the physical and mental well-being of a patient. An exercise programme should be prescribed for each patient individually, preferably with a graded increase over several weeks under supervision. There is little evidence that this alters prognosis although this has been suggested[55] and there is considerable difficulty in maintaining long-term adherence to an exercise programme. However, even fairly short periods of approximately 30 minutes of supervised exercise on three days of the week achieve an appreciable improvement in exercise tolerance,[56] and in the patient's sense of well-being.

Cigarette smoking is certainly harmful[57-59] and the prognosis is improved considerably if the patient stops.[60] It is likely but not proven that a similar relationship exists for other forms of smoking and strenuous efforts should therefore be made to persuade the patient to stop smoking entirely.

It is universally accepted that the treatment of hypertension is very important in patients with coronary heart disease to reduce the work of the left ventricle and to diminish the risk of stroke. It has been suggested that hypertension significantly accelerates the development of atherosclerotic plaques, both in animals[61] and in patients.[62]

There is considerable evidence that high levels of serum lipids in man correlate with early onset of clinical coronary heart disease.[63, 64]

Evidence is so far scanty that modification of diet in an attempt to lower serum cholesterol levels and correct abnormal lipoprotein or triglyceride patterns has any influence on the prognosis of established coronary heart disease. It has been demonstrated in human subjects that cholesterol in atherosclerotic arteries can exchange with that in the blood.[65, 66] In experimental animals reduction of dietary cholesterol has been shown to result in a decrease in size of atherosclerotic plaques.[67] Data in human subjects are considerably less convincing, since several modifications to life style were often carried out at the same time, but there is some evidence that low cholesterol, low saturated fat and high polyunsaturated fat diets decrease the rate of progression of coronary arterial disease and may reduce the mortality.[56, 68]

Guide lines in dietary treatment are the restriction of the calories derived from animal fat in the diet, and replacement by carbohydrate and protein, in types 1 and 5 lipaemia, and the reduction of carbohydrate intake in patients with carbohydrate-induced lipaemia of type 4.

Although there is good evidence that hyperlipidaemia is associated with an increased susceptibility to coronary heart disease, it has proved difficult to obtain

proof that its treatment either by diet or drugs does improve prognosis. The secondary prevention trials of clofibrate carried out in Newcastle and Edinburgh[69] appeared to show that patients who suffered from angina had a diminished risk of death and of further infarction when given the drug, while patients with a history of previous infarction only derived no such benefit. The improved prognosis of the former group did not correlate with the extent of reduction of blood cholesterol level. The American Coronary Drug Project Trial[70] carried out solely on survivors of cardiac infarction, some of whom also suffered from angina pectoris, did not demonstrate any improvement in prognosis in either class of patient when given a special diet or clofibrate or nicotinic acid. The value of such treatments therefore remains in doubt, but most clinicians would consider it logical to treat an obvious hyperlipidaemia (by Western standards) with appropriate diet and/or drugs.

Drug treatment of hyperlipidaemia is usually carried out with cholestyramine or clofibrate but other measures may be needed.[71, 72] Treatment based on these lines is at present dependent on the probability of improvement and cannot be supported by firm evidence: nevertheless, the weight of evidence supports the initiation of such a regime for many patients, particularly those with lipid disorders.

Symptomatic treatment with nitroglycerine or other effective vasodilators is accepted practice. The risks of beta-adrenergic blocking drugs have been over-estimated in the literature and patients who have angina pectoris that is not virtually prevented by modification of life style and the use of nitrates should be given a therapeutic trial of beta-adrenergic blocking drugs. Recent work suggests that beta-blockade may also improve prognosis.

Information Given to the Patient and Relatives

When a diagnosis of coronary heart disease is firmly established the patient should be told what measures he can take to influence the future course of events, and especially to give up cigarette smoking. In particular, he should be advised to contact his general practitioner urgently if he develops rest pain similar to his exercise angina. He should be advised to reduce his body weight to normal limits and to modify his diet appropriately if investigations have shown a metabolic disorder. There is little support for extensive modifications of diet in patients with no demonstrable lipid abnormality or in patients above the age of 55.

The prognosis of angina pectoris is considerably better than is usually appreciated by patients and it is important that they be given an encouraging outlook. The knowledge of prognosis in coronary heart disease has been much amplified by coronary arteriography. For example, isolated disease of the left anterior descending coronary artery has an average yearly mortality of 4 per cent, and isolated disease of the right coronary artery about 2 per cent, whereas, in contrast, triple vessel disease has an average yearly mortality of about 10 per cent.[73, 74] If the patient specifically enquires, it is right that he should be told his risk of a heart attack in the future is higher than average but this information

should not be volunteered by the doctor. It should also be tempered with advice concerning the possible ways in which the risk can be reduced. Particular emphasis should be laid on the ability of the patient to return to his previous occupation, possibly modified in terms of physical effort and long working hours, and of psychological stress, and he should be encouraged not to regard himself as chronically disabled.[75] The common practice of routinely advising patients to take 'a lighter job' is strongly deprecated.

The regular follow-up of patients with known coronary heart disease is highly desirable. The follow-up may be carried out by the general practitioner or by the hospital specialist.

Information given to the relatives should include answers to any specific questions raised but should not paint an unduly gloomy view of prognosis. It is almost universally accepted that screening of the first degree relatives of patients with premature coronary disease should be carried out even though this is very seldom done in Britain. Such screening should include serum cholesterol and lipoprotein estimation, ECGs and clinical examination. There was 90 per cent overall support for this view from the survey. The risk of cardiac neurosis exists in this field but it is a risk that should be accepted because of potential benefits to the relatives of patients.

5. CORONARY CARE OUTSIDE HOSPITAL

The overall mortality from an acute coronary heart attack is in the region of 40 per cent during the first four weeks. Of all deaths during this period, approximately 25 per cent occur instantaneously or within 15 minutes, 40 per cent during the first hour, more than 50 per cent within the first two hours and 65 per cent within the first twelve hours.[76,5] The relative importance of early death is even more evident in the young age groups, with more than 60 per cent of deaths among males of 50 or less occurring within one hour.[77]

It seems probable that more than 90 per cent of these early deaths result from ventricular fibrillation.[78,79] As early ventricular fibrillation can usually be corrected and the survivors have a good prognosis[80] it is apparent that many of these deaths could be prevented if the subjects were under intensive care at the time.

The median time between the onset of the symptoms of myocardial infarction and hospital admission is usually at least four hours[5] and may be as long as eight hours.[81,76] Because of this and of the time distribution of death in myocardial infarction, a high proportion of deaths, 60 to 70 per cent according to several studies, occur before admission to hospital.

The reasons for delay in admission to hospital have been studied in a number of areas.[5,82] The most important delay is that of the patient calling his doctor, but other major delays are due to difficulties in obtaining a doctor, to the time taken for him to get to the patient and make a diagnosis, to ambulance journeys, and to delay within the hospital. Since the major problem is outside hospital, various pre hospital schemes have evolved—

1. Mobile coronary care units (MCCU).
   (*a*) staffed by medical personnel.
   (*b*) staffed by trained paramedical personnel.
2. Static pre hospital coronary care units (life support stations).

Mobile Coronary Care Units

The mobile coronary care unit has been defined as a facility which enables personnel trained in coronary care to reach patients at the site of the heart attack (at home or elsewhere) as soon as possible, to start emergency treatment immediately, and to continue observation and treatment during transfer to hospital.[83]

Staffed by Medical Personnel. The prototype MCCU was developed at the Royal Victoria Hospital, Belfast, in 1966.[84,85] General practitioners were made aware of the problem of early deaths outside hospital and given a special telephone number, which allows a rapid response from the Coronary Care Unit. They were instructed in the emergency treatment of acute cardiac infarction, including resuscitation techniques. A team, consisting of a doctor and nurse, both trained in coronary care, is able to reach more than 50 per cent of patients within ten minutes of the receipt of the call from the general practitioner or lay individuals. The general practitioner may activate the mobile unit if a message he has received from a patient, or from the individual with him, suggests the likelihood of acute infarction. '999' calls from lay individuals which suggest the possibility of cardiac infarction are immediately relayed to the hospital coronary care unit and assessed by a registrar or senior house officer. The scheme operates without additional ambulance drivers, since the ambulance depot for the city of Belfast is in the grounds of the Royal Victoria Hospital. No special vehicle is used but two ambulances from the depot have been slightly modified. The establishment of the Cardiac Department has been increased by one registrar.

A different scheme was evolved for that part of Belfast remote from the ambulance depot.[86] Here, a mini-vehicle containing the necessary equipment and drugs is on standby proximal to the Coronary Care Unit of the district hospital. A team from the Coronary Care Unit travels in this mini-vehicle. If the patient has a cardiac infarction, one member of the team will accompany him to hospital in an ordinary ambulance, monitoring him on the way, the other will drive the mini-vehicle back to base.

MCCU staffed by medical personnel have been developed elsewhere in the United Kingdom, in Europe, the United States, in Australia and Japan. In most centres, either no additional members of staff have been necessary or one senior house officer or registrar has been added to the hospital staff. However, because in some areas difficulty has been encountered in obtaining doctors to staff the mobile coronary care unit, paramedical personnel have been employed instead.

Mobile Coronary Care Units Staffed by Paramedical Personnel. The first such unit in the United Kingdom was developed in Brighton.[87] Mobile coronary care is

now provided by 24 ambulance personnel using any vehicle of the existing fleet. The ambulancemen are trained to understand any complications they might encounter, to recognise common arrhythmias, to be skilled at routine resuscitative measures and to be competent to treat ventricular fibrillation with a d.c. shock. Some of the more experienced men also administer intravenous lignocaine or atropine under carefully defined conditions. During the first year of operation, five patients with primary ventricular fibrillation, which occurred shortly before or during transit, were resuscitated and subsequently left hospital alive. The results have improved with increased experience and the use of portable combined defibrillator/oscilloscope units. During 1974, 15 patients were discharged from hospital after resuscitation by ambulancemen.

Many units staffed by paramedical personnel operate in the United States of America. One outstanding organisation is that of Cobb, which operates through the Seattle Fire Department.[88] The aid-car, of which there are ten strategically placed in the city, and an MCCU are simultaneously dispatched when an emergency call recording 'a coronary episode' or 'collapse' reaches the Fire Department. Resuscitation measures are initiated by the personnel in the aid-car and completed by those in the MCCU. Among the patients resuscitated in the first two years, there were 57 long-term survivors and in the last year there were 64 long-term survivors. Cobb believes that telemetering of the cardiogram at the base hospital is unnecessary, but Rose[89] in Portland and Nagel[90] in Miami consider this facility important.

Experience with units staffed by paramedical personnel has shown that ventricular fibrillation can be effectively treated, and ambulancemen can be well trained in the recognition of arrhythmias and their correction. It has been doubted, however, whether they can evaluate patients as critically as a physician and they cannot be authorised to give dangerous drugs such as morphine or diamorphine. Furthermore, a significant proportion of cases attended by MCCU have not suffered a cardiac infarction and can either be cared for at home or be directed elsewhere for appropriate medical treatment. The prompt sorting out of such cases by a physician can play a useful and economic part in reducing demands on hospitals as a whole and on coronary care units in particular. On the other hand, the advantage of having appropriately trained and equipped ambulancemen is evident when dealing with calls from the public in which the nature of the emergency is not known.

It is apparent that many different types of MCCU with varying methods of staffing by doctors or paramedical personnel can be effective and that no one system is applicable to all areas.

Effectiveness of Mobile Coronary Care Units. Attention is particularly drawn to the following data—

1. It is possible to ensure that a significant proportion of patients with myocardial infarction are provided with intensive care early. More than 25 per

cent may obtain intensive care within one hour, compared with less than 5 per cent in the absence of MCCUs.[79, 91]

2. Correction of ventricular fibrillation outside hospital is a practical proposition and leads to long-term survival.[85]
3. Deaths during transport are virtually eliminated.[92]
4. The early initiation of intensive care and the correction and prevention of disturbances of rate and rhythm may favourably influence the magnitude of the area of infarction and thus the incidence of shock and pump failure, and the hospital mortality.[93, 91]

It is appreciated that a substantial number of deaths occur instantaneously or within fifteen minutes of the appearance of the first symptom. Clearly, when such deaths are unwitnessed, resuscitation is impossible, although the experience with MCCUs in Belfast, Seattle and Brighton shows that a proportion of cardiac arrests occurring outside hospital can be successfully treated, provided the appropriate organisation is available.

Equipment of Mobile Coronary Care Units–

1. The drugs and intravenous solutions normally available in a coronary care unit.
2. A battery-operated monitoring oscilloscope.
3. A battery-operated permanent recording instrument (cardiograph or tape-recorder).
4. A battery-operated d.c. defibrillator.
5. Oxygen supply, respirator-bag, endotracheal tubes and suction apparatus.

Combined oscilloscopes and defibrillators are now available; it is essential that these are light and compact because the apparatus may have to be carried some distance or up several flights of stairs. The entire equipment for a mobile coronary care unit need not cost more than £1,500 (March, 1975).

Static Pre hospital Coronary Care Units (Life Support Stations). These have been successfully established in skyscraper buildings in New York where one or more physicians practice. Such units also exist in some industrial complexes and in several football stadia and airports.

Management of the Patient in the Early Phase of Cardiac Infarction

Relief of Pain. Immediate pain relief is particularly important as it may correct the autonomic disturbances that are so frequent at the onset and which may respond to pain relief alone and diminish catecholamine release. Potent narcotic drugs such as morphine and diamorphine are usually necessary and the use of these drugs by paramedical personnel presents problems. There remains a need for an assessment of other analgesic methods, particularly nitrous oxide.[94, 95]

Corrections of Disturbances of Rate, Rhythm and Conduction. Major disturbances of rate, rhythm and conduction are common during the first hour. Their identification and treatment are most important.

Although these complications respond well to treatment, this can be undertaken only if appropriately trained and equipped personnel are available. Effective early management may favourably effect the outcome of the attack.

Importance of Treatment in the Early Hours after Cardiac Infarction. The Working Party considers that, in view of the high death rate in the first three hours after an attack, the facilities that are generally available are inadequate. First, the public should be further instructed on the indications to call without delay upon emergency skilled help, and MCCUs should be further developed. The exact means must depend on local conditions and requirements. Thus, their implementation should be on a local or regional basis, with the encouragement of the Department of Health and Social Security and the other national health authorities. It is clear that such expansion of present facilities would involve the employment of paramedical personnel and of more doctors, including general practitioners. The Working Party accepts that the number of lives that might be saved in this way in the country would amount to several thousand annually. Moreover, the provision of more emergency treatment facilities should encourage the better understanding of the causes of sudden unexpected death and might reduce the incidence of unexpected fatal heart attacks as a result. Widespread instruction of the public in resuscitation should be encouraged as a further means of rescuing victims stricken by acute heart attacks. Such instruction could be carried out by trained laymen or medical personnel in schools, factories and large institutions.

Home Care in Cardiac Infarction

In recent years, much attention has been focused on the relative merits of home as opposed to hospital care in cardiac infarction, particularly as a result of a study carried out in South-West England. Mather and his colleagues[96] have concluded that home treatment may be as effective as hospital treatment but critics of this study have pointed to defects in its design, to the relatively small and ill-defined minority of patients who were randomised and to the fact that many of the patients were seen late after the onset of symptoms when intensive care would not be expected to be effective.

The Working Party believes that patients with a recent cardiac infarction need help quickly and it may often be best obtained through a MCCU with subsequent admission to a hospital CCU. We doubt the value of treatment in general wards or of admission of uncomplicated cases to the coronary care unit if this is late in the course of the illness or if it involves a long and potentially hazardous journey.

The decision as to whether patients should be admitted to hospital should thus take into account the following factors—

1. *The time since the onset of symptoms.* Intensive care has most to offer patients within the high risk period of the first four hours. It contributes less to the uncomplicated patient who has survived twelve hours.

2. *The condition of the patient.* This can be misleading in the early hours but after twelve hours, and particularly after forty-eight hours have elapsed, the patient who appears well and has no signs of shock or cardiac failure has a good chance of survival.
3. *The transport facilities.* When a MCCU is available, transport involves no great risks, but in other circumstances, prolonged journeys may be hazardous, particularly in the first twelve hours.
4. *The availability of intensive care.* From the point of view of the control of arrhythmias, little may be gained from admitting a patient to a general ward. The decision as to whether a patient is admitted to hospital should therefore be determined, at least to some extent, by the availability of coronary care.
5. *The domestic situation.* Good conditions must be available for rest and nursing of the patient over a period of weeks.
6. *The feelings of the patient or his relatives* either for or against hospital treatment must be taken into account. Some patients are less anxious in hospital; others are more so.

6. THE CORONARY CARE UNIT (CCU)

A decade has now passed since the introduction of coronary care units (CCU) into the United Kingdom, and it is therefore an appropriate time to take stock of our experience and achievement in this field on a national level. There can be no doubt that patients will continue to require admission to hospital no matter what the role of home care in the management of acute cardiac infarction is eventually felt to be, so that conditions for optimum accommodation and care continue to be important matters deserving constant reappraisal. Neither does the undoubted value of prehospital care detract from the importance of the eventual in-patient management.

There would appear to be general agreement that some form of specialised accommodation for the care of these patients is desirable. The area must provide a calm and quiet atmosphere, which frequently does not exist in the general purpose intensive therapy unit (ITU) or general medical ward, while at the same time permitting constant observation and immediate resuscitation. It is acknowledged that for many reasons, some financial or architectural and others due to local staff shortages, it is not always possible to provide the optimum in unit design and care but, as becomes apparent in review of CCU facilities in the United Kingdom, much can be achieved by enthusiasm and improvisation.

As has been emphasised in the introduction to this report, details of treatment will not be given with regard to drugs and dosage; reference may be made to *Intensive Coronary Care.*[97] The Working Party considers it important to emphasise the possible dangers of accidental overdosage of potent drugs by intravenous infusion and the necessity of using either constant infusion pumps or small '100 ml' fluid-reservoirs for their administration.

Site, Size, and Design of the Coronary Care Unit

The CCU receives the majority of its patients from the accident and emergency department (A & E) unless a mobile CCU operates from the hospital, therefore proximity of the unit to the emergency department of the hospital is highly desirable. It has been suggested that the A & E department is the most dangerous place for a patient with acute cardiac infarction to be in, that there is often undue delay in initiating the appropriate standard of nursing and medical care and, frequently, rather second-rate resuscitative facilities are available. It is important to remind the staff of the A & E department at frequent intervals of the importance of rapid and efficient assessment of patients with possible infarction. The CCU should also be responsible for the training of A & E department staff in resuscitative techniques and have responsibility for advising on and checking all relevant equipment in the A & E department. One of the major advantages accruing from the possession of a CCU in the hospital is that it should operate as a training centre for nurses and doctors working in areas where cardiac arrest is likely to occur, and should ensure a high standard of resuscitative technique and facility throughout the hospital.

There is a similar advantage in close proximity of the CCU to general medical wards to which patients will progress and from which they will occasionally return. Late cardiac arrests, which are frequently unpredictable, now constitute a major cause of in-hospital mortality, and again there is much to be gained by making the general medical ward a functional extension of the CCU. Monitoring facilities, including the use of telemetry and computers, are now recognised as of extreme importance in the continuing observation of patients in general wards so that late arrhythmias may be promptly recognised. The CCU should again train ward personnel and check that resuscitative facilities are optimum. For uncomplicated cases a period of 24 to 48 hours in the CCU is usually adequate, followed by 10 to 21 days in hospital, if circumstances permit. Patients with complications will require longer periods, and each should be individually judged.

The number of CCU beds required within the individual hospitals is not easy to assess. It is tempting to talk in terms of CCU beds in relation to general medical beds but while this may be valid where a single District General Hospital serves a clearly defined population the local organisation of hospital care is frequently too complex to permit such simple calculations. Where a Hospital Management Committee has two or more modest-sized hospitals (general medical beds 50 or less) it is common practice for the CCU to be built in only one. This is logical in terms of finance and staff economy and need not necessarily result in hardship to the patient provided that local practitioners and ambulance services appreciate the internal arrangement and that the H.M.C. does not cover too wide an area. Under these circumstances one needs to think in terms of CCU beds in relation to H.M.C. general medical beds. Perhaps the best way of determining the need is to suggest that between six and eight CCU beds are required for every 250,000 to 300,000 of the population served. Units of less than three beds, however, would appear to be wasteful and unlikely to attract sufficient staff resources to be worth while.

The CCU should ideally be a separate ward area and neither part of a general purpose intensive therapy unit nor a general medical ward. The noise and general activity of both these areas is inappropriate to the needs of the patient with acute myocardial infarction and it is difficult to maintain the level of close observation required when the patient often appears superficially fit when compared with many others to be found in the ITU and general ward. There is, however, much to be said for the juxtaposition of ITU and CCU since there are both skills and equipment residing in the individual units that are frequently of value to the other.[98] This arrangement also encourages the interchange of nurses between the two units as discussed below.

A survey of the CCU facilities currently available in the United Kingdom was made in the summer of 1973. There was little information to be obtained from central authorities on this matter and it was necessary to circulate hospitals within the regions of the Scottish, Welsh and Northern Ireland authorities and the English Regional Boards. Information was obtained from 297 hospitals, each with 30 or more general medical beds. It was felt that smaller hospitals were unlikely to have the experience or medical and nursing staff to make a CCU feasible. The data is incomplete in that relatively little information was obtained from one English Regional Board.

Of the 297 hospitals, 179 had some form of CCU. Of these, 93 were self-contained and independent entities but 31 were part of a general purpose intensive therapy unit and 55 appeared to be a designated area of a general medical ward. The units enjoyed a separate nursing staff in 117 hospitals, and some form of screening facilities was available for the insertion of pacing wires at 122 units, either within the CCU itself or within the nearby cardiac catheterisation laboratory or radiology department.

If the ideal unit is regarded in terms of staffing and equipment as being separate from the ITU or medical ward, having its own independent nursing staff and possessing radiological screening facilities as an integral part of its equipment, only 52 of the CCUs analysed fulfil these criteria. If the criteria are extended to include CCUs with screening facilities in a nearby catheterisation suite the number of ideal CCUs rises to 58.

It appears therefore from this data that many CCUs in this country fall far short of the ideal. Approximately one in three hospitals dealing with general medical problems have a separate CCU adequately staffed and equipped but, if strict criteria are applied, only one hospital in five possesses an optimal unit. Unfortunately, there are fewer CCU beds in the United Kingdom than in many other European countries.

The internal design of the unit is frequently dictated by local conditions. Ideally, patients should be for the most part out of sight of each other but within view of the nursing staff. For this reason beds are best arranged around three sides of a central nursing station rather than on opposite sides of the ward. Cubicles are useful and may represent the best form of accommodation. Care

needs to be taken to ensure that the solid lower part of the partition is not so high that it obscures the patients from the nurse. Glass forms the upper major part of the partition and should have appropriate blinds or curtaining. It is important also to ensure that the size of the individual cubicle is large enough to accommodate the numbers of staff and the amount of equipment that may be required during an emergency. It is not essential to have a whole unit arranged in cubicles; there is not infrequently some delay in transferring patients from unit to ward, due to lack of available beds, and the fellowship to be derived from a few open plan beds is often welcomed by patients.[99-101]

In units undertaking pacemaking within the CCU a specific area should be set aside for this purpose. The hospital physics department should be consulted in order to establish the appropriate radiation protection procedure. The need for additional structural changes, such as the lead-lining on doors, varies greatly with the structure of the hospital and siting of the screening room so that no generally applicable advice can be offered.

Indications for Pacemaking. Complete atrioventricular block occurs in approximately six to eight per cent of patients with acute cardiac infarction and is associated with a substantial increase in overall mortality.[102] The prognosis of the individual patient varies according to the site of infarction, for whereas the mortality rate among patients with inferior infarction and complete block is around 20 to 30 per cent this rises to 50 to 75 per cent in the presence of anterior infarction, reflecting the greater degree of myocardial injury that is invariably present.[103-5]

When complete block complicates inferior infarction the escape rhythm has its origin in the proximal part of the bundle of His which often results in a ventricular rate of between 45 to 55 beats per minute which may permit an adequate cardiac output and stable heart rhythm rendering pacing totally unnecessary. The ventricular rate may, however, be slower, or an initially satisfactory rate may slow progressively resulting in the need for pacing. There appears to be little risk of precipitating ventricular fibrillation by the insertion of a pacing electrode in this group of patients and, therefore, many clinicians prefer to insert an electrode at the onset of complete block in cases of inferior infarction, leaving the pacing rate on demand at approximately 60 beats a minute. The actual timing of electrode insertion often depends on the continuous availability of a resident physician skilled in pacing. The Wenckebach phenomenon often precedes the development of complete block in this group but its progression is not inevitable and, since the onset of the escape rhythm is rarely an embarrassment to the heart, there is no need to insert a pacing electrode on the appearance of the Wenckebach pattern alone and/or a prolonged PR interval.

Complete heart block complicating anterior infarction is often sudden in onset and catastrophic in effect. Pacing may correct the slow heart rate but cannot compensate for the massive myocardial injury associated with this condition so that the value of pacing has often been called into question.[106, 107] The prognosis

is, however, so poor that most clinicians accept the hazard of provoking ventricular fibrillation on introduction of a pacing electrode into the ventricle, and also the undoubted increase in myocardial oxygen demand as a result of increasing heart rate.[108] It seems likely that the persistence of hypotension due to bradycardia must result in further myocardial necrosis from under-perfusion of the coronary circulation. Not only is artificial pacing indicated in the presence of complete heart block complicating anterior infarction but it is desirable to anticipate its development in order to permit the prophylactic insertion of a pacing electrode. Mobitz type II block and right bundle branch block, particularly when associated with superior left hemiblock or, less commonly, inferior hemiblock, frequently progress to complete atrioventricular block and constitute an indication for the insertion of a pacing electrode. Although the prognosis of patients with left bundle branch block is poor, death is more often the result of extensive myocardial injury than of complete atrioventricular block and this electrocardiographic pattern is rarely taken as an indication for insertion of a pacing electrode. It also appears to be associated with a high incidence of ventricular fibrillation where this is attempted.[109]

Many patients with established cardiogenic shock develop complete AV block as a terminal rhythm. No benefit can be expected from pacing in this situation.

Equipment

Maximum use should be made of wall-mountings for equipment, piped gases, and suction, to allow plenty of floor space. Both oxygen and suction are essential within the unit and are preferably supplied piped from a central hospital source. Air conditioning is a desirable luxury but few units will be so favourably endowed.

Beds. The design of beds should allow endotracheal intubation and external cardiac massage to be instituted with a minimum of delay. The essential prerequisites are an easily detachable bed head and a rigid surface beneath a 2 or 3 in. polythene foam mattress. Such a mattress allows effective cardiac massage to be undertaken but is reasonably comfortable to lie upon. The ordinary steel framed hospital bed can easily be adapted but purpose-built beds, which allow tilting in addition, are preferable. Ideally, all beds should have a transradiant base to enable insertion of pacing electrodes. This is preferable to transferring patients to a separate screening couch since adjustments of catheter position may be undertaken without the need for moving the patient.

Monitoring Oscilloscopes. The fundamental virtue of a display oscilloscope is that it should provide a clear, interference-free ECG trace on a screen of at least 6 in. in diameter. Commonly available refinements such as ratemeters and warning devices responding to changes in rate beyond pre-set limits are employed in many units but opinions concerning their value vary. In the CCU where patients and oscilloscopes are kept under an appropriate degree of nursing observation there would seem to be little value in the ratemeters, and the frequency of false alarms

generated by the warning devices may be disturbing to the patient. Several monitoring systems offered for CCU use are too complex in design, tending to increase unnecessarily the cost of establishing the unit. There is no evidence that electronic techniques claiming to assess the frequency of ventricular premature beats to predict the onset of serious ventricular arrhythmias are at a level of development that permits of their widespread practical application.

The need for a central multichannel 'slave' oscilloscope varies with the design and size of the unit. In large complex units such oscilloscopes serve a useful function, particularly when the number of nursing staff is reduced during the night or at mealtimes. In the small unit, however, the apparatus is frequently unnecessary for routine medical care, but in all units, particularly those fortunate enough to have some separate office accommodation for medical and nursing personnel, the 'slave' oscilloscope presents a unique opportunity for discussing rhythm and conduction disturbances away from the bedside.

It is of great value for the nurse to make permanent recordings of rhythm disturbances when they occur. A simple direct write-out ECG unit fills the purpose adequately, particularly if used in conjunction with some form of memory record. These recordings are of great value in the teaching of the junior medical staff and nurses. Continuous tape recording is excellent for research but conventional scanning techniques make tracing rhythm disorders extremely time-consuming and unsuitable for routine work.

The exact position of patient electrodes is not of critical importance but there is much to be said for allowing a standard electrode arrangement that is suitable for the detection of conduction abnormalities, both atrioventricular and intraventricular. A lead V_1 position fulfils these criteria quite adequately.

Recently there has been considerable interest shown in the electrical safety of monitoring equipment. This is particularly relevant when the patient has a pacemaking catheter *in situ*. In many new designs of monitoring equipment the patient input is isolated from the amplifier/display circuitry and thereby from true earth connection via the monitoring equipment. Devices are available to measure the size of current likely to be drained from faulty equipment.

Computers in the CCU. Current methods of monitoring in Coronary Care Units are demanding on staff, yet many arrhythmias remain undetected because of the difficulty of observing oscilloscopes at all times. On-line arrhythmia computers have been developed to overcome these problems; whether their expense is justified has yet to be established.

Radiological Equipment. In the large general hospital some screening facilities will be required for the insertion of pacing electrodes. It is frequently impossible to obtain rapid service from the radiology department at sufficiently short notice. Some CCUs will be situated close to a cardiac catheterisation suite which may represent the ideal arrangement but in most instances some form of mobile image intensifier and closed circuit television will be required The importance of adequate radiation protection for staff and patients has already been discussed.

This is usually best undertaken through the hospital physics department or the department of radiology.

Resuscitation Equipment. The unit must be self-contained in terms of basic resuscitative equipment. There must be equipment for defibrillation, intubation and ventilation which is capable of use in any part of the unit. The CCU must also carry a full supply of drugs used in resuscitation. Methods designed to augment the performance of the failing myocardium, such as intra-aortic balloon pumping, require continuing evaluation and research.

Other Equipment. At the head of each bed there should be notice boards to display vital data. Wall-mounted sphygmomanometers should be at such a level as to permit their use at the bedside. The advisability of having equipment that determines blood gases and acid base levels depends greatly upon the availability of pathological services. When such services are provided by the appropriate department they are usually more efficient than attempts by the staff of the CCU to provide its own services. There is no indication for the routine availability of sophisticated pressure manometry for the estimation of intravascular pressures and flows, although occasionally these may be most valuable.

Staffing

The nursing staff should be separate from that employed in the adjoining medical ward or ITU. There is, however, an advantage in nurses having adequate training for both CCU and general ITU work. It is essential for all nurses on the establishment to be qualified, although it is useful experience for the student nurse to work in the unit in order to overcome any fears she may have regarding the apparent scientific sophistication of the work, and to ensure the availability of future staff. It is essential for all nurses in the CCU to be either State Enrolled or State Registered Nurses.

Initial training on a combined ITU/CCU course is valuable but should be supplemented by service in a CCU. This is particularly important in the case of newly opened units.

The number of nurses required to staff a six-bed unit (day and night) is the equivalent of around eight or nine full-time nurses. It is a universal experience that the establishment is rarely filled.

Although it may be ideal, it is rarely possible to ensure that a junior member of the medical staff is resident on the unit throughout the 24 hours. If the nurse is trained to the standard at which she is able to diagnose and treat ventricular fibrillation such an arrangement is really unnecessary.

7. MANAGEMENT AFTER CARDIAC INFARCTION

Follow-up is important to ensure that risk factors are optimally controlled, to detect early any serious complications, and to provide the best medical treatment, and finally, to facilitate return to suitable employment and to assist with any social or domestic problems. The following considerations arise—

Location, Duration and Personnel

Some of the patients will have been treated at home in the whole of the acute phase; others will have spent the acute stage in hospital and have convalesced at home. For the latter, the hospital has a responsibility for follow-up, and for both classes the general practitioner will probably welcome a second opinion on subsequent management. In a great many patients, especially those who have sustained only one attack and been left with little or no disability, the object should be to attain a pattern of life which includes congenial and suitable employment. Patients with severe residual disability will require more regular supervision.

Radiography

If, as is usual, a radiograph of the heart is taken just before discharge from hospital, another, some two to three months later, may be a useful guide as to whether with increased activity the heart is enlarging and in danger of failure. Rarely, ventricular aneurysms may also present or appear to be enlarging at this time.

Electrocardiography

The chief purpose of taking an ECG at a follow-up clinic (apart from assessing the significance of any new attack of pain of which the patient may have complained) is to provide a base line of ECG appearance for comparison with later cardiograms if a new attack of infarction is suspected. Stabilisation may take months.

Control of Risk Factors

Diet, hyperlipidaemia, smoking and hypertension have been considered earlier in this report and will be mentioned again in the report on Primary Prevention. Other aspects are—

(a) Psychological Stress. Apart from its known tendency to promote increased appetite (and, therefore, obesity) in some people, and to make others resort to cigarettes, psychological stress has effects that are definite; their importance in post-infarction care, however, is difficult to assess. It has to be regarded here in two contexts: first in relation to arterial thrombosis and atherogenesis, and secondly in relation to episodes of acute myocardial ischaemia. In both cases the effect is mediated through the autonomic, and especially the sympathetic, nervous system and for this reason the results of long-term post-infarction trials of beta-adrenergic blocking drugs are awaited with particular interest. At least one such study[110] using alprenolol suggests that sudden death may be reduced by this method.

The thesis that chronic psychological stress promotes arterial thrombosis and atheroma is derived in part from the observation that catecholamines lead to mobilisation of fatty acids[111] and that, if these are of the saturated type, clotting of fibrin and aggregation of platelets are accelerated.[112] In due course atheroma is

derived from the resultant arterial thrombosis. On the other hand, it must be recognised that catecholamines also lead to accelerated fibrinolysis.[113, 114] For these reasons it may be that elevation of blood pressure through increased cardiac output and/or peripheral resistance is a more important consequence of long-standing psychological stress and a more important risk factor in leading to further atheroma.

There is, however, ample evidence that acute psychological stress can precipitate attacks of myocardial ischaemia in patients who already have an anatomical basis for it in their coronary arteries, and that such attacks may be accompanied not only by unpleasant anginal pain but also by dangerous and even fatal disturbances of heart rhythm.[115]

It is likely that psychological stress, both acute and chronic, is harmful, and patients should therefore be advised to avoid it as far as possible.

(b) Heart Failure. This should be treated along customary lines, bearing in mind that resistant failure should raise the possibility of a lesion such as a ventricular aneurysm, mitral regurgitation or ventricular septal defect that may require further investigation and surgical treatment.

(c) Alcohol. There is no justification for imposing complete abstinence.

(d) Anticoagulants. For patients of 55 years or over, there is little justification for routine long-term anticoagulant treatment after a cardiac infarction.[116] Whether such treatment, if already given in the acute attack, should be discontinued after the patient leaves hospital, or should be persevered with for three months, is for the individual clinician to decide.

For younger patients, especially males, there is evidence, from the Report of the Working Party on Anticoagulant Therapy in Coronary Thrombosis to the Medical Research Council[117] and other trials, of some value in such treatment being continued for some two to three years, though contrary evidence has been adduced.[118] Such treatment is not without its own hazards. Good co-operation by the patient is in any case most essential.

The value of drugs such as aspirin or dipyridamole, which diminish platelet adhesiveness, or the combination of an oral diguanide with an androgen to stimulate natural fibrinolysis, is unproven.

(e) Anti-arrhythmic drugs. It is suspected that a significant proportion of sudden deaths in the fully convalescent (and, indeed, in the fully recovered) phases of cardiac infarction are due to arrhythmias, whether precipitated by emotion or due to further infarction, and these might be prevented by long-term anti-arrhythmic drugs. Unfortunately, no reliable drug regime yet exists, although early experience with the beta-adrenergic blocking drugs appears hopeful.

(f) Exercise. Regular exercise, in amounts insufficient to cause breathlessness, angina pectoris or marked fatigue, is considered to be beneficial (*see* report on Cardiac Rehabilitation).[54]

(g) Sexual Intercourse. Many patients wish to know whether sexual intercourse is advisable after cardiac infarction. It is often wise to mention this matter

deliberately on interview and most patients should be able to resume a normal sex life. Since angina pectoris may be induced, the use of nitroglycerin and/or a beta-adrenergic blocking drug in prophylaxis should be considered.

(h) Pregnancy and contraception. Pregnancy need not be contra-indicated after a cardiac infarct, provided there are no persisting complications. Some other method of contraception is preferable to the use of the pill.

(i) Driving (*see* page 13)

8. THE SURGICAL MANAGEMENT OF CORONARY HEART DISEASE

Historical Background

Many attempts have been made to treat coronary heart disease surgically, but success has been achieved only in the last decade.[119] The procedures fall into two main groups. First, those designed to improve the blood supply to the myocardium, particularly to relieve severe angina pectoris and to improve the function of the heart muscle, and secondly those to correct underlying lesions that lead to resistant heart failure following cardiac infarction.

Investigation

Before surgery, the anatomy of the coronary arterial tree must be delineated by coronary arteriography and that of the left ventricle by left ventricular angiography. The last will also demonstrate the presence or absence of mitral regurgitation and will show the presence or absence of dyskinetic areas and of ventricular aneurysms. At the time of these studies pressure measurements are made in the great vessels and in the ventricular cavities. During such studies the patient should not be on beta-adrenergic blocking drugs, which may interfere with left ventricular function. Even in severely ill patients such investigations carry a low mortality and morbidity, but they should be undertaken only in centres where the operations are going to be performed and as soon as possible after the investigation, otherwise the situation may have altered in the interval. In a first-class centre the mortality is about 0.2 per cent and the morbidity is correspondingly low.

Surgical Procedures

The most commonly performed is that of venous by-pass in which a peripheral vein is removed from the arm or leg, inverted to avoid obstruction by the venous valves, and inserted into the aorta and to a point distal to the coronary arterial obstruction. An endarterectomy is sometimes necessary at the same time. With increasing frequency, two or three venous by-passes are performed in the same patient. Sometimes, either as an alternative or in addition, the internal mammary

artery is dissected free and inserted into the appropriate coronary artery. At present a coronary arterial by-pass is applied to patients whose response to the medical treatment of angina pectoris has proved unsatisfactory. In the future the indications for the operation may widen. The results of current operations carried out by skilled surgeons for eliminating or relieving angina pectoris are very good. Furthermore, the quality of the patient's life is greatly improved, and many who have been disabled can return to work. The mortality is low in properly selected cases but surgery is both hazardous and ineffective in patients with severe impairment of left ventricular funtion.

The long-term results of this type of surgery for coronary heart disease, both as regards the relief of symptoms and prognosis, remain uncertain and await the results of further observation and research. The place of coronary arterial by-pass grafting in unstable angina pectoris is not yet clearly defined, and is under investigation.

Other forms of surgery are undertaken for the complications of cardiac infarction that result in resistant cardiac failure. The results are good in cases with lesions that are amenable to such treatment. Overall, these patients represent a small percentage of those who have sustained a cardiac infarction. The operations performed are resection of left ventricular aneurysms, closure of acquired ventricular septal defects and replacement of mitral valves that have become regurgitant.

Prognosis

The long-term effect of coronary arterial by-pass operations in favourably affecting the natural history of coronary heart disease remains to be established.

9. THE FUTURE

Members of the Working Party are very aware that the whole field of coronary care is constantly changing; the recommendations made are only guidelines. Widespread advances are expected. Already the possibility of modifying the size of cardiac infarcts by drugs, the use of beta-adrenergic blocking drugs in the long-term prevention of death from heart attacks, and the application of computers in coronary care, all have great promise. There is no room for complacency; many difficulties remain to be solved. Attention is drawn to the need for a more positive and active approach to the problems of sudden unexpected death and death soon after cardiac infarction (p. 25). Mobile coronary care units should be further developed; feasibility of staffing by paramedical personnel should be carefully examined and the wider education of the public in effective resuscitation should be encouraged. Ways of providing skilled help to patients as soon as possible after a cardiac infarction has occurred should be further assessed, and such assessments should include consideration of traffic problems, efficient communications and training of paramedical personnel.

Abbreviated Report

The Working Party considered the whole field of the care of the patient with coronary heart disease. Primary prevention and rehabilitation are the subjects of reports by separate Working Parties.

The following aspects were reviewed—

THE DIAGNOSIS AND MANAGEMENT OF PRESYMPTOMATIC CORONARY HEART DISEASE

Coronary atherosclerosis develops in most of the adult population of Britain and other Western countries. This may never give rise to symptoms, even though it may eventually cause death. In many individuals, however, symptoms do occur, but their significance is not appreciated by the patient or by the doctor.

At present it does not seem practicable or useful to screen large segments of the asymptomatic population for coronary heart disease, and attempts to diagnose coronary heart disease before symptoms develop should be confined to those whose occupations put other individuals at risk and to individuals who are known to be at high risk because of a family history or other factors.

Fitness to Fly and Drive

Air Crew. Heart disease in air crew is a minor but important public hazard. In the decade ending 1972, there were one or two acute coronary episodes during international flying each year. During this period, acute coronary heart disease was considered to have been a possible contributory cause in eight accidents involving large transport aircraft.

There is a consensus that some form of screening for coronary heart disease is justifiable in pilots and air crew. It is generally agreed that an electrocardiogram should be recorded on all pilots for their initial licences and at regular intervals thereafter. The place of exercise tests is still uncertain, but is now under active consideration, and tests may possibly be introduced in the future. While they are undoubtedly of value in revealing unsuspected coronary heart disease, they may be difficult to interpret and there are many false positives and negatives.

There is certainly no case for carrying out coronary arteriography in all air crew because of the risk attached to it and also because there may be false positives and negatives. However, in certain individuals in whom there is doubt about the diagnosis because of equivocal symptoms or electrocardiographic changes, coronary arteriography can be justified.

While there is no convincing evidence that inclusion of lipid analysis would improve safety standards, severe lipid disorders are such important predictors of coronary heart disease that screening at entry is recommended. This would have economic advantages to airlines and would reduce for individuals the social problem of enforced premature retirement.

Drivers of Public Service and Heavy Goods Vehicles. The possible public hazard

from drivers in these categories must receive careful consideration since sudden collapse at the wheel is likely to have more serious consequences than would follow from a similar illness in drivers of private motor cars. Moreover, professional drivers spend a greater part of their lives on the road than private motorists and are therefore more likely to develop their first symptoms in potentially dangerous situations. However, the risk to the public from such accidents is relatively small; for example, approximately one crash resulting from coronary heart disease involved buses of the London Transport Executive for every 782,000,000 miles travelled.

At present, the law requires higher standards of medical fitness in applicants for vocational licences to drive public service vehicles (PSV) and heavy goods vehicles (HGV) than are required for private motorists. A medical report must be submitted with the first application. Medical certificates are also required on the first renewal of a PSV licence after the ages of 50, 56, 59 and 62 and annually from 65; for HGV licences a certificate must accompany every renewal application after the age of 60. Conditions that debar applicants are set out in the main report. They include angina pectoris, a history of cardiac infarction, syncope or arrhythmias, casual blood pressure readings of 200/110 mm Hg or over, electrocardiographic evidence of cardiac ischaemia or radiographic evidence of significant cardiomegaly.

The Working Party felt that certain aspects of the present licensing requirements are unsatisfactory and recommended these proposals for consideration—

1. The examinations are usually conducted by the applicant's own medical practitioner who might be reluctant to take any steps that would threaten the livelihood of his patients. It is suggested that the present statutory examination should not be carried out by the applicant's ordinary medical adviser.
2. Up to the present time there has been no statutory obligation for licence holders to declare any new disability. It is strongly recommended that a medical certificate from the applicant's usual medical practitioner should accompany every application for renewal of an HGV or PSV licence that did not involve a fresh examination. The Certificate should state that no disqualifying illness had occurred since the initial licence had been granted.
3. The questionnaire on the medical certificate for an HGV or PSV licence does not detail those cardiovascular conditions that should debar a driver. It is suggested that such details should form part of the medical certificate which is signed by the medical practitioner either at the time of examination or routine certification of applicants.
4. It is suggested that a medical examination should be mandatory for any HGV or PSV driver who is considered to be at fault in a crash.
5. It is recommended that an appropriate medical certificate for continued fitness be required for any HGV or PSV driver who is absent due to sickness for longer than 21 consecutive days.

Drivers of Motor Cars. The Working Party agreed with the recommendations of the Medical Commission for Accident Prevention in not regarding the diagnosis of coronary heart disease as a bar to driving private vehicles, except within two months of an episode of cardiac infarction and 'when angina pectoris is easily provoked when driving, either by the mechanical act of driving or by the annoyance caused by other drivers, or by everyday city conditions'.

SCREENING FOR PRESYMPTOMATIC DISEASE AND RISK FACTORS IN APPARENTLY NORMAL SUBJECTS

Large-scale screening surveys for coronary heart disease are at present impracticable. It must also be remembered that the detection of serious abnormalities may be upsetting to the individual patient, particularly when no certain methods of treatment are available. However, the recognition and treatment of systemic hypertension, obesity and diabetes mellitus are important and advice on physical exercise and stopping smoking should be given. Lipid analysis should be recommended in younger persons and in those with a family history of coronary heart disease. However, it has not yet been conclusively proved that correction of lipid abnormalities is of value.

THE MANAGEMENT OF THE PATIENT AFTER SYMPTOMS HAVE DEVELOPED

Investigation

Patients with suspected coronary heart disease should have clinical, electrocardiographic, and radiographic examinations. When the diagnosis is in doubt, an exercise electrocardiogram can be of value.

Studies of blood lipids and glucose tolerance tests should be undertaken in the younger patients.

Coronary arteriography is indicated for patients whose angina pectoris has not responded to medical treatment and for whom coronary arterial by-pass grafting is being considered. It is also of considerable diagnostic value in patients with atypical histories or electrocardiographic findings.

Coronary arteriography, which carries a small risk even in skilled hands, should be undertaken only in institutions where the investigation would be performed in more than 100 patients a year and where coronary arterial surgery is readily available.

Treatment

The general management of angina pectoris is important and includes advice with regard to the way of life so that patients will be encouraged to lead as normal a life as possible, although avoiding excessive physical exertion and mental stress. Dietetic measures include the reduction of weight in the obese, and appropriate modifications of the diet for diabetes mellitus and certain hyperlipidaemias.

Cigarette smoking should be discouraged. Hypertension requires treatment. The role of drug therapy in the management of hyperlipidaemia remains to be settled; there is as yet no definite evidence to suggest that the drug treatment of hyperlipidaemia affects prognosis. Nevertheless, it is the unanimous view of the Working Party that hyperlipidaemia should be corrected in individuals under the age of 55.

Symptomatic treatment with nitroglycerine or other vasodilator drugs is accepted practice. Beta-adrenergic blocking drugs are of symptomatic value in most patients and may improve prognosis.

CORONARY CARE OUTSIDE HOSPITAL

It is recognised that there is a place both for hospital and home treatment in the management of cardiac infarction. The members of the Working Party consider that mobile coronary care units (MCCU) can significantly contribute to the saving of lives after heart attacks. There is evidence that they permit a much larger proportion of patients to obtain early treatment, that ventricular fibrillation can be corrected with long-term survival, and that early initiation of intensive care may favourably influence the size of the cardiac infarction, and thus the incidence of shock, of pump failure, and hospital mortality.

It has been suggested that MCCUs might cause anxiety and provoke arrhythmias but the Working Party does not consider there is any evidence to suggest that such a service does any physical or psychological harm; the fact that a high proportion of successful resuscitations by mobile coronary care units have been on patients who sustained an arrest before the ambulance arrived, and that it is rare for a patient to die in a MCCU vehicle, would support these views.

The majority of members of the Working Party believe that patients with a recent cardiac infarction are best treated initially by a mobile coronary care unit with subsequent admission to a hospital coronary care unit. They doubt the value of treatment in general wards after admission, or of the admission of uncomplicated cases to coronary care units if this is late in the course of the illness. They consider there is a case for home treatment when patients are seen in good condition at a relatively late stage after the onset of symptoms. Transport may be hazardous if a mobile coronary care unit is not available and there is probably little to be gained by admitting a patient to hospital where there is no intensive care unit. Other factors that obviously need to be taken into consideration are the age of the patient and the domestic situation. Problems of staffing of mobile coronary care units and of the employment of paramedical personnel need further clarification.

It is recommended that—

1. The Department of Health and Social Security and the Scottish Home and Health Department should actively encourage the development of mobile coronary care; the exact means must depend on local conditions. Doctor-

manned MCCUs should be developed wherever possible. In areas where this is not practicable a service manned by trained ambulancemen or other paramedical personnel should be developed.

2. Advice should be given to the public through the mass media on the importance of calling for medical help quickly when a heart attack is suspected and the methods of obtaining such help.
3. More effort should be expended on instructing the public, particularly in such places as large factories and business organisations, on resuscitation techniques.
4. Patients with angina pectoris or previous cardiac infarction and their relatives should be instructed when and how to call for aid immediately a heart attack is suspected.

THE CORONARY CARE UNIT

It is the unanimous opinion of the members of the Working Party that some form of specialised accommodation for the care of patients after cardiac infarction is essential. The area must provide a calm and quiet environment such as seldom exists in the general purpose intensive therapy unit, or in a general medical ward, while at the same time permitting constant observation and facilities for immediate resuscitation. For information concerning the siting, size and design of the unit, its equipment, and staffing, the reader is referred to details in the full report. However, the Working Party has deliberately omitted details of therapy, as this field is frequently reviewed in medical journals.

MANAGEMENT AFTER CARDIAC INFARCTION

The skilled medical follow-up of patients is important after cardiac infarction to ensure that risk factors are optimally controlled, to detect and treat early any serious complications, to facilitate the return to suitable employment, and to help with any social or domestic problems. The role of further investigation and general management is discussed in the full report.

THE SURGICAL MANAGEMENT OF CORONARY HEART DISEASE

The operation of coronary arterial by-pass grafting is now well established in the management of angina pectoris. There is no doubt of the effectiveness of this operation in the relief of angina pectoris: it is considered to be indicated whenever angina pectoris has not responded adequately to medical therapy and provided that coronary arteriography has shown a lesion or lesions in the coronary arteries that are amenable to by-pass grafting. Surgery is unlikely ultimately to be successful in patients who have severe impairment of left ventricular function. The long-term effects of coronary arterial by-pass surgery on the morbidity and mortality from the coronary heart disease remain unknown.

Cardiac surgery is also helpful in some patients who, following cardiac infarction have resistant cardiac failure. The operations undertaken include resection of

ventricular aneurysms, closure of acquired ventricular septal defects, and the replacement of mitral valves that permit regurgitation.

It is clear that surgery already has an established place in the management of coronary heart disease and that an increase in the number of cases being submitted to surgery for this reason must be expected over the next few years. Together with this, a substantial increase in the number of coronary arteriograms required is also to be expected.

THE FUTURE

The Working Party recognises that the control of coronary heart disease must ultimately depend on its prevention. There is as yet, however, little progress in this field and it can be assumed that coronary heart disease will continue to be the major cause of death in the U.K. In the opinion of the Working Party, a more positive approach to the problems of sudden unexpected death, and to the high mortality in the first hours after a heart attack, is necessary. More attention must be paid to the organisation of emergency medical services, including the provision of immediate coronary care, and to the education of the medical profession, paramedical personnel, and the public. Passive acceptance of the high early mortality after cardiac infarction can no longer be justified, and research projects to examine these problems further are of the greatest importance.

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