REHABILITATION OF CASES OF ISCHAEMIC HEART DISEASE IN ARMED FORCES

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Ninety four unselected survivors from isceamic heart disease, all male service personnel, were treated within 1 to 6 months of recovery from the acute episode, by promotion of physical activity, correction of coronary risk factors and routine use of nicoumalone and prenylamine lactate. The results showed that this approach was conducive to more rewarding rehabilitation than was obtained in 89 patients who, in the past, were on conventional treatment based on advice regarding weight, diet, physical and mental activity. Thus out of 94 cases treated between February 1968 to October 1971, 28 (30 per cent) were fit in medical category A active service duties in operational areas in any part of the world in any terrain, including altitudes between 10,000 and 18,000 feet, 39 (42 per cent) were fit in medical category B service duties in non-operational communication zones in any part of the world including altitudes below 10 000 ft. and 26 (28 per cent) were fit for medical category C sedentary duties in non-operational areas in India only. One patient, who initially recoverd from congestive heart failure, died while in a state of temporary unfitness for service. No patient was released from service on account of ischaemic heart disease. Against this, by the conventional approach, out of 89 patients, 81 (91 per cent) were fit in medical category C sedentary duties in non-operational areas in India only 4 (4 5 per cent) were released from service, and 4 (4.5 per cent) died.

Introduction

The standards of physical fitness required for service in the Armed Forces are tough and exacting. However, to accommodate personnel who are disabled by illness, the standards of physical fitness in the Armed Forces in India, were defined till recently mainly in three categories- A, B and C. As these categories are fresh in our mind we may leave them as such for the purpose of this paper. Personnel in category A are fit for active service duties in operational areas in any part of the world and in any terrain inculding high altitudes between 10,000 and 18,000 feet. Personnel in category B are fit for all service duties in non-operational communication zones in any part of the world including altitudes below 10,000 feet. Personnel in category C are fit for sedentary service duties in non-operational areas in India only. Those personnel who are temporarily disabled by illnesss and require sick 'eave are placed in category D. And those personnel who are not likely to recover sufficiently enough to return to service duties even in category C are placed in category E and are released as unfit for further service, although most of them are still fit for sedentary civilian duties.

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To what extent can we rehabilitate survivors from an acute episode of ischaemic heart disease in the above categories?

It will be of interest to know that within about 1–30 months of treatment, 30% return to duties in category A, 42% in duties in category B, and most of the remaining 28% return to duties in category C. The numbers who are released from service as unfit fo druties even in category C, or who die are either nil or negligible.

How do we assess the Rehabilitation Category?

The assessment is made on the basis of an estimate of the effort tolerance, electrocardiographic and biochemical states of each patient. This is done initially and subsequently once a month. The test assessing the effort tolerance and the associated electrocardiographic changes are of a progressive series. The extent to which they can be undertaken depends entirely on the actual performance of patients initially and subsequently during treatment. An existing electrocardiographic abnormality needs some care but is not considered a bar to initiate the effort tolerance test.

Effort Tolerance

The effort tolerance is based on

1) the functional capacity of the patient in terms of classes I, II, III, and IV as defined by the New York Heart Association,

2) the capacity of the patient to undertake a three-and-half mile walk in one hour,

3) the capacity of the patient to undertake double Master's two step exercise test,

4) the capacity of the patient to undertake a Hill Climbing Test involving a climb of 1000 feet over a gradient of 1 in 2 within a specific time at an altitude of 15,000 feet. The performance is graded as excellent, good, satisfactory, poor, and unsatisfactory. Only excellent, good and satisfactory grades are acceptable. The equivalent indoor test is a patient's capacity to climb up and down, 1000 feet each way, a flight of 40 steps, each 8 inches high and 12 inches wide (gradient 1 in 1.5) within a specific time at sea level,

5) the capacity of the patient to withstand 45 minutes exposure and then undertake a double Master's two-step exercise test in a decompression chamber at (i) 15,000 feet, (ii) –10°C. and (iii) 15,000 feet plus –10°C.

Electrocardiograms

Electrocardiograms are taken at rest, and immediately 5, 10, and 15 minutes after three-and-half mile walk in one hour; after double Master's two-step exercise test; after Hill Climbing Test; and after exposure and double Master's two-step exercise test in the decompression chamber. The initial electrocardiographic changes at rest are graded as those of (1) myocardial infarction with significant Q pattern and S-T and T changes, (2) myocardial injury with S-T and T changes, and (3) myocardial ischaemic with T, T and S-T changes at rest or following double Master's two-step

exercise test. Electrocardiographic recovery is assessed on the basis of criteria as defined under the heading Rehabilitation Categories.

Biochemical Parameters

The Biochemical parameters include tests for impaired carbohydrate tolerance, and estimation of blood cholesterol and blood uric acid levels. The serial tests for impaired carbohydrate tolerance are the preprandial and the postprandial blood sugar estimations, 100 g. glucose tolerance test and if the results of preprandial and postprandial blood sugar level estimations and the 100 g. glucose tolerance test are negative, the prednisolone - glucose tolerance test. The norms for these parameters are selected on the basis of those levels at or below which we encounter the lowest incidence of the disease and are as follows :

Preprandial blood sugar less then 100mg. and postprandial blood sugar less than 140 mg. per cent ;

Glucose tolerance test with fasting blood sugar less than 100 mg., peak less than 160 mg., and 120 minutes less than 120 mg., per cent;

Prednisolone-glucose test (with prednisolone 10 mg. given 8 hours and 2 hours before the glucose tolerance test) with fasting blood sugar less than 140 mg. peak lese than 200 mg. and 120 minutes less than 140 mg. per cent.

Blood cholesterol less than 180 mg. per cent.

Blood uric acid less than 2.5 mg. per cent.

Rehabilitation Categories

The results of efforts tolerance, electrocardiographic recovery and the corrected metabolic abnormalities are computed as follows for defining a particular rehabilitation category :

Category C

Asymptomatic during physical activity required of him in this category as defined above,

Electrocardiogram at rest normalised or stabilised. No deterioration after three-and-half mile walk in one hour, Weight and metabolic abnormalities normalised.

Category B

Asymptomatic during physical activity required of him in this category,

Electrocardiogram at rest normalised or stablised. No deterioration after three-and-half mile walk in one hour, and after double Master's two-step Exercise test,

Weight and metabolic parameters normalised.

Category A

Asymptomatic during physical activity required of him in this category,

Electrocardiogram at rest normalised or stabilised. No deterioration after three-and-half mile walk in one hour, after double Master's two-step exercise test, after Hill Climbing Test, and after exposure and exercise tests in the decompression chamber at 15,000 feet: at -10°C, and at 15,000 feet plus-10°C.

Weight and metabolic parameters normalised.

By what treatment are these Rehabilitation Categories achieved ?

The essentials of treatment are to

1. correct obesity,
2. normalise blood pressure, carbohydrate tolerance, blood uric acid, and
3. promote physical activity and achieve maximum physical efficiency.

Weight - The norms for weight are —2 to —5 Kg. of the minimum as defined in the data for ideal weights for men and women, aged 25 and over, by the Metropolitan Life Insurance Company, Statistical Bureau[2]. Weight is reduced as far as possible with diets consisting mainly of milk or animal proteins 100 - 125 g., boiled vegetables, salads, and fruits with or without a small helping of carbohydrates. After weight is normalised, the individual caloric needs are met with a diet containing approximately protein 100 - 125 g., fat 50 - 75 g., and carbohydrates to make the rest. Fat is mostly provided as safflower oil or, when patients don't like this, by a 50 - 50 mixture of groundnut and safflower oils. Simple sugars are restricted. Whisky and gin are allowed in moderation but beers and sweet wines, on account of their adverse effects on blood coagulation are not advised.

Blood Pressure

The norm for diastolic blood pressure is 90 mm. Hg. or less. If raised diastolic blood pressure persists after weight reduction, judicious use of diuretics, diuretics plus guanethidine or diuretics plus methl - dopa is made to normalise it.

Carbohydrate tolerance

Abnormalities in carbohydrate tolerance still persisting after weight reduction are corrected to as near normal as possible with time-disintegration phenformin (DBI-TD) 50-150 mg. daily and, if this is not adequate with DBI-TD 50-150 mg. plus tolbutamide 0.5 to 1.5 g. daily. The purpose is to achieve under treatment a normal prednisolone glutose tolerance test, or as the next best minimum normal preprandial and postprandial blood sugar levels.

Blood Cholesterol

Raised blood cholesterol persisting after weight reduction and the prescribed diet is normalised with nicotinic acid 1500-3000 mg. daily and, if this is not adequate, with nicotinic acid 1500-3000 mg. plus clofibrate 750-1500 mg. daily.

Blood uric acid

Raised blood uric acid is normalised with probenecid 0.5 or less to 1.5 g. dalily.

Physical activity

No patient is required to be sedentary. Under anti-anginal cover with prenylamine lactate (Segontin) 180 mg. daily, and if this is not fast or adequate enough, with a combination of prenylamine lactate 180 mg. and propranolol 30-120 mg. daily, all patients are encouraged initially to take to increasing distances of walking, then taking part in recreational games and hobbies involving physical activity, and finally more strenuous activities to enable them to achieve ultimately the standard of physical fitness required for returning them to service duties in the rehabilitation categories as defined above.

Anti-coagulants

Nicoumalone 1-4 mg. is used routinely as an anti-coagulant on an indefinite long-term basis to keep the prothrombin-time and control-time ratio between 1.6:1 and 2:1 and the Lee-white coagulation time with in 30-30 minutes.

Smoking

Patients are advised to give up smoking.

What is the rationale of our treatement ?

Evidence has already accumulated and is being continuously substantiated by various workers on the role of smoking, physical inactivity, excessive calorie intake, obesity, hypertension, impaired carbohydrate tolerance, hyperlipidaemia and hyperuricaemia as coronary risk factors. Although the coronary risk factors are apparently a diverse group, they seem to lead to a common pathway involving blood lipids and blood coagulation. Thus smoking increases platelet adhesiveness, shortens plalelet survival, and antagonises both the lipolytic and anticoagulant properties of heparin[3]. Catecholamines which are released during smoking mobilise free fatty acids from the adipose tissues and help to raise serum cholesterol[4]. Physical inactivity, especially on cholesterogenic diets tends to be associated with raised serum cholesterol, phosholipids, triglycerides and free fatty acids levels[5, 6]. It also robs the individual of its beneficial effects on blood fibrinolytic activity which in fact may even return to below normal if exercise is undertaken only occasionally. In obesity there is an inherent tendency towards a high insulin response after oral glucose and lipoprotein and cholesterol blood levels are raised. Both clinical and experimental hypertension promote increase of serum beta-lipoprotein levels. Impaired carbohydrate tolerance associated with raised plasma insulin level or increased insulin resistance predisposes to an increased fatty acid response to glucose load[8]. In diabetics there is a greater incidence of low fibrinolytic activity than in controls, with increased platelet stickiness[9, 10] and incueased viscosity of the blood[11]. Ingestion of fats inhibits fibrinolytic activity in atherosclerotic subjects[12] and enhances platelet stickiness. Blood platelet counts correlate with blood cholesterol levels[13]. Long chain fatty acids from C10 onwards accelerate thrombus formation time[14]. Therefore rapid lipid mobilisation can result in thrombosis[15]. Blood uric acid probably acts as an intimal conditioning agent and thus furthers cholesterol deposition especially when the serum lipids are unstable. It may also impair glucose tolerance. While proof of efficacy of modification of these factors in the treatment of the disease is lacking, modifications seem reasonable and desirable.

The largest single factor which makes the maximum contribution to the disease in our patients seems to be a combination of hypercholesterolaemia plus hyperglycaemia plus hyperuricaemia which is present in about 80 per cent. Normalisation of these metabolic factors is therefore, one of the essentials of our treatment. Unfortunately what constitutes the dividing line between the normal and the abnormal is only arbitrary and constitutes a hurdle in evolving a consensus on the extent to which these metebolic factors should be tackled for the purpose of therapy. We have selected the norms as those levels at or below which we encounter the lowest incidence of the disease. For our patients, by virtue of their occupation, the caloric and protein intake have

to be high to be adequate enough for the requirements of energy and maintenance of normal weights. To make the diet anti-cholesterogenic we depend on a moderate fat content of 50–75 g. provided mostly as safflower oil in which the polyunsaturated fatty acids and the saturated fatty acids ratio is 10 : 1. When reduction of blood cholesterol level is not achieved with this diet recourse is made to nicotinic acid and in addition, if necessary to clofibrate. Nicotinic acid has the advantage of being cheap but is not complete in itself. It inhibits the mobilisation of free fatty acids[16] and lowers both free and ester cholesterol but does not affect the beta-lipoprotein cholesterol. In contrast, clofibrate reduces platelet stickiness, serum cholesterol, low density lipoprotein and SF fractions 0–12 and 12–400[17]. Phenformin is preferred for normalising impaired carbohydrate metabolism. In coronary heart disease phenformin reduces the insulin output, decreases serum cholesterol, serum triglycerides and serum phospholipids while free fatty acids vary widely and glucose tolerance remains unchanged[18].

Autopsy studies of patients of ischaemic heart disease brought in dead or who died within 5 hours of an acute attack have shown that the block in the coronary arteries is a recent thrombus with varying degrees, extent and site of atherosclerosis in about 85% of the patients and atherosclerosis alone in the remaining 15 percent. As intravascular thrombosis accounts for 85% of the deaths we use nicoumalone as an anticoagulant arbitrarily fully realising that it has no effect on factor VIII or on the anti Willibrand factor which is related to platelet stickiness. However, the justification for use of nicoumalone lies in the fact that from the initial infarct and in coronary disease manifested by angina the survival rate can be increased with the use of anticoagulants[19]. Our results suggest that the therapeutic measures which involve reduction of platelet stickiness, increased fibrinolysis, and reduced coagulation have a better effect then anticoagulants alone on not only survival but on recovery as well.

For the control of metabolic abnormalities and the use of anticoagulants cooperation of the patients is essential. The initial pace for this is set by promotion of physical activity under anti-anginal cover with prenylamine lactate. The more successful this is the better is the cooperation. In a few patients in whom the action of prenylamine lactate is not fast or adequate enough its sympathetic beta-receptor blocking properties can be augmented with propranolol. Prenylamine lactate is probably helpful in other ways. Though prenylamine caused only a short-lived increase in coronary flow at rest, [20] it seems probable that the coronary flow is more sustained during exercise especially in healthy collaterals. Although we have still to prove it, if so, the effect of physical activity in the development of collateral coronary circulation [21, 22] and the consequent improvement in myocardial function and reduction in mortality rate [23] would be augmented under cover with prenylamine lactate.

Are our patients in any way different from those which have been reported by workers studying coronary risk factors in other countries ?

Blood pressure and serum lipid level have been considered to together constitute the key factors in assessing the

magnitude of the risk of developing ischaemic heart disease. At any level of either factor the risk is greater with the increasing level of the other. [24] However, in one of our series of 94 patients diastolic hypertention did not occupy a significant place as a predisposing factor of the disease. Thus out of 94 patients only 13 had diastolic blood pressure between 91 and 115mm. of Hg., 30 had between 81 and 90 mm of Hg., and the rest had between 70 and 80 mm. of Hg. Moreover, 48 out of these 94 patients had not only hypercholesterolaemia but also associated hyperglycaemia and hyperuricaemia. Moderate smoking, if it at all affected the disease, was a factor in 37 out of 94 patients. Forty three out of 94 patients were 3-10 Kg. overweight. Before the onset of the disease the subject were fighting-fit soldiers. Therefore, physical inactivity as a predisposing cause was out of picture However, in 17 out of 94 patients the acute episode had occurred during the period of rest following severe physical stress.

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