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CASE REPORT

Fitness for Work among Firefighter with Myocardial Infarction: A Case Report

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ABSTRACT
A 38-year-old man who has been working as a firefighter was examined for his ability to work after a myocardial infarction. He is an active smoker for the past 20 years. The ejection fraction was more than 55% with no regional wall movement. The COROS showed that the left main trunk was normal, the left anterior descending artery was 50-60% stenosed in the proximal segment and 90% stenosed in the middle segment. Irregularities noted in the left circumflex artery and the right coronary artery showed 50% stenosis in the proximal segment. He was not able to complete Stage 3 Bruce protocol as he complained of shortness of breath and lethargy on stress test. The patient is temporarily unsuitable for his current position at work as the firefighters need to perform work intensities greater than 5 metabolic equivalents for continued period of time and a maximum capacity of 12 metabolic equivalents.
Keywords: Echocardiography, Exercise stress test, Firefighter, Fitness for work

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INTRODUCTION

The assessment of fitness for work among firefighters includes Exercise Stress Test and Echocardiography. The absolute contraindications of Exercise Stress Test are acute myocardial infarction within two days, high-risk unstable angina, uncontrolled cardiac arrhythmias, active endocarditis, severe aortic stenosis, decompensated symptomatic heart failure, acute myocarditis, acute pericarditis, acute aortic dissection, acute pulmonary embolus and acute non-cardiac disorder aggravated by exercise such as renal failure and thyrotoxicosis [1]. The absolute contraindications to dismiss the test are presence of ST-segment elevation (>1.0 mm) in leads without Q waves (other than V1 or aVR), drop in systolic blood pressure >10 mmHg (persistently below baseline)despite an increase in workload when accompanied by any other evidence of ischemia, moderate-to-severe angina (grade 3 to 4), symptoms of central nervous system such as ataxia, dizziness, or near syncope, signs of poor perfusion, sustained ventricular tachycardia, technical difficulties in monitoring the ECG or systolic blood pressure and when patient requests to stop. The Bruce Protocol has seven stages with 2.7, 4.0, 5.4, 6.7, 8.0, 8.8, 9.6 km/hour and gradient of 10, 12, 14, 16, 18, 20 and 22% respectively. The Modified Bruce Protocol has nine stages with 2.7, 2.7, 2.7, 4.0, 5.4, 6.7, 8.0, 8.8, 9.6 km/hour and gradient of 0, 5, 10, 12, 14, 16, 18, 20 and 22% respectively.

CASE REPORT

A 38 years old gentleman was referred to assess fitness for work following myocardial infarction. The patient complained of sudden chest pain which was crushing in nature and not associated with shortness of breath during the attack. He had no known previous illness and his parents had no medical illness. He is still an active smoker and has been smoking for past 20 years, 10 sticks per day (0.5 pack-year). He denies consuming alcohol.

He has been working as a firefighter since 2008. His training includes wearing Personal Protective Equipment and carrying hose which weighs around 30 kg. He needs to climb at least two flight of stairs with the load. In the afternoon, he needs to carry out sporting activities such as futsal for an hour.

Echocardiography showed Ejection Fraction was more than 55% with no Regional Wall Motion Abnormality. The Left Ventricular thickness and size were normal, and no significant structural and valve abnormalities. The COROS showed Left Main Stem was normal, Left Anterior Descending Artery displayed 50-60% stenosed at proximal segment and 90% stenosed at midsegment.The Left Circumflex Artery showed minor irregularities and the Right Coronary Artery showed 50% stenosed at proximal segment. The Exercise Stress Test as shown in Figure 1 was conducted after 6 weeks of the intervention and he was not able to complete Stage 3 Bruce protocol as he complained of shortness of breath and lethargy.

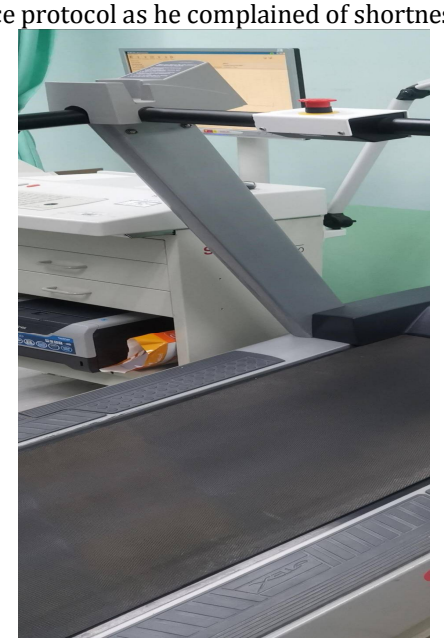

Figure 1: Exercise Stress Test

The diagnosis for this patient is Myocardial Infarction with Inferior STEMI possibly due to chronic smoking and dyslipidemia, aggravated due to strenuous work at workplace. Percutaneous Coronary Intervention was then performed. The patient is on Aspirin 75mg OD, Clopidogrel 75mg OD, Pantoprazole 40 mg OD, Atorvastatin 40mg ON, Perindopril 2mg OD, SL GTN 1/1 prn and Bisoprolol 2.5mg OD.

The patient is found to be temporary unfit for his current position in his job as he has been having shortness of breath upon conducting training. He needs to go through cardiac rehabilitation for four weeks. Two sessions are conducted in each week. The sessions include endurance (aerobic, cycling, moving the basketball by bouncing up and down on the floor), strengthening (lifting dumbbell, lifting sandbag at the ankle and mobility (using stepper and treadmill). He is considered at low risk as there's no significant left ventricular dysfunction and no exercise induced myocardial infarction and arrhythmias. Moreover, his functional capacity is more than 5 metabolic equivalents (MET).

DISCUSSION

Firefighting is a hazardous occupation; characterized by flames, smoke, high temperature, loud noise with gaseous and particulate toxicants. They are at risk of injuries such as burns, trauma and smoke inhalation. Firefighting increases the risk of cardiovascular diseases among firefighters by 10 to more than 100-fold compared to nonemergency fire department staffs [2]. The firefighters are enormously physical demanding task and are needed to be physically fit. The cardiovascular deaths amongst firefighters' accounts for 45% of all firefighter deaths which is mainly due to heat stress. The firefighter needs to wear vest and carry equipment around 30 kg during stair climb training sessions. The cardiometabolic demands are increased due to use of this personal protective equipment, exposure to heat, stair and ladder climbing, search and rescue operations and also heavy material handlings. These factors increase heart rate and blood pressure and thus variation in blood flow, decrease plasma volume and increase blood viscosity ensues resulting in myocardial injury and ischemia. In fire simulation training, there are more thrombus formation, with increased platelet activation and diminishing of vasodilator endothelial function resulting in myocardial infarction in ex vivo[3].The amount of oxygen consumed by the body is directly proportionate to energy required of the activity, termed as metabolic equivalents. The firefighters require at least a VO_2 max (maximum oxygen consumed per minute) of 42 ml O_2 /kg/min for fire suppression activities, which is equivalent of 12 METS [4]. The firefighters need to perform work of intensities greater than 5 METS for continued period of time and a maximum capacity of 12 METS. This

level takes into account of heat stress, psychological stress and upper body activities. The firefighters with cardiovascular disease may no longer be able to perform strenuous activities (fitness for work or return to work) except if he complies with National Fire Protection Association (NFPA) guidelines [5].This guidelines states that the firefighter is fit to return to work if he has no angina, no stenosis of more than 70% of lumen, normal left ventricular ejection fraction (LVEF), exercise tolerance of more than 12 METS during exercise stress test, no exercise induced angina, no ischemia or arrhythmia during exercise stress test and no presence of modifiable risk factor for plaque rupture {tobacco use, high blood pressure, total cholesterol of more than 180 mg/dL, low density lipoprotein (LDL) of more than 100 mg/dL, glycated hemoglobin (HbA1c) of more than 7}. The patient is not fit yet to return to normal activities based on the guideline as he was not able to complete Stage 3 Bruce protocol, exercise induced breathlessness and he is still actively smoking.

There are around 50% death mainly due to sudden cardiac death during firefighting activities. The main cause is due to coronary heart disease[6],other than obesity and Left Ventricular Hypertrophy. There wasalmost double the risk of sudden cardiac death among obese, where a third were either in class II or III obesity. Around 70% of them had Left Ventricular Hypertrophy[7].

One of the independent risk factors is for coronary heart disease and acute myocardial infarction is cigarette smoking. The odds ratio of smokers to non-smokers causing myocardial infarction is 3.71 [8]. Almost half of them had myocardial infarction with history of smoking for at least 10 years compared to only 7% among controls. Smoking raises Triglycerides and LDL-cholesterol, while reducing HDL-cholesterol. Cigarette smoking also increases vascular inflammation resulting in atherosclerosis. The coronary artery lumen is reduced and thereby reducing the blood flow. The oxygen demand is increased due to upsurge in heart rate and blood pressure. Cigarette smoking reduces tissue plasminogen activator, prostacyclin, and increases tissue factor, factor VII, fibrinogen and platelet activity resulting in hypercoagulability. The coronary flow is reduced due to reduce release in nitric oxide. Inferior wall infarct is due to disease of right coronary artery, while anterior wall is due to left coronary artery. There were 8% higher incidence of inferior myocardial infarction compared to anterior[9].Smoking affects right coronary artery more compared to left. The patient was advised to quit smoking and follow-up in quit smoking clinic.

The commonest aim for echocardiography is to assess left ventricular function. The assessment is made if there is suggestion of heart failure where severity and cause is identified. The ejection fraction is measured, which is the ratio between stroke volume and end-diastolic volume. The normal range is between 50% and 70%. The contraction of myocardium may be diminished (hypokinesia) or absent (akinesia) in ischemia or infarction respectively. The overall left ventricular systolic function can be assessed by calculating regional wall motion score index. The underlying causes may be coronary heart disease, dilated cardiomyopathy or valvular dysfunction. The cause and severity of murmur can be assessed by echocardiography. The valvular diseases can be assessed such as aortic valve and mitral valve disease. The echocardiography can be used to identify cause of atrial fibrillation such as valvular heart disease, coronary heart disease, cardiomyopathy or diastolic dysfunction where treatment can be guided. The echocardiography is warranted especially for those less than 45 years old with stroke to ascertain cardioembolic etiology [10]. The echocardiography conducted on the patient showed Ejection Fraction was more than 55% with no Regional Wall Motion Abnormality, normal Left Ventricular thickness, normal size and no significant structural and valve abnormalities.

CONCLUSION

The diagnosis for this patient is Myocardial Infarction with Inferior STEMI possibly due to chronic smoking and dyslipidemia, intensified due to strenuous work at workplace. The patient was found to be unfit for his current job since he needs to perform work intensities of 12 metabolic equivalents.

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