

Dukes treadmill score and myocardial perfusion scintigraphy - A comparative study in patients

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Abstract

Radionuclide myocardial perfusion imaging (MPI) can be used to demonstrate the presence of coronary heart disease and to risk stratify and guide management of patients with known disease. Treadmill test which is commonly used as screening test for CAD, and with help of DTS can to some extent accurately risk stratify the patients as well. Aim of the study was to compare Duke treadmill score and MPI in risk stratifying the patient with CAD. 130 patients were considered in the study. Most of the patients fell in moderate Dukes score (78 patients, 60%). MPI could further stratify those patients into high (28 patients, 36%) and low risk (50 patients, 64%) groups. Low and high Dukes scores correlated well with normal and severe defects in MPI respectively. Hence it is advisable to perform MPI in moderate Dukes Score patients for further risk stratification.

Key Word: Dukes treadmill score, myocardial perfusion scintigraphy.

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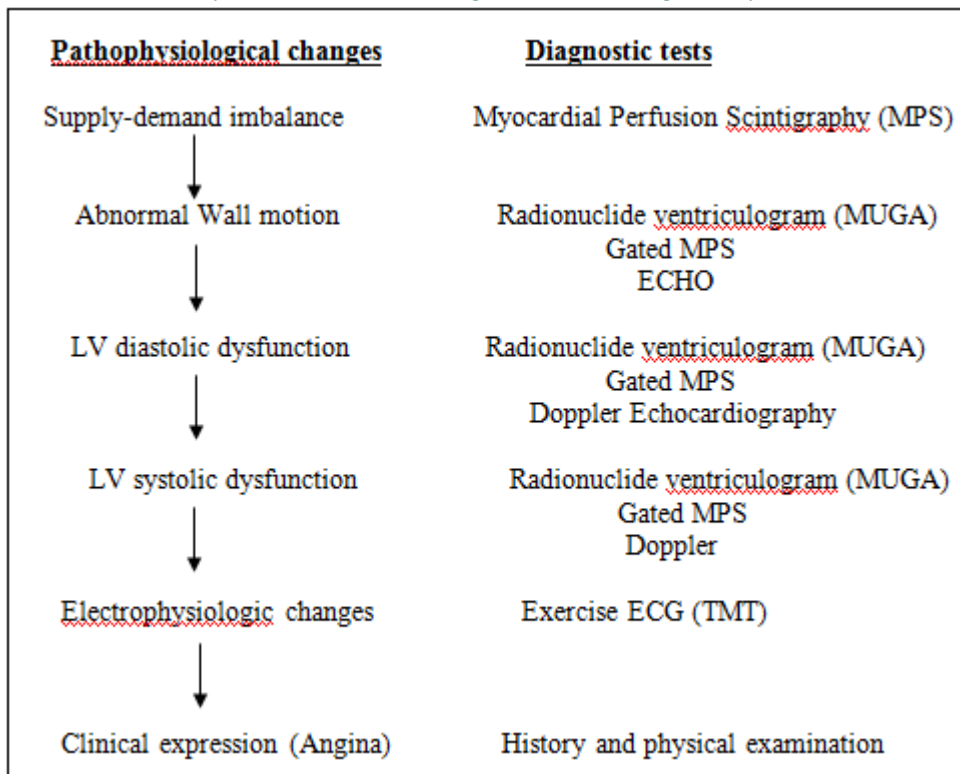
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INTRODUCTION

Coronary Artery Disease (CAD) is the leading cause of death and disability in both developed and developing countries. Proper risk stratification is critical for the management of the patient with known or suspected CAD. Decisions regarding revascularization procedure or medical therapy can only be made after accurately identifying the patients who may benefit with the given treatment strategy. The fact that most human die of Ischemic Heart Disease (IHD) than any other disease demands that better methods be developed to diagnose IHD and to determine response to therapy.¹ World Health task force on Nomenclature defines Myocardial Ischemia as “Diminished supply of blood in respect to cellular demands caused by coronary perfusion

changes”.² This definition is used to describe any patient with IHD caused by CAD, with all other possible causes of ischemia placed in other category. Most of the myocardial cell’s energy utilization goes to maintain the contractile state. If energy is not constantly replenished by oxidative metabolism, energy stores fall, metabolic byproducts accumulate and contractile activity declines.³ Therefore, direct serial tissue measurements of myocardial energy stores (creatine phosphate and adenosine triphosphate) can provide a sensitive guide to the presence of absence or ischemia⁴, although technically this is extremely difficult. Other less direct metabolic measurements of ischemia include local Pco₂, Lactate production, lactate pyruvate ratio, potassium or phosphate release. However, all these measurements require myocardial sampling and can be used only in experimental animals. Measurements of Coronary sinus blood require cardiac catheterization, and these measurements can be altered by conditions other than IHD. The objective demonstration of ischemia by Echocardiogram (ECG) or Myocardial Perfusion Scintigraphy (MPS) in patients with CAD^{5,6} is associated with a significantly higher morbidity and mortality. The cellular basis of ischemia is represented in Table I. Invasive and non-invasive techniques currently available for evaluating patients with CAD is outlined.

Table 1: Currently available noninvasive diagnostic tests for diagnosis myocardial ischemia



Exercise treadmill testing remains the cornerstone and acts as gatekeeper and decide further management. The pioneering work started by Master (7) has led to an established role for the ECG- monitored exercise- stress test in the evaluation of IHD. Few reports questioned the usefulness of exercised ECG especially in the populations where IHD would be expected to have a low prevalence. Nevertheless, ambulatory exercise ECG testing supplies information useful for evaluating predisposition to ischemia during daily activity. The test is considered as positive when there is typical angina and > 1mm reversible ST depression during a stress test.

To overcome above drawbacks many stress scores were derived. However most of them required calculator and computer for calculation of scores, hence were not applicable for routine practice. However Duke treadmill score is a simple and composite measure of functional capacity (Duration of exercise) and stress induced ischemia (ST-T changes in ECG due to inadequate blood supply). Duke’s score in addition is able to risk stratify patients into low, intermediate and high risk group. Performing a simple treadmill test and deriving the Duke’s Score classified most of the suspected patients of CAD in the intermediate group. Hence a better diagnostic test was sought for, which had better sensitivity and specificity.

MATERIALS AND METHODS

Inclusion Criteria: All the patients with known and suspected CAD who underwent MPS and who were able to undergo Bruce Treadmill Test during the period between Jan 2007 to Aug 2007.

Exclusion Criteria: Patients with known history of Myocardial infarction and patients with abnormal baseline ECG (RBBB, Conduction block).

Dukes Score: Dukes Treadmill Score was derived using three parameters

Exercise time: 5 (ST shift)- 4 (angina severity)

- a) Duration of exercise (in minutes)
- b) ST shift in ECG (in mm)
- c) Angina severity (0 denotes no angina; 1 mild angina; and 2 limiting angina)

Based on the DTS the risk was stratified into three groups (table 2):

| | Risk group | DTS |
|----|-------------------|------------|
| 1. | Low | >4 |
| 2. | Moderate | -10 to +4 |
| 3. | High | <-10 |

99mTc-MIBI-STRESS-REST MYOCARDIAL PERFUSION SPECT SCINTIGRAPHY

Myocardial SPECT Scintigraphy was performed with 99m-Tc sestamibi using of a single day “ stress- rest “ protocol according to ASNC guidelines. Interpretation of the scan was done semi quantitatively by visual

analysis assisted by circumferential profiles analysis using entegra software. Both exercise and resting tomographic views were reviewed side by side by experienced nuclear medicine physician. 17-segment model was used for reporting. An abnormal study was considered where there were reversible perfusion defects. A reversible perfusion defect was defined as perfusion defects on the exercise images that partially or completely resolved at rest in ≥ 2 contiguous segments in 17 segment

model. Based on the degree of intensity and Summed Stress Score (SSS) reversible perfusion defects were divided into following (table 3)

| | SSS | Pattern/degree of uptake |
|---|-----|---------------------------|
| 1 | 0 | Normal |
| 2 | 1 | Mildly reduced |
| 3 | 2 | Moderate-severely reduced |

RESULTS

Table 4: Duke's score

| Duke's score | Grade | Number (n=130) | % |
|--------------|----------|----------------|------|
| >4 | Low | 42 | 32.3 |
| -10 to 4 | Moderate | 78 | 60.0 |
| <-10 | High | 10 | 7.7 |

Table 5: MPS

| MPS | Number (n=130) | % |
|------------|----------------|------|
| Normal | 88 | 67.7 |
| Mild | 27 | 20.8 |
| Mod-Severe | 15 | 11.5 |

Table 6: Association of Duke's score with the MPS score

| Duke's score | Number of patients | MPS | | | P value |
|--------------|--------------------|------------|------------|------------|----------|
| | | Normal | Mild | Mod-severe | |
| Low | 42 | 37 (88.1%) | 4 (9.5%) | 1 (2.4%) | 0.0016** |
| Moderate | 78 | 50 (64.1%) | 22 (28.2%) | 6 (7.7%) | 0.0157* |
| High | 10 | 1 (10.0%) | 1 (10.0%) | 8 (80.0%) | <0.001** |
| Total | 130 | 88 (67.7%) | 27 (20.7%) | 15 (11.5%) | - |

DISCUSSION

Duke Treadmill Score, Myocardial Perfusion Scintigraphy and Invasive Coronary Angiography have all demonstrated significant power for diagnosing as well as to assess extent and severity of Coronary artery disease in both diagnosed and suspected patients. Exercise treadmill testing has long been the cornerstone of noninvasive risk stratification. Mark *et al.* demonstrated that a treadmill score incorporating exercise time, ST segment changes, and angina was a powerful predictor of survival.¹ For outpatients, those with a low-risk DTS had a 99% 4-y survival compared with a 79% survival rate for patients with a high-risk score. The DTS maintains prognostic power even in models that incorporate clinical characteristics.⁴ Despite the utility of the DTS as a prognostic tool, other investigators have shown that radionuclide imaging techniques offer complementary prognostic information for patient management.

Balady *et al.*⁸, reported that, in more than 3,000 asymptomatic patients at risk of coronary artery disease who were followed over a period longer than 18 years,

the exercise stress test was able to help detecting those at higher risk, both for patients with high-risk Framingham score, as well as the low-risk scorers. Three variables obtained during the exercise stress testing were relevant: ST-segment depression >1mm, exercise capacity in METs and lack of capacity to reach foreseen submaximal heart rate. For each MET added to performance under stress, there was a 13% reduction in the risk of events. It is worth mentioning that ST-segment depression and number of METs reached under stress, two of the most significant pieces of data, which separately, provided enhanced information on risk to the Framingham score, are also used to obtain the DTS score. In the present study it is seen that low Duke Score is correlating well with normal MPS. Moderate Duke Score shows correlation with either normal or mild defect in MPS. This is expected as TMT is a screening test for CAD. Majority of the patients fall in intermediate category. Hence MPS may risk stratify these patients into normal or patients having CAD. However High Duke Score is correlating with severe defects in MPS suggesting that DTS can delineate patients who have severe CAD. In patients who

have undergone CABG/ Angioplasty, out of 25 patients, 5 patients had abnormal MPS suggesting progression of CAD even in grafted or stented vessel. This explains that DTS and MPS can be used to assess progression of CAD even in revascularized patients.

LIMITATIONS

Number of patients included especially in high Duke score/ severe defects in MPS category.

CONCLUSION

Duke Treadmill Score and Myocardial Perfusion Scintigraphy can be used independently and collectively for diagnosis and prognosis of the patients with Coronary Artery Disease. Treadmill test is a screening test for CAD. Duke Treadmill score adds incremental value to routine treadmill test by risk stratifying patients into low, intermediate and high risk group. Patients who fall under low and high risk DTS, clinical management decisions can be taken using DTS only, and MPS adds marginal incremental value. But majority of the patients fall in intermediate Duke score. This is the group where MPS provides predominantly significant clinical impact and management decisions. In the present study, MPS may be considered more sensitive and specific in risk

stratifying the patients with CAD especially intermediate risk group in DTS.

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