

## Estimation of stress myocardial perfusion using Quantitative Analysis

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**Abstract:** heart disease is one of the cause's numbers of death in world. If the heart could not pump blood and distribute it's to all parts of the body, pain in the chest will be happened while heavy work or walk a rush. Myocardial perfusion imaging (MPI) techniques is an ideal approach to doing the assessments of myocardial perfusion. As non-invasive imaging modalities, it can examine the functions of the various segments of the heart muscle to reflect whether there is a malfunction on heart. estimation of heart function done by <sup>99m</sup>Tc sestamibi heart scintigraphy ranging from simple methods such segmentation of the left ventricle. The result shows that Estimation of stress myocardial perfusion characterize to three mode of blood perfusion (end-diastolic, end-systolic volumes and ejection fraction), and estimated well by linear equation for the three mode of blood perfusion (end-diastolic, end-systolic volumes and ejection fraction). The characterize different mode of blood perfusion can estimate the classes without stress the patients using the linear equation.

**Keywords:** Stress, Rest, Myocardial perfusion, Blood perfusion

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### I. Introduction:

Nuclear cardiology, echocardiography, cardiovascular magnetic resonance (CMR), cardiac computed tomography (CT), positron emission computed tomography (PET), and coronary angiography are imaging modalities that have been used to measure myocardial perfusion, left ventricular function, and coronary anatomy for clinical management and research [1]. Myocardial perfusion imaging (MPI) techniques is an ideal approach to doing the assessment of myocardial perfusion. As non-invasive imaging modalities, it can examine the functions of the various segments of the heart muscle to reflect whether there is a malfunction on heart. In myocardial perfusion imaging studies, there are stress and rest sets of data [2]. Regional myocardial function and perfusion are important in coronary artery disease because they indicate myocardial viability and predict prognosis after revascularization at the regional level [3,4]. Single-photon emission tomographic (SPET) imaging is the preferred technique for assessment of myocardial perfusion and compares favorably with conventional planar methods [5-10].

Radionuclide Thallium 201 (<sup>201</sup>Tl) and Technetium 99m (<sup>99m</sup>Tc) have become the most widely used in MPI procedure [11]. Radionuclide <sup>201</sup>Tl that is produced in the cyclotron has long half-life ( $t_{1/2} = 73$  h) and low energy photon (60 to 83 keV) therefore, the image results have low resolution, great scatter and attenuation. Radionuclide <sup>201</sup>Tl has been abandoned for assessment of myocardial perfusion which it. In 1990, radionuclides <sup>99m</sup>Tc have been introduced of utilization for the assessment of myocardial perfusion [12]. Several characteristics of this radionuclide provided clear advantages over <sup>201</sup>Tl for gamma camera imaging. Compare to radionuclide <sup>201</sup>Tl, radionuclide <sup>99m</sup>Tc is produced through a generator which have higher energy (140 keV) and that is ideal for standard gamma camera imaging with lesser scatter and attenuation, and shorter half-life ( $t_{1/2} = 6$  h)[12]. Radionuclide <sup>99m</sup>Tc will be labeling pharmaceutical methoxyisobutyl isonitrile (sestamibi) that is commonly used to study perfusion myocardial[11]. Radiopharmaceutical <sup>99m</sup>Tc-sestamibi would accumulate in the myocardial tissue of the bloodstream. SPECT imaging is a tomographic technique that provide three-dimensional (3D) heart organ for given information of uptake radiopharmaceutical on each segment of the heart[13].

The adequacy of characterization of heart disease using SPECT scintigraphy and ECG reduce medical problems from the diagnosis of coronary disease in intermediate-risk patients and to improve the effectiveness of treatment and decreasing the risk of premature death.

## II. Material And Method

Patient's females and males with average age 59.3 year injected Tc99m sestamibi Scintigraphy, and scanned by dual head SPECT gamma camera parameters Cardiac Gated SPECT, and the Data collected from 2013 to 2017 in Nuclear Medicine department at Riyadh care center. The patients suspected of suffering from disorders of the heart muscle patients that injected with 99mTc sestamibi perfusion and the percentage obtained under conditions of stress and rest. The variables were being used for patients social background (age, sex and BMI), and the (End-diastolic volume, End-systolic volume and Ejection fraction).

**Procedure: Protocol stress:** Stress testing the heart organ in myocardial perfusion imaging techniques are through physical exercise and pharmacologic. When stress testing was done, it is necessary to observe the heart rate on the computer check the condition of the patient. Radiopharmaceutical injection can perform after the heart rate has reached 85 percent [14,15]. Radiopharmaceutical was injected with the range of dose between 20–30 mCi.

**Protocol rest:** Testing rest was done after 2 to 4 hours of scanning images under stress completed [13]. The test was done by using radiopharmaceutical injection with doses greater than the stress condition in the range 8-30 mCi [11].

**Scanning and acquisition SPECT:** Scanning was done with dual head SPECT gamma camera parameters Cardiac Gated SPECT. This study were applied parameters zoom 1.46 x (40.9) cm, matrix size 64 x 64, the number of angles 64, time per angle 20 seconds, the saturation level of 32.767, the relative angle detector 900 , the initial angle of 450 , and the direction of rotation clockwise. SPECT gamma camera detector was positioned on the patient's body left chest. The detector was rotated 180 degrees from the position of 45 degrees right anterior oblique (RAO) to 45 degrees left posterior oblique (LPO) [16].

## III. Results And Discussion

This study carried out to Estimation of stress myocardial perfusion using Linear equations, and the estimation of heart function done by 99m Tc sestamibi heart scintigraphy ranging from simple methods such segmentation of the left ventricle, and the results was as follow:

**Table 1** show statistical parameters for all patients at End-Diastolic Volume, End-Systolic Volume and Ejection fraction:

Rest	Mean	SD	Stress	Mean	SD
EDV	98.81	37.55	EDV	94.58	27.35
ESV	51.17	49.24	ESV	40.32	13.78
EJ	55.93	13.78	EJ	59.59	15.41

Table 1 show statistical parameter for all patients at the three mode of blood perfusion as mean  $\pm$ SD in the end-diastolic volume at rest was  $98.81 \pm 37.55$  and at stress was  $94.58 \pm 27.35$ , in end-systolic volume at rest was  $51.17 \pm 49.24$  and at stress was  $40.32 \pm 13.78$  and in ejection fraction at rest was  $55.93 \pm 13.78$  and at stress was  $59.59 \pm 15.41$ .

**Table 2** show correlation between the rest and stress at EDV, ESV and EJ

### Paired Samples Correlations

	Correlation	P.value
Pair 1 Rest EDV & Stress EDV	0.795	.000
Pair 2 Rest ESV & Stress ESV	0.513	.000
Pair 3 Rest EJ & Stress EJ	0.716	.000

Table 2 show paired sample Test show the correlation between the rest and stress at three mode of blood perfusion. in paired one the correlation vale between rest and stress at end-diastolic volume was 0.795, in paired two the correlation vale between rest and stress at end-systolic volume was 0.513 and in paired three the correlation vale between rest and stress at ejection fraction was 0.716, and at the three blood perfusion mode the p.value show p.value 0.00 which mean there is no significant difference at end-diastolic volume, end-systolic volume and ejection fraction.

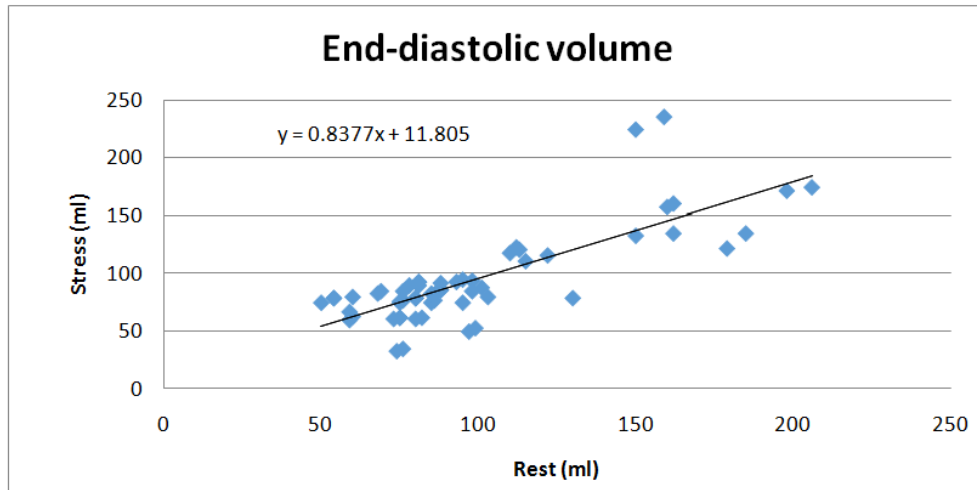


Figure 1: end-diastolic curve rest and stress

Figure 1 show there was a linear regression between the rest and stress at end-diastolic volume, the rate of change in stress was 0.8377 at each ml from rest.

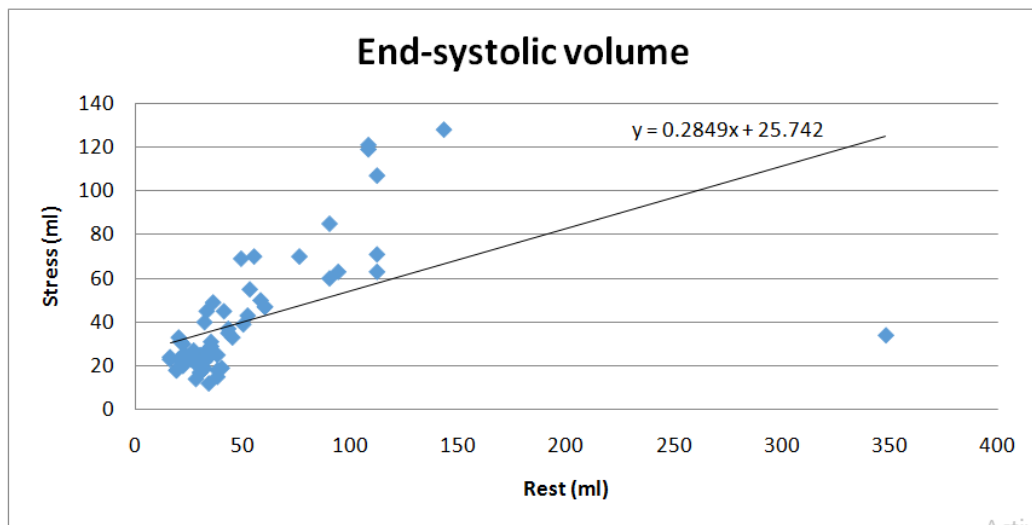


Figure 2: end-systolic curve rest and stress

Figure 2. show there was a linear regression between the rest and stress at end-systolic volume, the rate of change in stress was 0.2849 at each ml from rest.

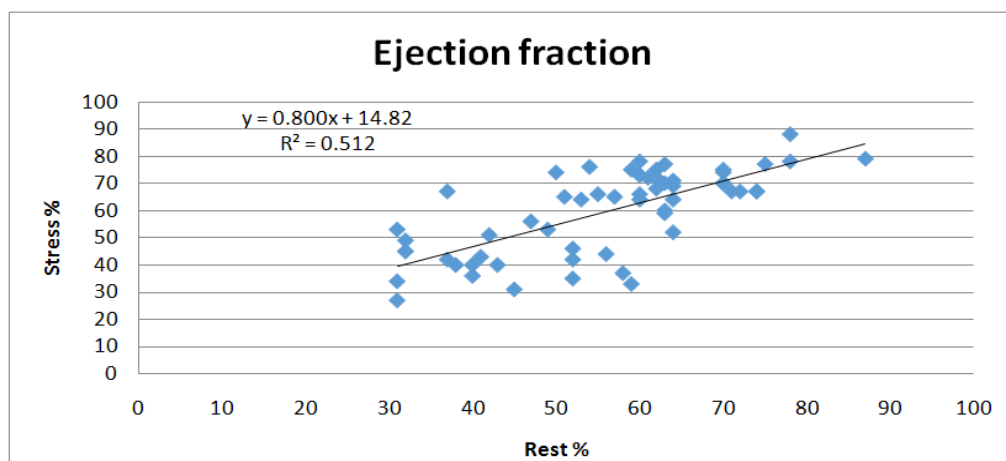


Figure 3: ejection fraction curve rest and stress

Figure 3. show there was a linear regression between the rest and stress at ejection fraction percent, the rate of change in stress was 0.8004 at each percent from rest.

#### IV. Conclusion

This study carried out to Estimation of stress myocardial perfusion using Linear equations, and the estimation of heart function done by <sup>99m</sup>Tc sestamibi heart scintigraphy ranging from simple methods such segmentation of the left ventricle, Therefore in this study from the mode of blood perfusion can estimate the classes without stress the patients using the following linear equations:

*Equation for the regression values to estimate the stress test:*

**Stress End-diastolic Volume= 0.8377 Rest + 11.805**

**Stress End-systolic Volume= 0.2849 × Rest + 25.742**

**Stress Ejection Fraction= 0.8004 × Rest + 14.823**

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