

## COMPARISON OF LV FUNCTION ON 4DM-SPECT AND QGS FOR THE ASSESSMENT OF MYOCARDIAL VIABILITY

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## Keywords

## Article History

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## Abstract

**OBJECTIVE:** This study designed to compare left ventricular EF, and SV and DV on QGS and 4D-MSPECT for the assessment of myocardial viability.

**MATERIALS AND METHODS:** This study was done that included 50 patients. Anon convenient sampling method was used and all the patient who visited us during our study period were included in the study. Patients of both genders and all ages were selected. Critically ill, trauma cases and all those patients who had a history of impaired kidney and liver function, cardiac arrhythmia and expected pregnancy were excluded. Data were collected using the Siemens Ecam signature series Gamma Camera interfaced with esoft Syngo p computers. The study was conducted at Punjab Institute of Cardiology Lahore, Nuclear Medicine Department. Data was collected through the specified proforma. After entering the data, it was analyzed descriptively and analytically by using SPSS( statistical package for the social science) version 26.0.

**RESULTS:** EF calculated with QGS strongly correlated with calculated 4D-MSPECT ( $y=2.63+0.81x$ ,  $r^2=0.765$ ). These two procedures yielded values were nearly equal. The ES volumes computed by QGS and 4DM-SPECT had a strong association ( $y=13.28+0.82x$ ,  $r^2=0.798$ ) ED volumes determined by QGS and 4D-MSPECT are also correlated ( $y=62.35+0.56x$ ,  $r^2=0.4389$ ).

**CONCLUSION:** Both QGS and 4D-MSPECT have their unique strengths in assessing left ventricular function and myocardial viability. The choice between these techniques should be driven by the specific clinical questions, cost consideration, and the availability of resources. Clinicians must weight the advantages of detailed perfusion assessment provided by 4D-MSPECT against the goal of delivering accurate, clinically relevant, and cost effective care to individuals with left ventricular failure and coronary artery disease.

**KEY WORDS:** Left ventricular ejection fraction, End systolic volume, End diastolic volume, Myocardial viability.

**INTRODUCTION:**

SPECT with gated myocardial perfusion is becoming more prevalent in most nuclear cardiology labs. As it provides assessment of LV EF and LV volumes in addition to providing more exact information regarding myocardial perfusion, left ventricular sizes and ejection fraction. Evaluation of left ventricular volumes and excess ejection fraction is predictive.. Reduced life expectancy is seen in people with depressed and enlarged left ventricular volumes. Patients who have normal - sized cardiac chambers and a preserved ejection fraction will live longer . Finding individuals those who may benefit from coronary artery revascularization include those with severe CAD and LV dysfunction depending on finding a healthy myocardium. Both normal (non ischemic cardiomyopathy or stunning)and aberrant (cardiac scar that is dormant) myocardial perfusion can occur in dysfunctional myocardium .

In a myocardium that is defective, myocardial perfusion can occur. By using radioactive technologies, regions of the myocardium with normal perfusion are viable and do not require further viability testing Myocardium that is hypo-perfused and dysfunctional might scar, which is (metabolically inactive) or hibernate , which is (metabolically active). Myocardium that is in hibernation may perform better with coronary revascularization or inotropic stimulation. SPECT(99mTcand 201Tl),PET radiotracers(18FFDG), If a scar is present, cardiac magnetic resonance imaging with late gadolinium enhancement or low dose dobutamine imaging can detect viability of the myocardium. While 18F-FDG absorption shows metabolic glucose in the heart activity,99mTcand 201Tl tracers reveal the mitochondrial function and myocyte cell wall integrity (99mTc), showing survival. (1)

As previously mentioned , standard A SPECT scan techniques 201Tl or 99mTc perfusion imaging during rest ,as well as image redistribution with201Tl at 4 and/or 24 hours, either reinjecting 201Tl or not.(1) Low-dose dobutamine is used to assess the effects of nitrate-enhanced perfusion, stress perfusion (ischemia implies viability), (2) changes in regional/global function, and inotropic contractile reserve. (3) are crucial auxiliary tools to improve myocardial viability

detection. When it is available, myocardial metabolic imaging using 18F-FDG provides a more precise method of determining viability.(4) In addition to viability, a wide range of additional factors, such as patient comorbidities, also have an impact on clinical outcomes in patients with viable myocardium. Examples include target vessel status, revascularization time, and negative left ventricular remodelling. Additionally, sub endocardium may suffer large degrees of infarction even with relatively whole circulation.

Qualitative assessment; Qualitative evaluation particularly if significant subendocardial infarction occurs despite somewhat intact perfusion. Multiple parameters can be used to qualitatively evaluate cardiac vitality. Normal 99mTc or 201Tl myocardial uptake of the tracer is a sign of viability.(5) Inducible ischemia and an increase in perfusion from stress to rest are signs of viability. Vitality was suggested by redistribution of 201Tl in cardiac segments on 4- and 24-hour redistribution images, together with considerably reduced tracer uptake on resting 201Tl images. (6) Segments of hypo-perfused myocardium that clearly improve after nitrate administration<sup>139</sup> or that are viable on modest doses of dobutamine and have a contractile reserve. To improve the identification of ischemic viable myocardium during 99mTc MPI protocols or 201Tl stressredistribution-reinjection protocols, sublingual nitroglycerin of 0.4 to 0.8 mg should be given. This is especially important for patients whose invasive coronary angiography revealed collaterals.(7)

Semiquantitative assessment; On rest, reinjection, or redistribution images, myocardial segments with normal perfusion or mild hypoperfusion (scores 0 or 1) are viable; segments with moderate hypoperfusion (scores 2 and C3) represent nonviable myocardium; and segments with severe hypoperfusion (scores C2 and D3) are nonviable myocardium. Quantitative assessment; The photographs after redistribution and reinjection, as well as rest 99mTc or 201Tl images, can all be quantitatively evaluated using the methods listed below. (1) Peak radiotracer activity, also known as the ischemic-to-normal ratio of the myocardial counts, and the magnitude and severity of the insufficiency in comparison to sex-matched normal limits databases. Myocardial segments are considered viable if their peak

radiotracer activity on normalized polar graphs is greater than 50% and nonviable if it is less than 50%. Nonviable perfusion defect pixels are those with counts that are two standard deviations or more outside of the gendermatched normal range database. (8). Notably, the level of viability defined as more than 10% of myocardium in dormancy (9) is a crucial factor in determining whether or not the LV will restore its function after coronary revascularization. (10)

The left ventricle's functionality and myocardial vitality are both evaluated using imaging techniques called quantitative gated SPECT (QGS) and myocardial single photon emission computed tomography, or 4DMSPECT. Here is a little contrast between the two:

1. Imaging Technique: QGS: QGS is a software package used to analyze and quantify data obtained from conventional SPECT imaging. 4DM SPECT: 4DM SPECT is a specialized technique that acquires multiple gated images to create a dynamic 4D representation of the heart's motion and perfusion.

2. Data Acquisition: QGS: QGS typically uses static images and relies on traditional SPECT data. 4DM SPECT: 4DM SPECT acquires multiple gated images over time, providing information on both perfusion and motion.

3. Assessment of Left Ventricular Function: QGS: QGS can provide information on wall motion, ejection fraction, and left ventricular function abnormalities. 4DM SPECT: 4DM SPECT can offer more detailed information about left ventricular function, including not only ejection fraction and wall movement but also ventricular volumes and regional wall motion analysis over the cardiac cycle.

4. Assessment of Myocardial Viability: QGS: QGS primarily focuses on assessing left ventricular function and may not provide detailed information on myocardial viability. 4DM SPECT: 4DM SPECT can assess myocardial viability by combining perfusion and motion data, allowing for a more comprehensive evaluation of the heart's viability.

5. Clinical Application: QGS: QGS is often used for standard myocardial perfusion imaging and functional assessment. 4DM SPECT: 4DM SPECT is particularly useful when more detailed information about cardiac motion and viability is required, such as in cases of ischemic heart disease or evaluating the effectiveness of interventions like revascularization.

In summary, QGS is primarily focused on static SPECT images for assessing left ventricular function, while 4DM SPECT is a more advanced technique that combines dynamic imaging to provide detailed information on myocardial viability and left ventricular function. The choice between them depends on the specific clinical targets and the level of detail required in the assessment.

#### **MATERIALS AND METHODS:**

This study was done that included 50 patients. A non convenient sampling method was used and all the patient who visited us during our study period were included in the study. Patients of both genders and all ages were selected. Critically ill, trauma cases and all those patients who had a history of impaired kidney and liver function, cardiac arrhythmia and expected pregnancy were excluded. Data were collected using the Siemens Ecam signature series Gamma Camer interfaced with esoft syngo p computers. The study was conducted at Punjab Institute of Cardiology Lahore, Nuclear Medicine Department. Data was collected through the specified proforma. After entering the data, it was analyzed descriptively and analytically by using SPSS( statistical package for the social science version) 26.0.

Prior to beginning the study, the Institutional Ethics Committee was notified and given permission. All patients were informed of the purpose and nature of the investigation. Participants in this study included those with clinical signs like obesity, hypertension, diabetes, smoking, hyperlipidemia, and family history of ischemic heart disease. All examinations were performed with ECG. To reduce gallbladder activity, patients were instructed to arrive on an empty stomach. Prior to the trial, patients were not allowed to engage in any physical exercise.

The cardiovascular and general systems were examined. An electrogram of the patients was taken. Tc99m Sestamibi (Cardiolite, Dupont USA), made from fresh elute, was given after an intravenous canula was passed.. Data collection began 45 minutes after injection. 8 intervals were used to gather gated SPECT data for each cardiac cycle. Imaging was carried out in a step-and-shoot fashion with 30 steps, 50 seconds per step over 180 degrees, starting from a right anterior oblique position of 132 degrees. A 64 × 64 matrix of data was organized on the computer's hard disc. The researcher used data collection sheets to collect information only

with informed, written consent. Information was gathered in accordance with the questionnaire's variables, which are listed below.

Participants' histories, complaints, and clinical diagnoses were recorded. Age, gender, and the type of scan were questions that were directed at the people. SPECT, short for Single Photon Emission Computed Tomography This approach involves injecting a radioactive tracer into the patient's bloodstream. The tracer builds up in healthy heart tissue and generates gamma rays that a gamma camera can detect. SPECT provides 3D images of myocardial perfusion and viability. The trial covered all patients with coronary artery disease, regardless of gender. They were referred by the surgical OPD or ward at the Punjab Institute of Cardiology in Lahore. During this time, 50 patients were chosen based on their age, gender, and radiological findings. Informed consent given orally was obtained, and thus the 4DMSPECT and Myocardial blood flow SPECT on QGS were obtained from the radiologist's office.

**RESULTS:** 50 individuals (38 men, 12 women) 32 to 77 years old participated in the study. Angiographical evidence of coronary artery disease was present in all subjects. In two patients, stents, and 7 patients were post CABG and 21 patients had prior myocardial infarction out of 50. EF calculated with QGS strongly correlated with calculated 4DMSPECT ( $y=2.63+0.81x$ ,  $r^2=0.765$ ). These two procedures yielded values were nearly equal. The ES volumes computed by QGS and 4DM-SPECT had a strong association ( $y=13.28+0.82x$ ,  $r^2=0.798$ ) ED volumes determined by QGS and 4D-MSPECT are also correlated ( $y=62.35+0.56x$ ,  $r^2=0.4389$ ).

**Table 1: shows the percentage of Gender present in the study.**

| Gender |           |         |               |                    |
|--------|-----------|---------|---------------|--------------------|
|        | Frequency | Percent | Valid Percent | Cumulative Percent |
| Male   | 38        | 38      | 76            | 76                 |
| Female | 12        | 12      | 24            | 100                |
| Total  | 50        | 50      | 100           |                    |
| System | 50        | 50      |               |                    |
|        | 100       | 100     |               |                    |

In total 50 patients, who had CAD, there were 12

females (24%) and 38 males (76%). More patients were male.

**Table 2: shows the percentage of History of CAD in the study**

| HISTORY OF CAD |           |           |         |               |                    |
|----------------|-----------|-----------|---------|---------------|--------------------|
|                |           | Frequency | Percent | Valid Percent | Cumulative Percent |
|                | STENT     | 2         | 2.0     | 4.0           | 4.0                |
|                | POST CABG | 7         | 7.0     | 14.0          | 18.0               |
|                | MI        | 21        | 21.0    | 42.0          | 60.0               |
|                | NSTMI     | 17        | 17.0    | 34.0          | 94.0               |

In total 50 patients, there were 2 patients with Stent (4.0%) , 7 patient with Post CABG (14.0%), 21 patients of MI (42.0%), and 17 patients of NSTMI (34.0%). More patients had MI.

**Table 3 shows the percentage of HTN patients used in the study.**

| HTN     |        |           |         |               |                    |
|---------|--------|-----------|---------|---------------|--------------------|
|         |        | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid   | No     | 13        | 13.0    | 26.0          | 26.0               |
|         | Yes    | 37        | 37.0    | 74.0          | 100.0              |
|         | Total  | 50        | 50.0    | 100.0         |                    |
| Missing | System | 50        | 50.0    |               |                    |
| Total   |        | 100       | 100.0   |               |                    |

There were 50 patients in all, 13 without HTN (26.0%), and 37 with HTN (74.0%).

More patients had HTN.

**Table 4: Shows the percentage of DM patients present in the study.**

| DM    |       |           |         |               |                    |
|-------|-------|-----------|---------|---------------|--------------------|
|       |       | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | No    | 30        | 30.0    | 60.0          | 60.0               |
|       | Yes   | 20        | 20.0    | 40.0          | 100.0              |
|       | Total | 50        | 50.0    | 100.0         |                    |

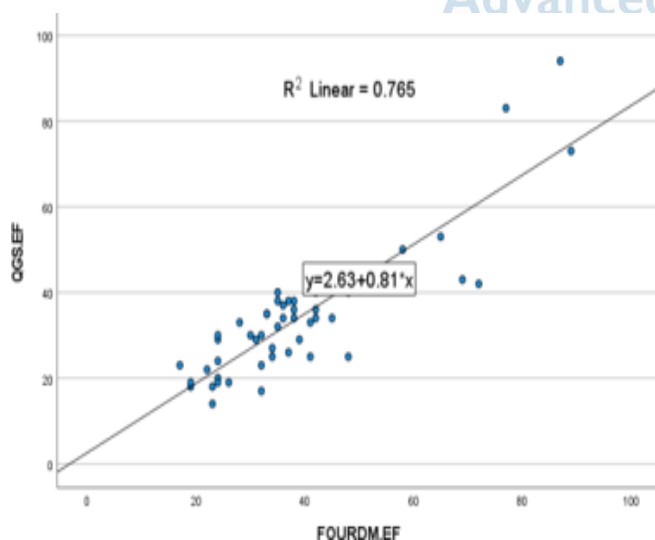
|          |        |     |       |  |  |
|----------|--------|-----|-------|--|--|
| Missi Ng | System | 50  | 50.0  |  |  |
| Total    |        | 100 | 100.0 |  |  |

50 patients in all, 30 without diabetes (60.0%), and 20 with diabetes (40.0%). More patients had no DM

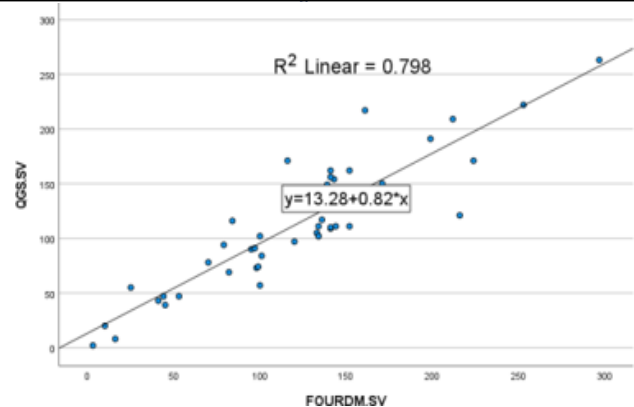
**Table 5: shows the percentage of SM patients present in the study.**

| SM        |         |           |            |                  |                    |
|-----------|---------|-----------|------------|------------------|--------------------|
|           |         | Frequency | Percentage | Valid Percentage | Cumulative Percent |
| Valid     | No      | 39        | 39.0       | 78.0             | 78.0               |
|           | Yes     | 11        | 11.0       | 22.0             | 100.0              |
|           | Total   | 50        | 50.0       | 100.0            |                    |
| Missi n G | Syst em | 50        | 50.0       |                  |                    |
| Total     |         | 100       | 100.0      |                  |                    |

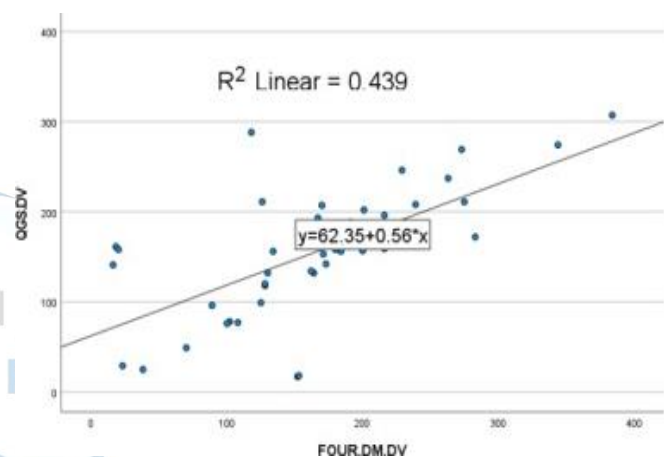
Of a total of 50 patients, there were 11 patients with a smoking habit (22.0%) and 39 patients had no smoking habit(78.0%). More patients had no smoking habit.



**Graph 9: Shows correlation between Ejection Fraction on QGS and 4DM-SPECT in coronary artery disease.**



**Graph 10: Shows correlation between left ventricular systolic volume on QGS and 4DM-SPECT in coronary artery disease.**



**Graph 11: Shows correlation between left ventricular diastolic volume on QGS and 4DM-SPECT in coronary artery disease.**

### DISCUSSION:

A myocardial viability evaluation is crucial for guiding treatment decisions among patients with coronary artery disease and left ventricular failure. Various imaging techniques, To assess left ventricular function and myocardial viability, techniques like 4D Myocardial Single-Photon Emission Computed Tomography (4D-MSPECT) and Quantitative Gated SPECT (QGS) are employed.(23) This study aims to address this gap by conducting a systematic and in-depth comparison of left ventricular function assessment using QGS and 4D-M SPECT. The primary focus will be on evaluating their efficacy in detecting viable myocardium, thereby aiding clinicians in making informed choices regarding revascularization strategies and predicting patient outcomes.(24)

This study holds significant importance as it directly impacts clinical judgement in people with left ventricular failure and coronary artery disease. By providing a comprehensive comparison of QGS and 4D-M SPECT in assessing myocardial viability, this research will empower healthcare professionals to choose the most accurate and cost-effective imaging technique. Ultimately, this informed decision-making process will enhance patient outcomes, optimize resource utilization, and improve the overall quality of care in the field of cardiology.(25)

When it comes to distinguishing viable myocardium from scarred tissue, both QGS and 4D-M SPECT provide valuable insights. 4D-M SPECT's ability to capture myocardial perfusion over time allows for a more comprehensive viability assessment, particularly in complex cases. However, QGS, with its quantitative analysis, also offers valuable information about viable tissue. The choice between the methods may depend on the specific clinical scenario and the need for detailed viability mapping.(26)

## CONCLUSION:

In conclusion, both QGS and 4D-MSPECT have their unique strength in assessing left ventricular function and myocardial viability. The choice between these techniques should be driven by the specific clinical questions, caused consideration, and the availability of resources. Clinicians must weigh the advantages of detailed perfusion assessment provided by 4D-MSPECT against the cost effectiveness and accessibility of QGS. Ultimately, the decision should align with the goal of delivering accurate, clinically relevant, and cost effective care to individuals with left ventricular failure and coronary artery disease.

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