

# The Contribution of Myocardial Scintigraphy in the Diagnosis of Ischemic Heart Disease at Mohamed VI University Hospital Center of Marrakech: About 121 Cases Collected From January 2017 to November 2019

Ghezouani H\*, Raouah MA, Jourani S, Elhattaoui M

Cardiology Departement; Marrakesh University Hospital Centre, Morocco

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\*Corresponding author: Ghezouani H

## Abstract

## Original Research Article

The applications of nuclear medicine in cardiology began in January 2017 at the University Hospital of Marrakech with the use of myocardial scintigraphy. Stress tests were coupled to the study of perfusion and myocardial function. After few months of operation, we propose to determine the contribution of myocardial scintigraphy in the assessment of cardiac pathologies at the Mohamed VI University Hospital Center in Marrakech. This is a retrospective descriptive study that took place from January 04, 2017 to November 04, 2019. One hundred and twenty one patients were included in the study; they all presented a cardiac disease and underwent a myocardial scintigraphy. Men were the most represented (83%) and the average age was 55 years old. The majority of patients (77%) had at least one cardiovascular risk factor. The diagnosis of coronary artery disease was the most important indication for myocardial scintigraphy (54%). 105 patients underwent a physical effort test according to the modified Bruce protocol, followed by a myocardial scintigraphy and then an examination at rest, the Dipyridamole protocol was performed in 16 patients. Ischemic heart disease was diagnosed in 33 of our study group (27.27%). The integration of myocardial scintigraphy in the assessment of heart diseases could contribute to a better management of our patients and to an early diagnosis of ischemia in asymptomatic patients.

**Keywords:** Myocardial scintigraphy; Heart disease; Ischemia; Mohamed VI University Hospital Marrakech.

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## INTRODUCTION

Cardiovascular diseases remain the leading cause of death worldwide. Ischemic heart disease is the most common, responsible of heart failure and high mortality. Their screening, diagnosis and prognosis are crucial for a better management and adaptation of the treatment. Ischemic heart disease is due to insufficient oxygen supplies to the myocardium due to the development and complications of atherosclerosis in one coronary artery (or more). This resulting lack of oxygen can cause damage to the myocardium at different levels, from ischemia to myocardial necrosis.

For many years, myocardial perfusion scintigraphy has played a leading role in the management of coronary artery disease because of its highly precise performance in the diagnosis of myocardial ischemia. Moreover, it has a widely recognized value for risk stratification, evaluation of

treatment effectiveness and research of myocardial viability [1].

Scintigraphic explorations are based on the principle of photon emission imaging. They consist in visualizing an anatomical or functional structure of the organism in locating the spatial and temporal distribution of a radioactive tracer with an external detector: a scintillation camera.

At the Cardiology department of Mohamed VI university hospital, myocardial scintigraphy has been practiced for almost three years in the nuclear medicine department. This study aims to highlight the importance and the contribution of this exam in the management of diagnosed and non-diagnosed coronary patients.

## MATERIAL AND METHODS

### Objectives

The general objective is to analyze the preliminary results of myocardial scintigraphies performed in the nuclear medicine department of the University Hospital of Marrakech

### The specific objectives of our study are

- Describing the epidemiological and clinical profile of patients who had a myocardial scintigraphy;
- Analysing different scintigraphy results;
- Showing the interest of myocardial scintigraphy
- Formulating some recommendations in order to optimize the prescription of myocardial scintigraphy and to improve the management of coronary patients followed in our department

## METHODOLOGY

### Population

All patients who have ran a screening for ischemic myocardial from January 04, 2017 to November 04, 2019

### Protocol

The exam was performed in one day, the stress test was done first. An exercise stress test was performed in all patients and a pharmacological stress test in 16 patients, under the supervision of trained medical professionals.

### Exercise Stress test

The stress tests were performed on a treadmill under the supervision of a cardiologist according to Bruce's protocol with a 12-lead ECG recording and a blood pressure check before the start of the effort and during each step. Exercise was stopped according to MHR (Maximum Heart Rate), exhaustion or the appearance of clinical or electrical signs of ischemia.

### Pharmacological stress

It was performed with dipyridamole in slow IV over 4 min, from 0.56 to 0.7 mg / kg, followed 5 min later by the injection of 7 to 10 mCi of sestamibi-Tc99m, under clinical and electrical monitoring (EKG). All the patients were advised not to take xanthine derivatives (such as those contained in coffee or tea for example) during the 12 hours preceding the examination.

### Acquisition of images

The images were acquired in synchronization with the EKG (Gated SPECT). However, quantitative data on the function of the left ventricle were not studied in this series. Stress images were acquired by a wide field single-head gamma camera (Ecam Siemens1), on a non-circular orbit of 1808 (458OAD / 458 OPG), in 32 projections, within 30 min after <sup>99m</sup>Tc- sestamibi. The hepatic clearance of <sup>99m</sup>Tc- sestamibi was improved by ingestion of temperate water, yogurt, toast and walking. The images at rest

were taken 3 h after stimulation, after injection of <sup>99m</sup>Tc-sestamibi activity ranging from 20 to 25 mCi.

The interpretation of the images was carried out after a quality control including the search for patient movements and the assessment of the counting rate. The images were visualized after reconstruction and reorientation according to the 3 planes: minor axis, major vertical axis and major horizontal axis. The interpretation of the images was adapted to the 17-segment model.

All patients underwent a stress test and then an acquisition. Exercise stress test is performed on a treadmill or ergometric bicycle according to a protocol starting with a load of 30 watts, which is incremented by 30 watts every three minutes. It is stopped when the patient reaches or exceeds 85% of the maximum heart rate (MHR).

## RESULTS

### Epidemiological aspects

121 myocardial scans were performed. The average age of our population is 55 years [36 years-75 years] with a male predominance (sex ratio: M / F = 6/1) (Fig. 1).

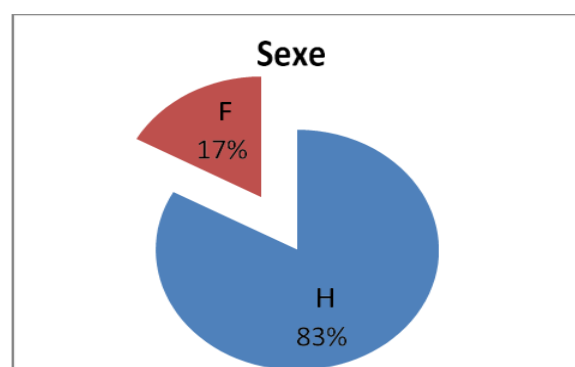


Fig-1: Distribution of the population studied by sex

### Clinical aspects

Among the cardiovascular risk factors, hypertension and advanced age were the most represented risk factors, followed by smoking, dyslipidemia, diabetes and family history of coronary heart disease (Fig. 2).

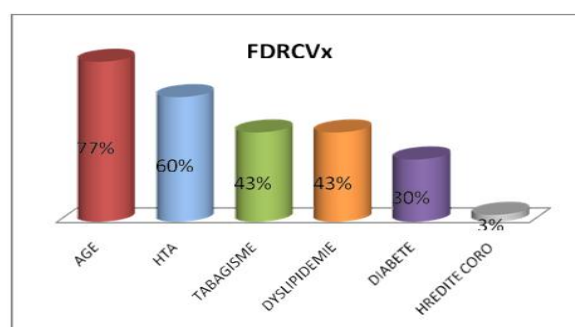


Fig-2: Analysis of cardiovascular risk factors

The myocardial scintigraphy was performed in 33% of patients with history of myocardial infarction and 20% with history of Non-ST-elevation myocardial infarction (NSTEMI) (table 1).

**Table-1: History of patients included in the study**

History	Patients
MI	33%
NSTEMI	20%
Atypical chest pain	33%
Coronarography	54%
PCI	17%
CBAG	7%

**Resting EKG**

The resting ECG was normal in 35 patients (28.92%). Ischemia lesions were noted in 23 patients (33%) and necrosis in 14 cases (20%).

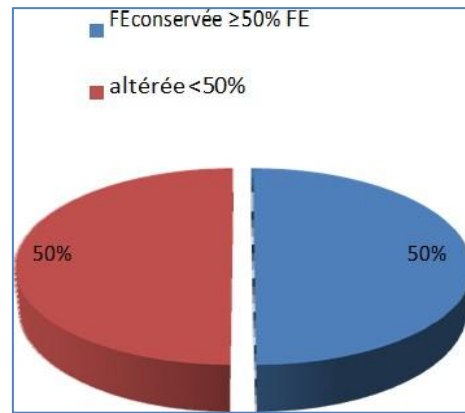
**Exercise stress test**

The duration of the cardiac stress test varied from five to twenty five minutes with an average of 15 minutes. The stress test was below maximum in 5 cases (4.10%) and maximum in 100 cases (82.64%).

Fatigability was the most common reason for stopping the test (28 patients- 23.14%), followed by precordialgia in 4 cases (3.30%). The cardiac stress test was negative in 48 cases (39.66%), doubtful in five cases (4.10%) and positive in twenty cases (16.52%)

**Cardiac echography**

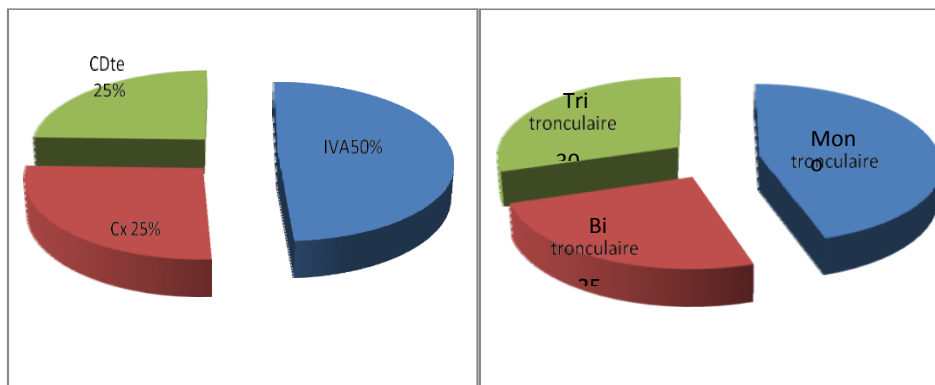
All the patients underwent a cardiac echography that showed an altered left ventricular function in half of the cases.



**Fig-6: Trans-thoracic cardiac echography data**

**Coronarography**

54% of patients (65 cases) benefited from coronary angiography that objectified a monotonular lesion in 45% of the cases (29 patients), two lesions in 25% of the cases (16 patients) and three lesions in 30% of the cases (20 patients). 17% of cases (11 patients) underwent angioplasty and 7% of cases a coronary artery bypass surgery (Fig. 3).



**Fig-7: Coronarography data**

**Myocardial scintigraphy**

Myocardial scintigraphy was indicated in 120 patients (99% of cases) in order to diagnose ischemia, in one patient in order to evaluate myocardiac viability (1% of cases).

Diagnosing myocardial ischemia required a stimulation test with an exercise test in 105 patients. Dipyridamole protocol performed in 16 patients.

Myocardial ischemia is diagnosed in 121 patients. 33 patients (27.27% of cases) had abnormal exercise myocardial perfusion which was reversible at

rest. 88 patients (72.72% of cases) showed no signs of myocardial ischemia.

**Clinical application**

**Clinical case**

Mr. M M, 50 years old  
 Cardio-vascular risk factors: chronic smoking (cessation for 2 years).  
 Medical history: STEMI in March 2017  
 Trans-thoracic echocardiography: LV size is normal.  
 LV systolic function: 45%  
 Antero-septal and ant basal and median hypokinesia  
 RV: normal size and function

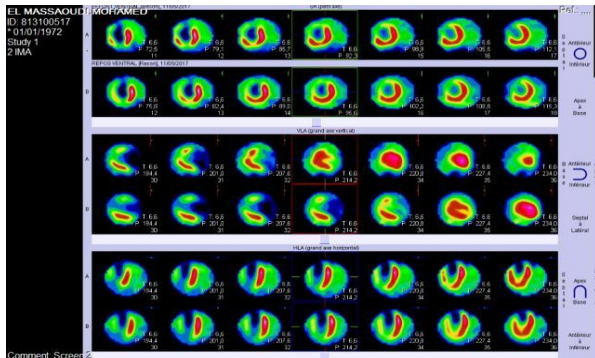
## Coronarography

Occlusion of the proximal LAD at the level of the 1st septal

## The myocardial effort scintigraphy

Stress test: maximum conducted at 85% of MHR for 130 Watt, clinically positive and electrically negative. SDR: + 10 (intermediate risk).

Perfusion scintigraphy: necrosis of the anterior wall, necrosis of the apex, necrosis of the middle and basal antero-septal septo-apical segments.



**Fig-8: Rest and effort acquisitions of perfusion scintigraphy**

The semi quantitative assessment showed a score of 55% of the mass of the LV

Lack of anterior viability at the basal and median level  
Lateral and septal viability is preserved

## DISCUSSION

Despite the increasing development of highly effective techniques in the exploration of coronary artery disease, myocardial perfusion scintigraphy still has its place and importance even in developed countries. It is a non-invasive exam, with clinical efficiency proven both in the diagnosis and in the evaluation of the various therapeutic procedures. Unfortunately, this exam is not widely used in Africa, despite the increased prevalence and incidence of coronary artery disease. The nuclear medicine department at the Mohammed VI university hospital in Marrakech, in association with the cardiology department, is the only center in the region where this exam is performed.

In our study, 121 myocardial scans were performed over a period of 33 months. This relatively low frequency is explained by the fact that the radiotracer used is not always available for the examination. Furthermore the cost of myocardial scintigraphy remains high and most of the time not affordable for patients without health insurance.

The average age of the patients enrolled in our study is 55, with extremes ranging from 36 to 75. This shows the early onset of cardiovascular disease in our

population and the increase in the frequency of cardiovascular disease with age. Atheromatous lesions are more common in the elderly, which means that the frequency of ischemic heart disease increases with age. These results corroborate those of Tapsoba *et al.* [1], Tahirou *et al.* [2], Branly *et al.* [3] and Cadiou *et al.* [4] who find, respectively, an average age of 49 years; 47.27 years; 55 and 54 years old.

In our study, we found a male predominance in 83% of the cases, i.e. a sex ratio M / F = 6/1. Tapsoba *et al.* [1], Tahirou *et al.* [2], Branly *et al.* [3] also found a male predominance with, respectively, 60.27%; 56.80% and 87%. This male predominance could be explained by the protection conferred on women by estrogens against cardiovascular diseases and, in particular, against coronary pathology.

Our study population consisted of known or suspected coronary patients. The diagnosis of coronary artery disease was the main indication for performing myocardial scans. Tahirou *et al.* [2] found that 72.97% of their patients with atypical precordialgia had undergone scintigraphy for coronary artery disease. Several authors find that in the field of myocardial ischemia screening, myocardial tomoscintigraphy is the reference examination with sensitivity of 90% and a specificity of 80% [5, 6].

During our study, 75% of patients had at least one cardiovascular risk factor and hypertension was the most incriminated modifiable risk factor (60%), followed by smoking (43%), dyslipidemia (43%) and diabetes (30%). Hypertension is the most implicated risk factor in several studies with varying proportions. Tahirou *et al.* in Niger [2], Sfar *et al.* in Tunisia [7], Bèye *et al.* in Mali [8], Seck *et al.* in Senegal [9] and Gimbally-Kaky and Bouramou in Congo [10] found, respectively, 29.09%, 73.7%, 62.5%, 46% and 53.3% of patients with hypertension. Tahirou *et al.* [2] in his study shows that the more patients have cardiovascular risk, the greater the probability of developing coronary disease. In developing countries, the occidentalization of lifestyles, smoking, excessive alcohol use, sedentarity, increase the cardiovascular risk. This probably explains the increasing incidence of cardiovascular diseases in young population. In addition, the inaccessibility of this population to adequate care services and treatment leads to an increase in cardiovascular mortality [11]. In our study 33% of our patients had already had an MI and 33% had suffered from angina-like pain. Our results are identical to those of Hassan and Mertes [12] who found that 28% of patients had suffered from a MI.

Myocardial effort scintigraphy performed according to the modified Bruce protocol, followed by that of rest, was performed in 86% of patients. This high rate could be explained by the fact that the modified Bruce is a very easy to use protocol and that it

is suitable for the treadmill. There is little demand for the evaluation of therapeutic efficacy with scintigraphy (only 6.85% of cases). This low rate could be explained with the fact that practitioners do not perceive its interest during the care of cardiac patients. An information campaign could help solving this issue.

In our study, 105 patients (86.77%) performed an effort stress test according to the modified protocol of Bruce before the scintigraphy. Most of these patients were under anti-angina therapy, which was stopped on average for 48 hours. Antianginal treatments, in particular beta-blockers, are likely to reduce the perfusion anomalies observed in myocardial tomoscintigraphy. This is why it is classically recommended to stop these treatments when this examination is requested for diagnostic purposes. In our study, bisoprolol was the most used beta-blocker in 64% of cases. This result is different from that of Tapsoba *et al.* [1] which first found Atenolol 83.33% of beta-blockers.

In our study, the average waiting time between injecting the radiotracer and acquiring images was 15 minutes, and in all patients the images were acquired using a dual-head gamma camera. All patients were supine. When the myocardial scintigraphy is synchronized with the EKG, it makes possible to distinguish between infarction and artefact.

In addition, it allows an automatical calcul of the left ventricle ejection fraction and a better visualization of ventricular kinetic on the screen [13]. In our study, 72.72% of patients had normal myocardial fixation on exercise scintigraphy. If our protocol was ignored, in these patients, resting myocardial scintigraphy was not necessary. Normally, when effort scintigraphy is normal, rest is expected to be as well. The myocardial fixation anomalies after the stress test were mainly located at the level of the inferior wall. Indeed, during scintigraphy, photons emitted from different parts of an organ of interest pass through different anatomical structures (chest wall, breasts, diaphragmatic dome), which can lead to artefactual images within scintigraphic sections. It leads to an attenuating artifact, depending on the position of the tissue, the patient's BMI, and the depth of the target organ. In men, the left diaphragmatic dome is responsible of attenuation of the lower wall in 25% of myocardial scans, resulting in perfusion artefacts. These artefacts can be accentuated in patients with an abdominal protuberance, a raised left diaphragmatic dome or obesity [14].

In our study, the scintigraphy was abnormal in 27.27% of the cases. Our results are similar to Tapsoba *et al.* [1] with 28.33% of abnormal scintigraphies, Sfar *et al.* in Tunisia [7] which find 36.8% and that of Hachamovitch *et al.* [15] in the United States, which found 26% of abnormal results.

## CONCLUSION

Our study on the contribution of myocardial scintigraphy in the diagnosis of ischemic heart disease at University hospital of Marrakech, allowed us to confirm the invaluable contribution of this exam in the management of cardiac pathologies, more precisely of coronary heart disease. It makes it possible to detect myocardial ischemia with great sensitivity and allow a better evaluation of therapeutics efficiency.

Considering the increase of cardiovascular disease in Africa, integrating myocardial scintigraphy into the health check of cardiac patients could contribute to a better patient management and early diagnosis of ischemia in asymptomatic patients. The introduction of myocardial scintigraphy in cardiological practice would require permanent availability of the inputs used to carry out this exam and a reduction of its cost.

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