

Incidental pathologic extracardiac uptake of ^{99m}Tc -tetrofosmin in myocardial perfusion imaging

Irini Kotsalou¹,
Panagiotis Georgoulas²,
Stefanos Furlis³,
Antonis Zoumboulidis¹,
Konstantinos Giaslakitotis⁴,
Athina Androulaki⁴,
Panagiotis Chronopoulos⁵,
Nikolaos Dimakopoulos¹

1. Department of Nuclear Medicine, NIMTS Hospital, Athens, Hellas
2. Department of Nuclear Medicine, University Hospital of Larissa, Hellas
3. Department of Cardiology, NIMTS Hospital, Athens, Hellas
4. Department of Histology, Laiko Hospital, Athens, Hellas
5. Department of Radiology, NIMTS Hospital, Athens, Hellas

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Correspondence address:

Panagiotis Georgoulas, Lecturer,
Nuclear Medicine Department,
University Hospital of Larissa,
Mazourlo Larissa,
P.C. 41110, Hellas
Tel.: +302410 682918
Fax: +302410670117
E-mail: pgeorgoul@med.uth.gr

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Abstract

Technetium-99m-tetrofosmin (^{99m}Tc -TF) myocardial perfusion studies have incidentally detected various extracardiac abnormalities. The interpretation of these findings may be essential for early diagnosis and treatment of important diseases. We present a rare case of a mediastinal thymoma incidentally detected during myocardial perfusion imaging. A 60 year-old woman, with precordial symptoms of possible myocardial ischemia, underwent a ^{99m}Tc -TF stress-rest single photon emission tomography test. Intense uptake of the radiotracer in the left paracardiac area, was observed. The computerized tomography and the magnetic resonance imaging tests revealed a mass in the left lower anterior mediastinal area. Biopsy and histology showed that this mass was a thymoma.

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Introduction

Technetium-99m-tetrofosmin (^{99m}Tc -TF) is a lipophilic cationic agent, developed for myocardial perfusion scintigraphy (MPS) [1, 2]. During acquisition of MPS, depending on the patient's body size and the camera field of view incidental findings by the heart (exocardiac), in the thorax or in the upper abdomen, can be visualized [3, 4]. These findings may indicate benign or malignant disease and may require further investigation and treatment which could be life saving for the patient [3, 4].

We here present a rare case of a mediastinal thymoma detected incidentally, in a ^{99m}Tc -TF myocardial single photon emission tomography (SPET) scintigram and underline the importance of similar findings.

Case description

A 60 year-old woman, presented with atypical precordial symptoms, underwent a ^{99m}Tc -TF stress-rest SPET MPS. The patient exercised for 10 min according to Bruce protocol achieving the 102% of the predicted maximum heart rate for her age, with a peak blood pressure of 190/100 mmHg. She did not complain for chest discomfort during the treadmill testing and the exercise electrocardiogram (ECG) was negative for ischemia. A stress MPS was obtained after the intravenous (iv) injection of 185 MBq of ^{99m}Tc -TF, 1-2 min before cessation of the exercise. Twenty minutes after the administration of the radiopharmaceutical, 250 ml of milk (3.5% fat) was ingested for optimum excretion of the tracer by the gallbladder. Acquisition started 40 min after the ^{99m}Tc -TF administration. Four hours after the first injection, ^{99m}Tc -TF SPET, MPS was obtained at rest, after the iv injection of 555 MBq of ^{99m}Tc -TF. Images were acquired from 45° at the right anterior oblique to the 45° left posterior oblique position, in step and shoot mode with 64 projections, matrix 64x64, pixel size 6.8 mm, 30 sec per projection for stress and 50 sec per projection for rest scintigrams. The high-count rest scan was acquired as a gated-SPET study with 8 frames per cardiac cycle. Acquisitions were obtained using a 2-headed Sophy camera (Sophy Industries, France) equipped with low-energy, parallel-hole, high-resolution collimators. The energy window was set at ±10% symmetrically along the 140 keV photopeak. Data processing was accomplished by a Butterworth filter (cut-off 0.35, order 4.0).

The MPS gated-study was normal. An incidental finding of intense extracardiac uptake of the radiotracer in the left paracardiac area, was observed (Fig. 1). The computerized tomography (CT) and magnetic resonance imaging (MRI) tests revealed a mass of 6 cm diameter in the left lower anterior mediastinal area (Fig. 2). After a biopsy and subsequent pathology test who diagnosed thymoma, the patient underwent surgical resection of the mass

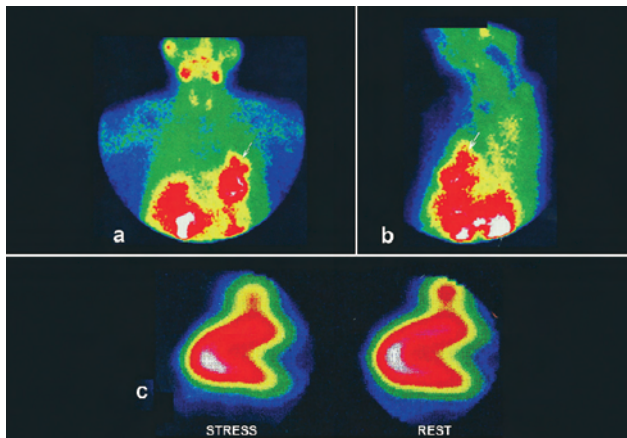


Figure 1. Anterior (a) and left lateral (b) projections of the thorax, demonstrated intense ^{99m}Tc -tetrofosmin uptake in the left paracardiac area (arrows). Myocardial perfusion SPET imaging was normal (c).

through medial sternotomy followed by adjuvant radiotherapy of the mediastinum, because of microscopic invasion of the tumor capsule. The immunohistochemical examination, established the diagnosis of a thymoma type AB and stage 2b (Masaoka II2 and TNM Pt2) whose 10-year free disease survival is approximately 90% (Fig. 3) [4]. About 30%-40% of these patients have a variety of symptoms, including chest pain as had our patient [3]. Our patient had normal MPS and normal ECG. Neurologic evaluation with nerve conduction studies, did not reveal signs of myasthenia gravis.

Discussion

MPS is a widely used diagnostic technique for the evaluation of myocardial perfusion. The mechanism of ^{99m}Tc -TF cellular uptake is not fully known, but it seems to be similar to that of sestamibi. ^{99m}Tc -sestamibi is passively diffused through the capillaries and cell membranes in a non specific manner, dependent on its lipophilicity, and its sarcolemmal and mitochondrial transmembrane electrical potential [2]. Within the cell it is trapped in the mitochondria, its retention is being based on whether mitochondria are intact, reflecting viable cells [2]. After i.v. administration, normal uptake of ^{99m}Tc -TF is seen in several organs, most commonly in the heart, lungs, breasts mainly during lactation, lymph nodes and in the abdomen: in the liver, gall bladder and the bowel [3]. Elimination of the radiotracer mainly occurs through the kidneys and the hepatobiliary system [2].

Pathologic uptake of ^{99m}Tc -TF can occur in benign or malignant tumors and also in infectious or non-infectious diseases [3]. The mechanism of uptake of ^{99m}Tc -TF in non-cardiac lesions is not completely understood, but the size of the lesion, its mitochondrial-rich cellularity and perfusion (factors) play a significant role [5, 6]. Overexpression of P-glycoprotein or multi-drug resistance can decrease tumor uptake and are also associated with resistance to cancer treatment.

There are few reports in the literature presenting incidental tumor findings in MPS and many of these were of signifi-

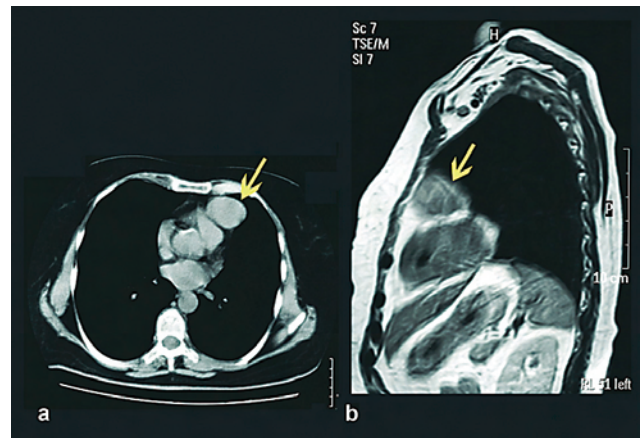


Figure 2. Computed tomography (a) and magnetic resonance imaging (b) revealed a solid mass located in the left lower anterior mediastinal area, in contact but not infiltrating pericardium, while signs of pressing the left lung were also noticed (arrows). Thymoma was the possible diagnosis.

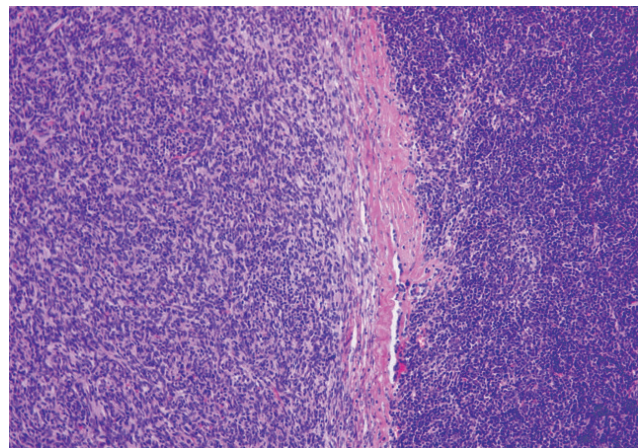


Figure 3. Histologic and immunohistochemical examination confirmed the diagnosis of a mixed type AB thymoma, stage Masaoka II2 and TNM.

cant clinical importance for the patients [3, 7-12]. Only a few cases of thymoma have been reported in these studies [8-12].

Thymomas are the most common primary tumors of the anterior superior mediastinum, accounting for 20%-30% of all mediastinal tumors. They are usually slow growing tumors and their prognosis depends on the invasion of surrounding tissues. Surgical resection is the primary treatment for thymomas.

Douglas et al (2000), reviewed three cases of incidental occult thymoma, detected during dual isotope, thallium- ^{201}Tl and ^{99m}Tc -TF SPET imaging [8]. The authors noted that solitary extracardiac uptake on ^{99m}Tc images without ^{201}Tl uptake, corresponded to well-differentiated, while the opposite to poorly-differentiated thymomas [8]. Our case was a solitary extracardiac uptake of ^{99m}Tc -TF of a well differentiated thymoma.

Benign ^{99m}Tc -TF incidental extracardiac uptake in the neck and chest has been reported in: thyroid diseases, parathyroid adenomas, benign lymph node hyperplasia, esophagitis, neurofibroma, smoker's lung, lung infections, sarcoidosis and

scapular hibernoma [3, 13-15]. Photopenia in the lung bases due to pleural effusions and abnormal right liver configuration caused by elevation of the right hemidiaphragm has also been reported during ^{99m}Tc -TF MPS [7]. In malignant diseases extracardiac uptake has been reported in: thyroid cancer, neuroendocrine tumors, mediastinal tumors, lung cancer, breast cancer, esophageal carcinoma, lymphoma, Kaposi's sarcoma, multiple myeloma and in nasopharyngeal cancer [3, 16-18].

Also ^{99m}Tc -TF incidental uptake in MPS has been detected during cardiac acquisition, when the area being viewed includes the lower thorax and the upper abdomen, in abnormalities of the liver, gallbladder, kidneys, oesophagus, stomach, bowel, bone marrow [7] and specifically in hepatocellular carcinoma, melanoma, sarcomas and in multiple myeloma [3, 19-21].

Others, reviewing the raw data cine images of 566 patients during ^{201}Tl -dipyridamole ^{99m}Tc -TF rest-stress MPS, found 234 abnormalities [7, 22] such as: bone marrow visualisation (39.7%), duodenogastric and enterogastric reflux (20.1%), non-visualisation of the gallbladder (13.2%), small-atrophic, scarred, vaguely seen or ectopic kidneys, splenomegaly, liver diseases, like hepatomegaly and cirrhosis and breast attenuation causing photopenia in the liver. The authors suggested that ^{99m}Tc -TF is accumulated in the red bone marrow due to high and/or expanded haematopoietic activity. It is obvious that all these coincidental abdominal abnormalities should alert the referring physician to suggest further investigation. Of course, duodenogastric and enterogastric refluxes, which represent approximately 20% of the abdominal abnormalities, may cause symptoms mimicking angina.

In conclusion, we report a rare case of a thymoma identified incidentally by the ^{99m}Tc -TF MPS and suggest that any extracardiac focal uptake of ^{99m}Tc -TF should be examined for possible further investigation.

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