

## Incidental Detection of Thyroid Neoplasm on $^{99m}\text{Tc}$ -SestaMIBI Myocardial Perfusion Scan - A Novel Tumour Tracer Revisted

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### Abstract

We report a case of a young Indian male who had an incidental abnormal focal uptake of  $^{99m}\text{Tc}$ Technetium-MIBI (Methoxy Isobutyl Isonitrile) in the right lobe of thyroid while undergoing  $^{99m}\text{Tc}$ -MIBI myocardial perfusion gated SPECT (Single Photon Emission Computed Tomography) imaging as a part of his myocardial ischemia status evaluation.

This focal uptake was eventually detected to be a malignant thyroid nodule for which he underwent total thyroidectomy. His biopsy was reported as Hurthle cell nodule. Though incidental detection of thyroid, breast and lung malignant pathology on  $^{99m}\text{Tc}$ - MIBI myocardial perfusion scans is well known, this case is a reminder and exemplifies the potential of  $^{99m}\text{Tc}$ -MIBI not only as an excellent myocardial perfusion agent but also as a non specific tumour tracer (for its larger usage as a tracer for neoplastic survey).

**Keywords:** Medullary thyroid carcinoma;  $^{99m}\text{Tc}$ -MIBI; SPECT; Thyroidectomy; FNAC

### Introduction

Incidental finding of thyroid nodule(s) during various anatomical imaging procedures like USG, CT and MRI scan is relatively common. However, identification of such unsuspected thyroid nodule in functional imaging techniques like whole body PET CT or other conventional nuclear medicine scans have added benefit because of their physiological basis. Various radiopharmaceuticals have been seen to detect incidental thyroid nodules.

$^{99m}\text{Tc}$ - MIBI has been used in characterization of cold nodules in thyroid especially where FNAC is negative [1] and also in detecting recurrent Medullary Thyroid Carcinoma in patients with calcitonin values in excess of 6000 ng/liter .

### Case Report

This 42 year old, Indian male patient with no known major illnesses had presented for an annual health checkup which included a cardiac work up as well. During his cardiac evaluation, he underwent a  $^{99m}\text{Tc}$ -MIBI stress myocardial perfusion scan following abnormal ECG findings on tread mill test.

10 mCi (millicurie) of  $^{99m}\text{Tc}$ - MIBI was administered intravenously at the height of exercise on a treadmill and a planar immediate post stress thorax imaging was acquired on Siemens Symbia E Gamma Camera that is routinely done as a quality control measure (for radiotracer labeling) and also to look for early sign of LV dysfunction.

Myocardial Gated SPECT (Single Photon emission Computed Tomography) imaging is done after a delay of 45-60 minutes post

injection and patients are encouraged to have a fatty meal to ensure better gall bladder clearance.

A usual practice is to acquire an immediate anterior thorax planar image to check the quality of  $^{99m}\text{Tc}$ - MIBI preparation as well to document any associated LV (left ventricular) dysfunction and abnormal non- cardiac  $^{99m}\text{Tc}$ - MIBI tracer uptake.

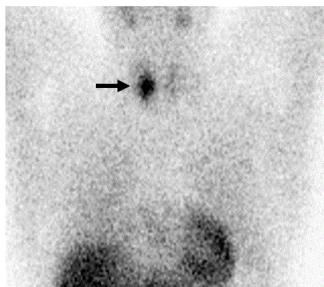
In this patient, post stress planar anterior thorax image showed an incidental focal  $^{99m}\text{Tc}$ - MIBI uptake in right lobe of thyroid that showed significant tracer retention in 2 hours delayed image (on region ratio calculation). Thus raising the suspicion of a thyroid neoplasm. His rest SPECT myocardial perfusion scan was done 3 hours later with 30 mCi of  $^{99m}\text{Tc}$ -MIBI.

A delayed anterior neck image acquired after 2 hours of injection showed focal retention of radiopharmaceutical (Figures 1 and 2). On subsequent physical examination, the thyroid gland was found to be minimally enlarged with no palpable nodules (Figures 3).

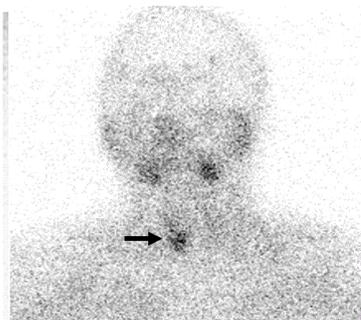
His  $^{99m}\text{Tc}$ -MIBI myocardial perfusion scan was negative for myocardial ischemia (Figure 4). USG guided FNAC was suggested in view of the  $^{99m}\text{Tc}$ -MIBI concentration right thyroid gland with no palpable abnormality.

USG neck showed an isoechoic nodule with abundant intralesional vascularity and calcifications in the right thyroid lobe. Multiple subcentimetric bilateral level II, III cervical lymph nodes were also seen with nodes on right side showing loss of fatty hilum, largest node measured 1.6 × 0.5 cm in size.

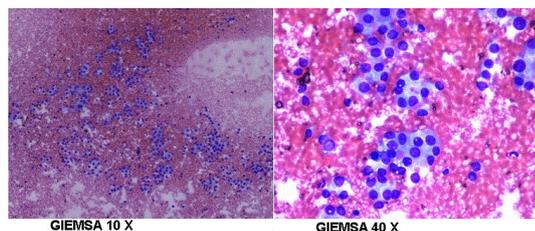
FNAC from the right thyroid nodule showed moderate cellularity and was inconclusive to rule out an occult malignancy (Figures 3). Patient subsequently underwent total thyroidectomy and his histopathology was reported as Hurthle cell nodule.



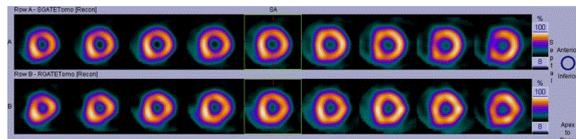
**Figure 1:** Showing planar gamma camera image ( $^{99m}\text{Tc}$ - MIBI, single detector, high resolution collimator, 256 x 256 matrix, 1 min acquisition, anterior projection, supine position) showing increased focal  $^{99m}\text{Tc}$ - MIBI uptake in the lower pole of the right lobe of thyroid with physiological cardiac and hepatic tracer uptake.



**Figure 2:** Shows delayed gamma camera planar images ( $^{99m}\text{Tc}$ -MIBI, single detector, 256 x 256 matrix, 1 min acquisition, anterior projection, supine position) after 2 hours in anterior projection showing retention of  $^{99m}\text{Tc}$ -MIBI uptake in the lower pole of the right lobe of thyroid.



**Figure 3:** Giemsa 10 X and 40 X zoom images of the slides of the FNAC sample from the nodule in the right lobe, showing moderately cellular showing sheets, papillary clusters, repetitive follicles and singly dispersed epithelial cells exhibiting mild anisocytosis and finely granular chromatin and mild degree of nuclear overlapping. Occasional cells have longitudinal grooves. No definite intranuclear inclusions. Hurthle cells are also noted in clusters and singly dispersed.



**Figure 4:** Stress and Rest  $^{99m}\text{Tc}$ - MIBI Myocardial Perfusion scintigraphy axial images ( $^{99m}\text{Tc}$ - MIBI, high resolution collimators, 64 x 64 matrix, 1.45 x zoom, both detectors, 37 views, detector configuration 76 degree, non-circular orbit, step and shoot mode acquisition) from apex to base of the heart showing normal perfusion in all segments of the left ventricular myocardium with no evidence of ischemia. Stress gated images were acquired after 45 min of  $^{99m}\text{Tc}$ - MIBI injection at peak exercise (after the patient had achieved >85% target heart rate and double product of >25,000). Rest gated images were acquired after 45 min of re-injection of 30 mCi  $^{99m}\text{Tc}$ - MIBI at rest.

## Discussion

$^{99m}\text{Tc}$ - MIBI is a lipophilic cationic organometallic complex composed of one atom of Technetium Tc (I) and six ligand molecules of 2-methoxy isobutyl isonitrile (MIBIN) [2]. A critical property of myocardial perfusion agents like MIBI is its uptake being directly proportional to regional blood flow. Its tumour seeking property is based on its ability to get concentrated intracellularly in actively dividing cells, i.e. mitochondrial complex [3].  $^{99m}\text{Tc}$ - MIBI sequestered within mitochondria by the large negative transmembrane potentials [4]. Accordingly, more intense MIBI concentrations have been found in malignant tumor cells than in normal cells because of the higher electrical gradient of the former. The mechanism of cellular radiopharmaceutical accumulation has been reported to depend on the size of a tumor, the blood flow within it [5], and the richness of mitochondria in the tumor cells [5,6].  $^{99m}\text{Tc}$ - MIBI uptake is documented to detect differentiated thyroid carcinoma nodal metastatic spread, breast malignancies, lung malignancies, brain tumors, sarcomas etc. [7] and also medullary carcinoma thyroid [1].  $^{99m}\text{Tc}$ - MIBI scanning was even found to be more sensitive than CT for localizing soft-tissue metastatic disease [8]. Also, once inside the cell,  $^{99m}\text{Tc}$ - MIBI becomes a substrate for P-glycoprotein which mediates its excretion from the cell. Hence, it can also act as a surrogate for a range of chemotherapeutic agents and this may be used to predict tumour response to chemotherapy as the level of  $^{99m}\text{Tc}$ - MIBI uptake appears to be inversely dependent on the P-glycoprotein expression of the tumour [9].

## Conclusion

This incidental finding highlights the inherent tumour avidity of  $^{99m}\text{Tc}$ - MIBI which has been underutilised in general as a non-specific tumour detecting agent and also reflects the potential for thyroid nodule evaluation especially of those with high clinical suspicion but with equivocal or FNAC negative results.

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