Extra Cardiac Uptake of Technetium-99m Sestamibi that Led to the Diagnosis of Thymoma

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AUTHORS' CONTRIBUTIONS
Leena Aziz contributions: Literature review, writing the case, writing discussion, including figures and references, submission and follow-up correspondences.
Kusai Aziz contributions: Provided the case, reviewed the literature search, provided clinical representation, participated in writing the discussion of the case, supervised first author, supervised submission of the case.

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None

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Yes

HUMAN AND ANIMAL RIGHTS
None

ABSTRACT

The thymus is an important gland for the development of T cells. Thymic tumors are very rare. A 60 year old lady presented with chest pains and was found to have extra cardiac findings on the raw images (the rotatogram) of the myocardial perfusion scan that led to the diagnosis of thymoma which was surgically removed. It has been shown in different case reports that cancer was diagnosed based on extra cardiac activity from myocardial perfusion scans. Our study demonstrates that the review of rotatograms should be done carefully and consistently with every nuclear cardiology case with the reporting of any extra cardiac activity which can lead to the diagnosis of tumors including malignant ones. Findings should be communicated clearly with the patient and their referring physicians.

CASE REPORT

BACKGROUND

Cardiovascular diseases are the most common cause of death in the United States and worldwide. Therefore, noninvasive cardiovascular tests are performed frequently. Stress tests with nuclear medicine studies including SPECT (Single Photon Emission Tomography) and less frequently PET (Positron Emission Tomography) are widely used for the noninvasive detection of CAD (coronary artery disease). Cardiac SPECT studies involve obtaining raw data that include the myocardium in addition to other organs in the field of view of nuclear cameras. Technetium-99m based compounds are among the most common used in nuclear cardiology, but at the same time these compounds are taken up by tumor cells. Our case report illustrates an example of an extracardiac activity in the mediastinum area that was noted during the review of a nuclear cardiology study that led to the diagnosis of Thymoma in a patient who presented with chest pain leading to surgical thymectomy with improvement of the patient's symptoms. Our case adds to a growing number of case reports and small retrospective studies that clearly show that the reporting of extracardiac uptake in nuclear cardiology studies can lead to the detection of benign and malignant tumors which in turn can lead to management steps that reduce patients'morbidity and mortality especially in the case of malignant tumors. This growing evidence supports the recommendation that raw images of nuclear cardiology studies should be reviewed systematically with the reporting of the presence of any extracardiac activity, along with its location and clear communication to the referring physician.

CASE REPORT

A 60 years old lady with hyperlipidemia and hypertriglyceridemia was referred for cardiovascular evaluation because she was admitted to the hospital with central retrosternal chest pain that radiated to the back while sitting and resolved with taking two baby aspirin and resting. Her EKG was abnormal and showed sinus rhythm with incomplete right bundle branch block and inferior infarction. Therefore an exercise test with nuclear imaging was ordered to evaluate for possible underlying coronary artery disease. The patient underwent the exercise stress test using standard Bruce protocol where she exercised on the treadmill for 5 minutes and 9 seconds with normal blood pressure response. She reported shortness of breath during exercise.

Imaging Findings: The patient underwent SPECT myocardial perfusion imaging using the same day protocol and with Technetium-99m Sestamibi used as the myocardial perfusion tracer. Her myocardial perfusion scans were normal (Figure 1). However, the review of the raw images (rotatograms) revealed an incidental finding of increased tracer uptake in the regions of the mediastinum, which raised the suspicion of cancer activity (Figures 2,3).

Management: It was recommended to the patient to follow up with her primary care physician for further evaluation including CT of the chest and the recommendation was communicated to the referring physician.

Follow-Up: The patient presented for follow-up several months later and stated that the work up of the extracardiac activity led to the diagnosis of thymoma and she underwent surgical thymectomy.

DISCUSSION

Etiology and Demographics: The thymus is a gland located in the upper mediastinum and plays an important role in immune function by producing and activating T cells, particularly before birth and during childhood. It also functions as part of the endocrine system, producing thymopoietin to support T cell production. Tumors of the thymus include thymoma and thymic carcinoma, which both arise from epithelial cells surrounding the exterior of the thymus.

Thymomas are rare, with an incidence of 0.13 per 100,000 person-years in the U.S., and are most common in older adults. The male-to-female ratio is approximately 1:1, with a mean age of diagnosis of 59–61 years. Thymoma is associated with a 21–29% increased risk of secondary malignancies, such as B-cell non-Hodgkin lymphoma, due to immune compromise. Annual incidence rates for thymic carcinomas are lower (0.42–0.48 per million) [1].

Clinical and Imaging Findings: Thymomas could present as chest pain, shortness of breath, swallowing problems, or as paraneoplastic syndromes like myasthenia gravis. Sometimes it can be asymptomatic and discovered incidentally during imaging. A case report showed that thymomas can lead to cardiac complications like myocarditis [2].

Treatment and Prognosis: Thymomas are usually removed surgically when possible, and in cases that are not resectable, other modalities of treatment are used such as radiation therapy. Thymomas are usually slow-growing tumors with excellent overall prognosis for early stages.

Differential Diagnosis: Other sources of chest pain such as coronary artery disease, esophageal diseases, or thyroid tumors.

Nuclear tracers are used commonly for the diagnosis and localization of tumors, especially malignant ones. Recently this has been more commonly done by PET. Technetium-99m is taken up in tissues that are metabolically active, and this is why it is used sometimes for the diagnosis of certain types of cancers like bone metastases. But it is not used routinely for the diagnosis of thymomas. It has been reported in the past the diagnosis of thymoma with the use of tetrofosmin SPECT [3]. Although the exact mechanism that leads to the uptake of technetium isotopes by thymomas is not well studied, it could be similar to other pathways described of the uptake of technetium by prostate and breast cancer cells [4].

This case report supports previous studies that emphasized the need for looking at the raw images (rotatograms) systematically and to report any extra cardiac uptake and communicate it with the patient and referring physician for further workup and evaluation which can lead to early detection of tumors including malignancies which can lead to saving patients' lives [5].

TEACHING POINT

The review of rotatograms should be done carefully and consistently with every nuclear cardiology case with the reporting of any extra cardiac activity which can lead to the diagnosis of tumors including malignant ones. Findings should be communicated clearly with the patient and their referring physicians.

QUESTIONS

Question 1: The incidence of thymoma is:

A) 13%
B) 0.13%
C) 13 per 1,000
D) 13 per 100,000
E) 0.13 per 100,000 (applies)

Explanation: [Thymomas are rare, with an incidence of 0.13 per 100,000 person-years in the U.S., and are most common in older adults.], Reference 1

Question 2: The review of rotatograms in nuclear cardiology cases is:

A) Not necessary

B) Somewhat necessary
C) Necessary
D) Should be performed in some cases
E) Necessary and should be performed in all cases (applies)

Explanation: Had the rotatograms not been reviewed, it is likely that the patient's thymoma would have gone undiagnosed as the tumor was not detected before. [This case report supports previous studies that emphasized the need for looking at the raw images (rotatograms) systematically and to report any extra cardiac uptake and communicate it with the patient and referring physician for further workup and evaluation which can lead to early detection of tumors including malignancies which can lead to saving patients' lives.], Reference 5

Question 3: On SPECT studies, cancers usually present as:
A) An area of increased density (applies)
B) An area of decreased density
C) An area of similar density to the background
D) A and B
E) A, B, and C

Explanation: Due to active metabolism, cancer is usually presented in areas of increased tracer uptake on SPECT studies. [Technetium-99m is taken up in tissues that are metabolically active, and this is why it is used sometimes for the diagnosis of certain types of cancers like bone metastases.]

Question 4: Which modality can be used in the diagnosis of cancer?
A) PET scans
B) SPECT scans
C) CT scans
D) All of the above (applies)
E) None of the above

Explanation: The case report mentions PET scans, SPECT scans, and CT scans as modalities for detecting cancer and tumors. PET scans and SPECT scans are used for localizing tumors and CT scans are used to evaluate the findings. [Nuclear tracers are used commonly for the diagnosis and localization of tumors, especially malignant ones. Recently this has been more commonly done by PET.] [It has been reported in the past the diagnosis of thymoma with the use of tetrofosmin SPECT.], Reference 3. [It was recommended to the patient to follow up with her primary care physician for further evaluation including CT of the chest and the recommendation was communicated to the referring physician.]

Question 5: Thymomas can present in the following way(s):
A) Chest pain
B) Dysphagia
C) Myasthenia gravis
D) Asymptomatic
E) All of the above (applies)

Explanation: The presentation of thymoma can range from asymptomatic to local thoracic symptoms to paraneoplastic syndromes. [Thymomas could present as chest pain, shortness of breath, swallowing problems, or as paraneoplastic syndromes like myasthenia gravis. Sometimes it can be asymptomatic and discovered incidentally during imaging. Rarely, thymomas can lead to cardiac complications like myocarditis.]

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FIGURES

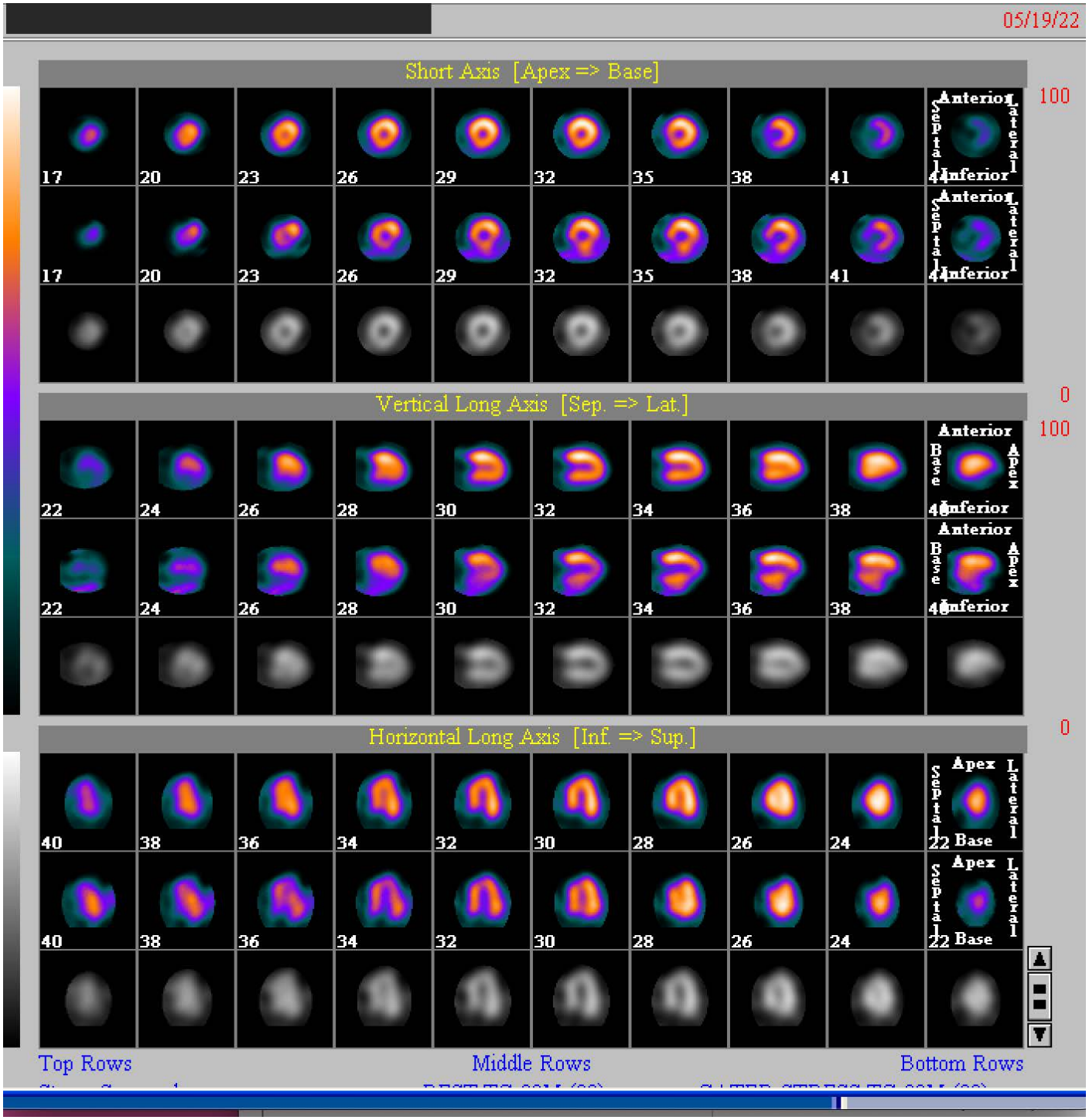

Figure 1: *60 years old female with chest pain that led to the diagnosis of thymoma. SPECT myocardial perfusion scans were normal.*

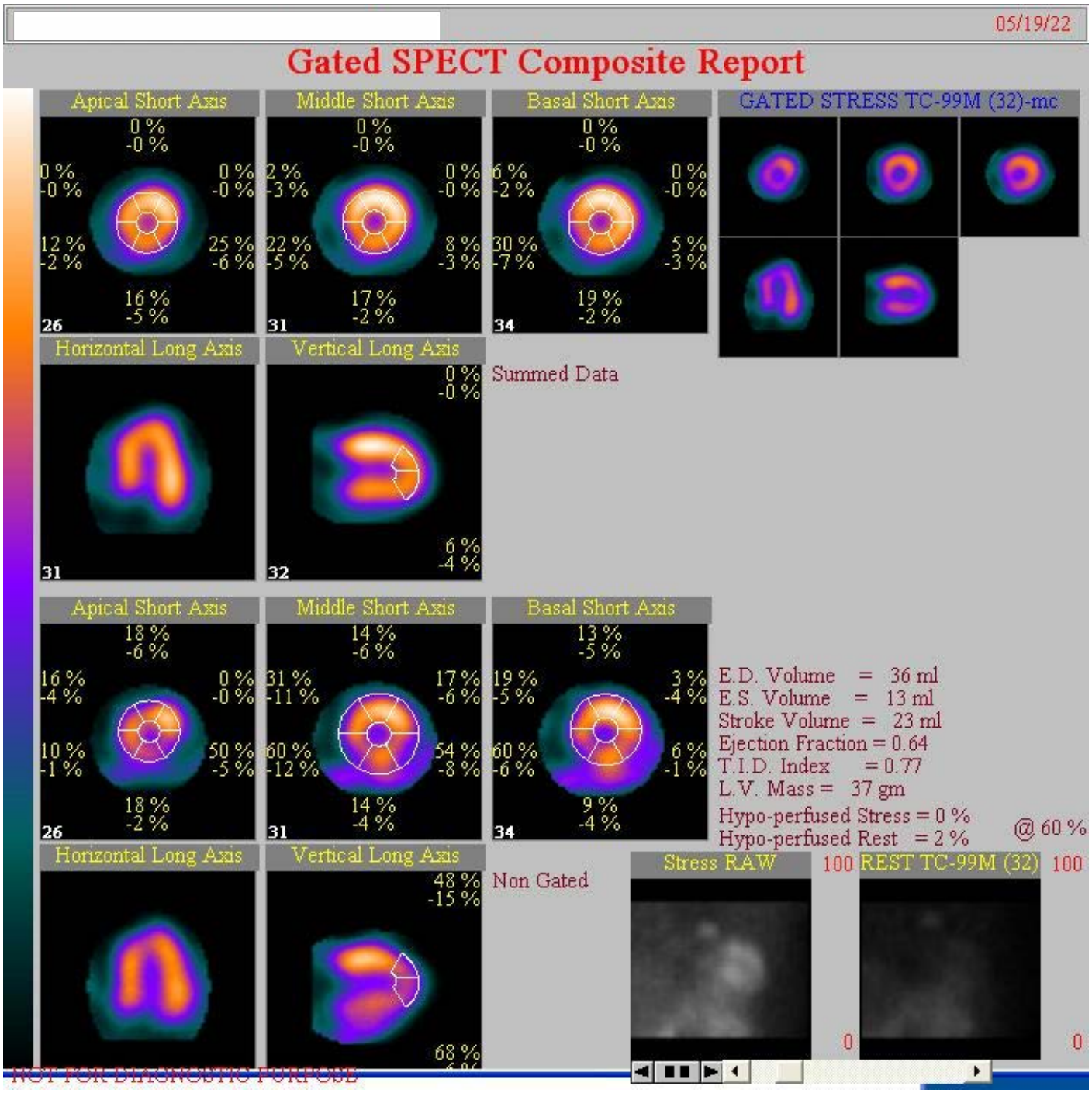

Figure 2: *60 years old female with chest pain that led to the diagnosis of thymoma. The raw images (rotatogram) showing the extracardiac activity.*

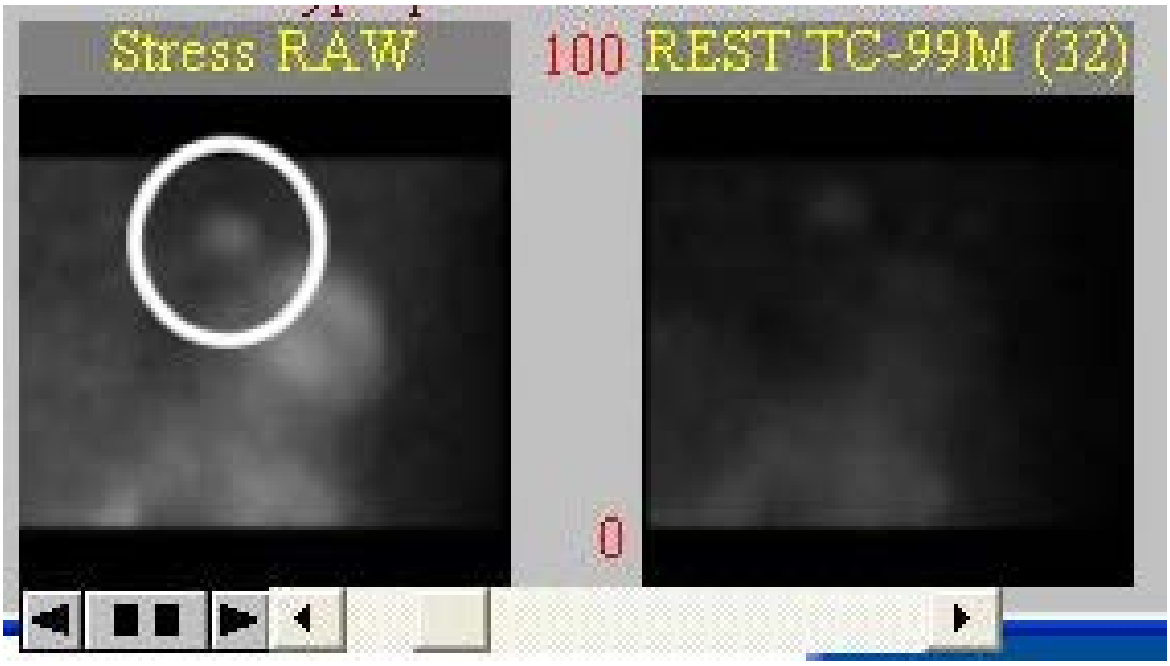

Figure 3: *60 years old female with chest pain that led to the diagnosis of thymoma. Enlarged raw images (rotatogram) of the SPECT with extracardiac activity encircled.*

KEYWORDS

Thymoma; extracardiac; SPECT; chest pain; tumor; mediastinum

ABBREVIATIONS

EKG = ELECTROKARDIOGRAM
SPECT = SINGLE PHOTON EMISSION TOMOGRAPHY
CT = COMPUTED TOMOGRAPHY
PET = POSITRON EMISSION TOMOGRAPHY

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