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Mediastinal masses in nuclear medicine studies: A diagnostic algorithm.

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Abstract:

There are multiple reasons of an anterior mediastinal mass. In this case, we discuss possible etiologies offer an algorithm to narrow the differential diagnosis. When the mass is unable to be diagnosed radiographically, the next step in imaging is a physiologic assessment with radionuclide modalities.

Introduction:

There are multiple reasons of an anterior mediastinal mass. In this case, we discuss possible etiologies offer an algorithm to narrow the differential diagnosis.

Case:

A 50 year old female presented to the Nuclear Medicine department for evaluation of a mediastinal mass. The patient had an 8 year history of this mediastianal mass with recent interval increase in size visualized on chest computed tomography angiography obtained for an unrelated reason. Due to high suspicion for lymphoma, positron emission tomography/computed tomography (PET/CT) for further workup of the enlarged mass was performed. The patient was injected with 17.8 mCi (658 Mbq) of 18-fluoro-2-deoxyglucose. The mediastinal mass was non-FDG avid (figure 1) and there was no abnormal FDG uptake in the thyroid region. Given the negative PET/CT, it was recommended that the patient undergo a technetium thyroid study as ectopic thyroid tissue was of concern. The patient was injected with 9.5 mCi (351 Mbq) of Tc-99m.The study showed the thyroid gland in a hypertrapping state and no radiotracer activity in the substernal region (figure 2). Due to a continued high suspicion for ectopic thyroid tissue, the patient underwent a limited single-photon emission computed tomography/computed tomography (SPECT/CT) with iodine-123 (^{123}I) of the neck and upper thorax after the oral administration of 424 uCi (15 Mbq) of ^{123}I. The images showed activity in the thyroid gland as well as in the substernal soft tissue density located adjacent and anterior to the aortic arch (figure 3). These findings are consistent with substernally located ectopic thyroid tissue.

Discussion:

The differential diagnosis of a mediastinal mass is widespread and most frequently includes: lymphoma, thymic mass, germ cell tumor, and ectopic thyroid tissue, with primary thymic neoplasms, thyroid masses, and lymphomas most commonly diagnosed in the adult population (*1*). The morphologic and radiologic features of each process helps to differentiate and diagnose the mediastinal mass. When there is suspicion of a mediastinal mass, a posteroanterior and lateral chest radiograph is typically the first line imaging. Although this basic modality provides limited tissue characterization, mass localization is achieved which can aid in narrowing the differential diagnosis. CT is a very important tool in evaluating a mediastinal mass, and is typically the next step after chest radiography. CT imaging has the ability to further characterize the mass based on specific location, degree of soft tissue vascularization, and attenuation of air, fat, water, and calcium. These specifications are often sufficient in achieving a diagnosis (*1*,*2*).

However, when the mass is unable to be diagnosed radiographically, the next step in imaging is a physiologic assessment with radionuclide modalities. The importance of nuclear studies in determining the diagnosis of mediastinal masses is usually underestimated and is not suggested by many authors (*3*). In this case, we will emphasize role of nuclear studies in determining the diagnosis of anterior mediastinal mass. FDG PET/CT is a very efficacious tool with many applications, largely in the setting of malignancy. In our case, PET/CT was obtained due to suspicions that the mediastinal mass represented lymphoma. Both Hodgkin and non-Hodkin lymphomas are FDG avid, and in general, FDG PET is more sensitive (85% to 95%) and specific (95%) than CT for detecting lymphoma (*4*). Due to this, it has the ability to differentiate between a lymphoma versus a more benign etiology.

Similarly, thyroid scintigraphy plays a role in evaluation of mediastinal mass when thyroid etiology is being considered. Thyroid scintigraphy is performed primarily with Tc99m, ^{123}I, and rarely iodine-131 (^{131}I). The use of Tc99m over radioiodine is typically preferred for several reasons. One example is that Tc99m has a faster acquisition time due to its significantly higher allowable administered dose (5–10 mCi [185–370 MBq]) compared to ^{123}I (200–300 µCi [7.2–11.11 MBq]). Subsequently, Tc99m is considered more patient-friendly due to this shortened exam time and less time the patient is required to lie supine with an extended neck. Another reason that Tc99mm is preferred is that it is more convenient and more readily available to hospital radiopharmacies compared to ^{123}I, and as a result, is better able to accommodate last-minute scans (*5*).

As was the case with our patient, she underwent thyroid scintigraphy with Tc99m initially, presumably due to the numerous above-mentioned benefits of Tc99m over ^{123}I. However, when there are suspicions that a mediastinal mass represents functioning thyroid tissue, imaging with either ^{123}I or ^{131}I is the method of choice, not Tc99m. This is due to the increased background activity with Tc99m caused by the activity of the salivary glands in the neck, the attenuation of gamma rays by the sternum and surrounding soft tissues, and also the substantial blood pool activity from the heart and great vessels all interfering with the visualization of retrosternal or deep functioning thyroid tissue (*6, 4*).

Conclusion:

It is important to recognize the applications of ^{123}I in thyroid scintigraphy and its appropriate clinical use. It can lead to unnecessary imaging, overall decreased health care cost, and decreased radiation exposure to the patient.

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Figure 1: non-FDG avid anterior mediastinal mass

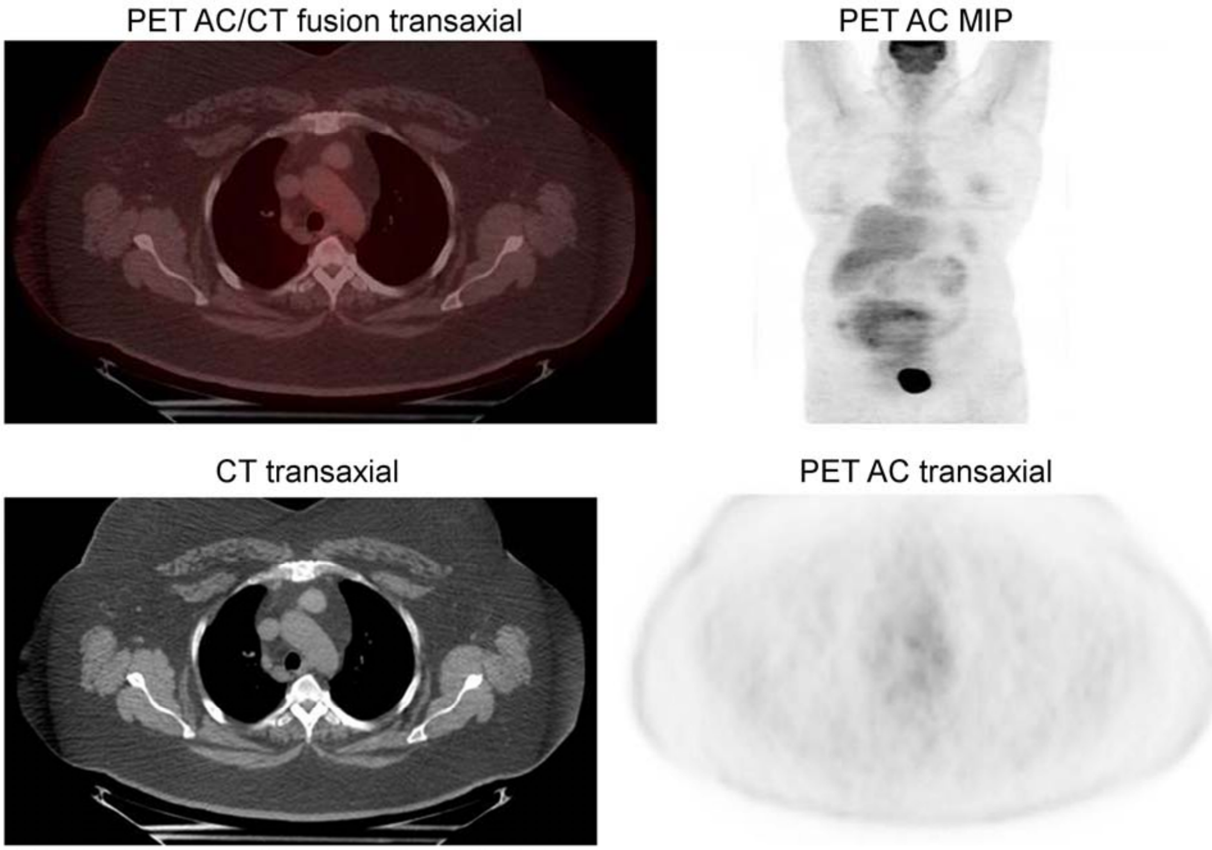

Figure 2: technetium thyroid showing the thyroid gland in a hypertrapping state and no radiotracer activity in the substernal region

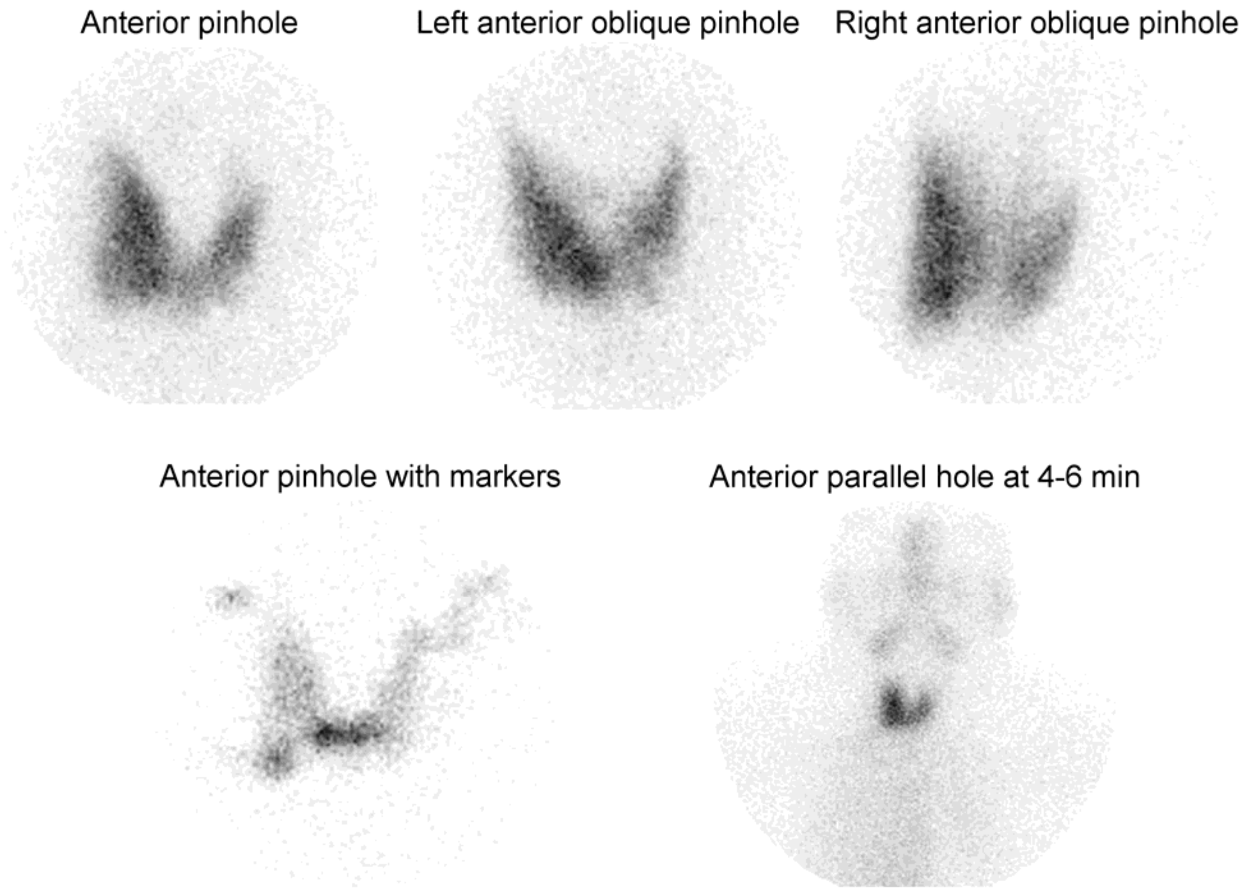

Figure 3: ^{123}I with SPECT/CT of the neck and upper thorax showing activity in the thyroid gland as well as in the substernal soft tissue density located adjacent and anterior to the aortic arch