Imaging of the cisterna chyli on PET-CT in patients with known malignancy: Report of two cases

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Abstract

A normal cisterna chyli is a structure that may simulate retrocrural adenopathy on unenhanced CT. Our case report is significant because it highlights two cases in which patients with prior primary malignancies (medullary thyroid carcinoma, esophageal carcinoma) underwent PET-CT for restaging, and in each case, a prominent right retrocrural structure is seen representing either a cisterna chyli or retrocrural metastasis. The physiologic activity of the structure on PET-CT is considered and cross-sectional abdominal images are examined in full as well. In both cases, the structure has a low attenuation on CT and a low SUVmax on PET-CT, consistent with a benign process. These cases demonstrate that with the combined use of CT attenuation and PET SUVmax as guiding parameters, a cisterna chyli should be more readily distinguishable from retrocrural adenopathy, and thus can help to avoid unnecessary invasive management of the patient.

Introduction

The cisterna chyli is a dilated lymphatic sac that lies in the prevertebral space in a retrocrural position, most commonly at the L1-L2 vertebral level [1]. It serves as the origin of the thoracic lymphatic duct. Classically, the cisterna chyli receives lymphatic fluid from three lymphatic vessels: two lumbar lymphatic trunks deliver lymph from the lower extremities, and an intestinal trunk delivers fatty lymph from the intestines [2]. From the cisterna chyli, the lymph continues cephalad into the thoracic duct, ultimately draining into the venous system, usually via the internal jugular vein [1,3].

Imaging of the cisterna chyli has been described for lymphangiography, MRI, and CT. The prevalence with which the structure is visualized by each modality differs, from 52% with
lymphangiography, 96% with MRI, to as low as 1.7% with CT [1,2,5]. We present two cases of known malignancy where the cisterna chyli is visualized with PET-CT. It is important to become familiar with the appearance of the cisterna chyli on PET-CT, to avoid confusing it with an enlarged retrocrural lymph node that might signify a recurrence of malignancy.

Case Report 1

A 72-year-old male with a history of thyroid medullary carcinoma treated with surgical resection and radiation therapy was found to have a left paratracheal mass on MRI. This mass measured 3.8 x 2.9 x 7 cm, extending from the level of the true vocal cord, down to the level just above the aortic arch. As a follow-up to this finding, he underwent a PET-CT examination which revealed that the paratracheal mass was hypermetabolic, with an SUVmax of 14.9, suggesting a regional metastasis. Also visible was an active satellite node left and lateral to the paratracheal mass, a node in the anterior mediastinum adjacent to the innominate vein, and a 3 mm soft tissue nodule anterior to the vocal fold, suspicious for additional metastasis. A cross-sectional abdominal view revealed a hypo-attenuating, inactive, right retrocrural tubular shaped structure, at the T-12 vertebral level, compatible with the cisterna chyli. This structure displays attenuation nearly identical to the abdominal aorta, suggesting the presence of lymphatic fluid within, and it is also found to be within normal anatomical parameters, as described in previous studies of the cisterna chyli. On PET-CT, this structure was found to have an SUV max of 1.48, consistent with low metabolic activity. PET-CT, therefore, shows it to be physiologically inactive in comparison to the areas of tumor recurrence. (Figure 1).
Figure 1. Patient with history of thyroid medullary carcinoma. A, Unenhanced CT of abdomen. Note the attenuation value of the cisterna chyli, 16.8 HU, is within the normal range for fluid. The cisterna chyli appears adjacent and to the right of the abdominal aorta, posterior to the right crus of the diaphragm. Cisterna chyli = 1 Abdominal aorta = 2. Subcutaneous fat = 3. B, PET-CT of cisterna chyli shows an SUVmax of 1.48. Relatively low metabolic activity suggests that the cylindrical structure is not a malignant recurrence.

Case Report 2

A 76-year-old male with a history of squamous esophageal carcinoma, treated with esophageal resection, gastric pull-through, local lymph node dissection, chemotherapy, and local radiation underwent PET-CT for surveillance of recurrence. PET-CT showed a right perigastric mass near the anastomosis measuring 2.7 x 2.0 x 3.3 cm (coronal, sagittal and vertical axes) with an SUVmax of 6.7, consistent with local recurrence. No evidence of focal disease was noted in the mediastinum or the periesophageal region, nor was any other abnormal activity visualized. On the concurrent CT, there is a prevertebral fluid-containing cyst at the level of T11, measuring 1.7 x 1.5 cm, without
activity on F-18 FDG PET. There is also a hypodense structure in the right retrocrural region at the level of T12 with an SUV max of 1.35 on PET, likely a cisterna chyli. The structure appears tubular with attenuation similar to the adjacent non-enhanced abdominal aorta. (Figure 2). Thus, PET-CT was able to confirm that the suspicious structure on CT was most likely benign, rather than a suspicious enlarged retrocrural lymph node.

![Figure 2](image.png)

**Figure 2.** Patient with a history of esophageal carcinoma. **A,** Non-enhanced CT of abdomen. Note the cisterna chyli (1), whose mean attenuation value of 10.4 HU is within the normal range for fluid. Cisterna chyli = 1 Abdominal aorta = 2. Subcutaneous fat = 3. **B,** PET-CT of cisterna chyli shows an SUV max of 1.35. Low metabolic activity is suggestive of a non-malignant structure.

**Discussion**

The cisterna chyli is a normal structure that has a highly variable appearance. In our images, the cisterna chyli, as seen on PET-CT, falls within the normal parameters seen by lymphangiography, ultrasound, MR, and CT [1,4,5,7,8]. Rosenberger et al., in the first known study to characterize the cisterna chyli, reported it to lie most commonly at the L1 or L2 level (64%), while other investigators report it to lie in the prevertebral space at levels as far superior as T10 and as far inferior as L4 [2]. With regards to its shape, the cisterna chyli is quite variable in appearance. Some adhere to the idea that it is a true cisterna chyli only if it is in the form of the bullous, dilated, lymphatic pouch. Rosenberger found this classic configuration in 53% of the lymphangiographic images in his study [1]. Many others, however, have broadened the definition, referring to any structure immediately caudal to and continuous with the thoracic duct as the cisterna chyli, regardless of the presence or absence of an ampullar, dilated configuration [1,2,4]. The variant configurations, also first described by Rosenberger, were subsequently quantified by Pinto et al. in an MR study of 200 patients [4]. Sixty-seven percent of these patients exhibited single-vessel cisterna chyli, ranging from straight thin tubes to focal round collections. More complex arrangements, some of which consisted of two or more converging straight tubes, tortuous tubes, or focal plexuses, were noted in the remainder of the patients in this study [4]. With regards to its appearance on transverse abdominal imaging, the majority of previous studies of the retrocrural space demonstrate the cisterna chyli to be directly to the right of the abdominal aorta. An MR study of 125 patients, which demonstrated visible cisterna chyli in 96% of cases, showed 70% of them to have midline cisterna chyli, with 20% and 14.2% possessing
To date, the appearance of the cisterna chyli on PET-CT has not been fully described. As it is a normal structure, it is important to be familiar with its appearance before evaluating patients with known malignancies of the mediastinum or other locations that may potentially metastasize to retrocrural lymph nodes. This will help to avoid inadvertently interpreting the cisterna chyli as retrocrural adenopathy, which it can mimic on plain CT [8]. Past reports have suggested that retrocrural adenopathy could be distinguished from other normal retrocrural structures, based upon size alone. In fact, in a study of 151 patients who underwent CT scans, Callen et al. concluded that discrete retrocrural structures greater than six millimeters in diameter represent enlarged lymph nodes, while smaller retrocrural structures represent azygous veins or normal lymphatic structures, such as the cisterna chyli [6]. However, this idea was challenged by Smith and Grigorpoulos, who studied the incidence and characteristics of the cisterna chyli with CT. They found the diameter of the cisterna chyli to be greater than six millimeters in 86% of the studies [5]. Although their population was small (n=7), it highlights the importance of relying on parameters other than size in distinguishing cisterna chyli from retrocrural adenopathy.

Our cases illustrate how PET-CT can diagnose the retrocrural structure in question as a normal cisterna chyli. Firstly, its identity, which is recognizable by the combination of its classic tubular shape, its position to the immediate right of the abdominal aorta, and its location at the T-12 vertebral level, can also be assured by its attenuation of 16.8 Hounsfield units (HU), a value to be expected of a lymphatic fluid-filled structure, since fluid attenuation values are generally between 0-20 HU. Secondly, in our cases, the retrocrural structures’ low FDG-PET SUVmax values of 1.5 and 1.3 respectively support the conclusion that these are indeed the cisterna chyli. In contrast to the low attenuation, low SUVmax cisterna chyle, Figure 3 demonstrates PET-CT in a comparison patient with rectal carcinoma and a metastatic retrocrural node (31 HU) with SUVmax = 5.0. The retrocrural SUVs of our cases are both very low in comparison to the SUVs of the respective malignant recurrences, 14.9 and 6.7, thus suggesting that they do not represent metastases.
Figure 3. Comparison case of a patient with a history of rectal carcinoma. A, Non-enhanced CT of abdomen shows a 2 cm retrocrural lymph node (arrow) with a mean attenuation of 31 HU. B, The retrocrural node (arrow) has an SUVmax of 5.0.

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