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Journal

Clinical Imaging, 38(4)

ISSN

0899-7071

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Publication Date

2014-07-01

DOI

10.1016/j.clinimag.2014.02.002

Peer reviewed

Published in final edited form as:
Clin Imaging. 2014 ; 38(4): 529–531. doi:10.1016/j.clinimag.2014.02.002.

Imaging of invasive thymoma in the costophrenic recess presenting as thickening of arcuate ligaments of the diaphragm

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Abstract

Imaging findings in a patient with invasive thymoma in the costophrenic recess are presented, in whom CT and MRI revealed lateral arcuate ligament thickening. Increased FDG uptake on subsequent PET/CT was helpful in suggesting the correct diagnosis. A second patient with much more obvious invasive thymoma occurring in the costophrenic recess is presented for comparison. It is a well-known fact that thymic malignancies can metastasize to the pleura even years after resection. Rarely, they may present as focal thickening of the diaphragmatic lateral arcuate ligament.

Keywords

Computed tomography; Arcuate ligament; lateral; Thymoma; FDG/PE

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Introduction

The lateral arcuate ligament is a fascial thickening which serves as a diaphragmatic attachment and extends from the transverse process of L1 to the mid 12th rib, overlying the quadratus lumborum muscle (Figures 1 and 2) [1]. The lateral arcuate ligament can sometimes be detected on CT or MRI as a nodular structure contiguous with the diaphragm in the posterior retroperitoneum [2]. In one series of 100 unselected patients undergoing CT, five were found to have retroperitoneal pseudotumors due to the lateral arcuate ligament, and the findings were bilateral in three cases [2]. We recently encountered a patient with invasive thymoma in the costophrenic recess, in whom the CT and MRI findings resembled the lateral arcuate ligament. This appearance likely reflects the known predilection of invasive thymoma to spread and recur in the pleural space [3, 4]. We describe this case to highlight the potential pitfall of mistaking invasive thymoma in the costophrenic recess for the lateral arcuate ligament. Another patient with much more evident invasive thymoma in the costophrenic recess was also encountered recently and is presented for comparison.

Materials and Methods

We identified two patients from the records of the senior author between 2005 and 2013, one of whom presented with invasive thymoma in the costophrenic recess demonstrating CT and MRI findings resembling the lateral arcuate ligament. The second patient demonstrating much more conspicuous CT findings is presented for comparison. Clinical and imaging findings were recorded by review of all available medical and radiological records. For patient 1, spiral contrast-enhanced CT-only (non-hybrid) was performed in the cephalic to caudal direction on a multidetector row PET/CT (Biograph 16 Hi-Rez; Siemens AG, Erlangen, Germany) at a collimation of 5 mm after the administration of 150 mL of intravenous iodinated contrast (Iohexol, Omnipaque 350; GE Healthcare), MR images were obtained on a 1.5 Tesla whole body MR scanner (Signa; General Electric Medical Systems, Milwaukee, WI) using the body coil for excitation and a torso phased-array surface coil (GE Medical Systems, Milwaukee, WI) for signal reception. MR sequences included in-phase and opposed-phase T1-weighted axial spoiled gradient echo, fat-saturated T2-weighted axial rapid acquisition with refocused echoes, T2-weighted coronal single-shot rapid acquisition with refocused echoes, and fat-saturated axial T1-weighted 3-dimensional spoiled gradient echo before and after the intravenous administration of 0.1 mmol/kg gadolinium chelate (gadodiamide, Omniscan; Nycomed). PET/CT images were obtained from the skull base to the thighs (Biograph 16 Hi-Rez; Siemens AG, Erlangen, Germany) after the administration of 23 mCi of ^{18}F-FDG. For patient 2, spiral CT was performed in the cephalic to caudal direction on a multidetector row CT (Lightspeed; GE Healthcare, Milwaukee, WI) at a collimation of 5 mm after the administration of 100 mL of intravenous iodinated contrast (Iopamidol, Isovue 370; Bracco Imaging) and PET/CT images were obtained from the skull base to the thighs (Gemini LXL, Philips, Andover, MA) after the administration of 10.8 mCi of ^{18}F-FDG.

Case reports

Patient 1

A 39 year old man who presented with myasthenia gravis underwent resection of an anterior mediastinal invasive thymoma followed by adjuvant chemotherapy. Surveillance CT performed 6 years later demonstrated new plaque-like nodular soft tissue thickening adjacent to the right side of the diaphragm in the vicinity of the lateral arcuate ligament (Figure 3). A subsequent PET/CT scan demonstrated increased FDG uptake with an SUV of 2.4 in this lesion. The left lateral arcuate ligament and left diaphragmatic crus exhibited mildly increased FDG avidity as well; no other manifestations were identified. Ultrasound guided biopsy of the right diaphragmatic thickening confirmed a diagnosis of invasive thymoma.

Patient 2

A 60 year old man underwent resection of an anterior mediastinal invasive thymoma followed by adjuvant chemotherapy. CT performed 7 years later because of a new right-sided varicocele revealed a right inferior pole renal mass without lymphadenopathy or other cause for the varicocele. This CT also demonstrated very conspicuous large mass-like soft tissue thickening adjacent to the left side of the diaphragm in the vicinity of the lateral arcuate ligament (Figure 4). A subsequent PET/CT scan demonstrated increased FDG uptake with an SUV of 6.0 in this lesion. No additional CT or PET abnormalities were identified to suggest additional metastases. Ultrasound guided biopsy of the left diaphragmatic mass confirmed a diagnosis of invasive thymoma.

Discussion

In the vast majority of cases, plaque-like or nodular soft tissue prominence in the retroperitoneum at the level of the kidneys and in continuity with the diaphragm is due to normal variation in the appearance of the lateral arcuate ligament (Figures 1, 2) [5], and the primary importance of such an appearance is to recognize this pseudotumor at CT or MRI and prevent further inappropriate work up or testing. Our study suggests that in the highly selected subset of patients with a history of invasive thymoma, the possibility of recurrent disease in the costophrenic recess should be included in the differential diagnosis. Comparison with prior studies to document progressive abnormality or with PET scan to confirm increased FDG uptake may be helpful in establishing a malignant etiology, as in our two patients [6-8].

The pleural cavity is a well-known location of both primary and metastatic disease. Metastatic disease is probably the commonest neoplasm to involve the pleura, with common primary sites including non-small cell lung cancer, breast cancer, and lymphoma [8, 9]. Primary diaphragmatic tumors are also a source of potential confusion; however, secondary findings such as a pleural effusion or diaphragmatic disruption can help avoid misinterpretation [10-12]. Endometriosis in the vicinity of the lateral arcuate ligament can usually be confidently diagnosed based on clinical or imaging characteristics [13]. Many of these disease entities are unlikely to present as isolated lesions in the costophrenic recess,

which an elongated or plaque-like morphology is most likely to cause confusion with the lateral arcuate ligament.

This case study has a number of limitations. Cases were identified retrospectively by a single author, with the associated potential biases. For example, we do not know the frequency with which invasive thymoma recurs in the costophrenic recess, or how often recurrence in this location resembles the lateral arcuate ligament. We also do not have surgical proof that the recurrences described in this study were truly in the costophrenic recess. We believe this is the most plausible explanation for the imaging appearances, particularly given the known predilection of thymoma to spread in the pleural cavity. The costophrenic recess extends inferiorly to the level of L1 and the lesion locations are compatible with this [14]. Irrespective of the true anatomic space occupied by the invasive thymoma in Patient 1, the CT and MRI findings remain potentially confusing, since they could be mistaken for the normal variant pseudotumor of the lateral arcuate ligament and PET/CT may be useful in detecting pathology [6-8].

Awareness that invasive thymoma in the costophrenic recess may resemble lateral arcuate ligament thickening may help prevent misdiagnosis and facilitate appropriate patient management.

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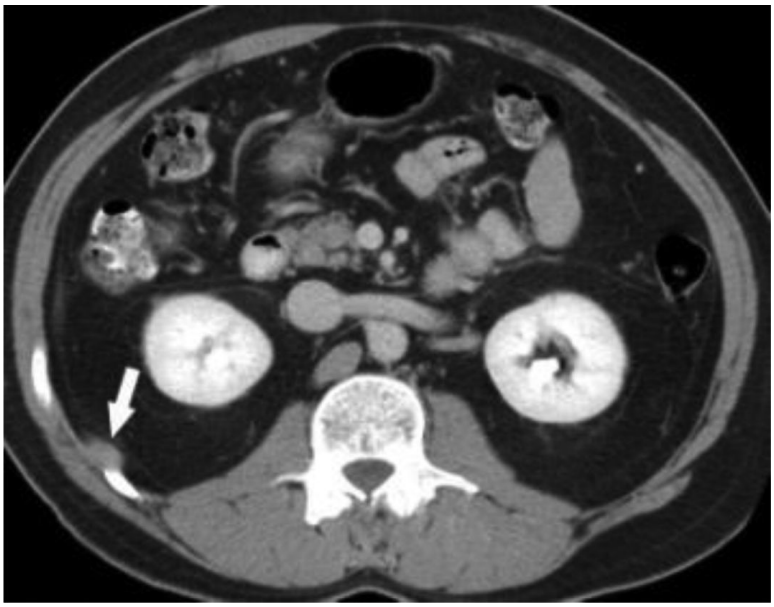

Figure 1.

Axial contrast-enhanced CT image in a 47 year old man presenting with right lower quadrant abdominal pain demonstrates normal variation/thickening of the lateral arcuate ligament (arrow).

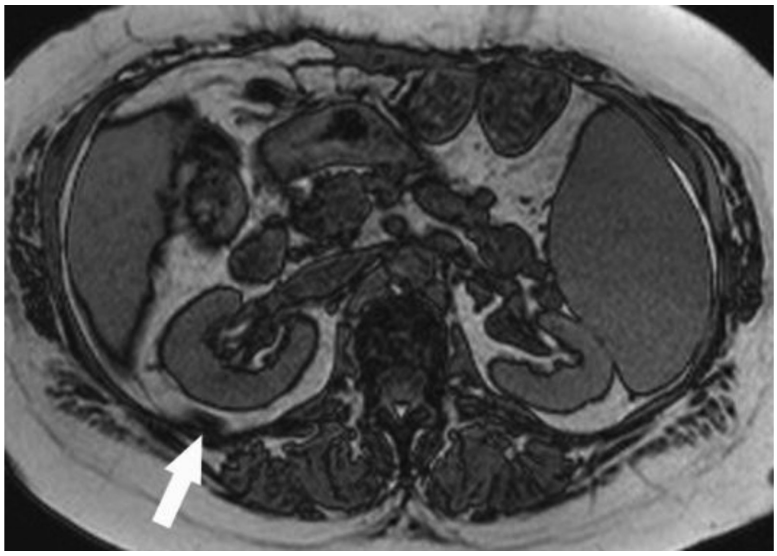

Figure 2.

Axial T1 gradient echo T1-weighted opposed-phase image in a 55 year old woman for pre-liver transplant evaluation shows normal variation/thickening of the lateral arcuate ligament (arrow).

Figure 3A.

Axial contrast-enhanced CT image obtained in a 39-year-old man 6 years after neoadjuvant chemotherapy and thymectomy.

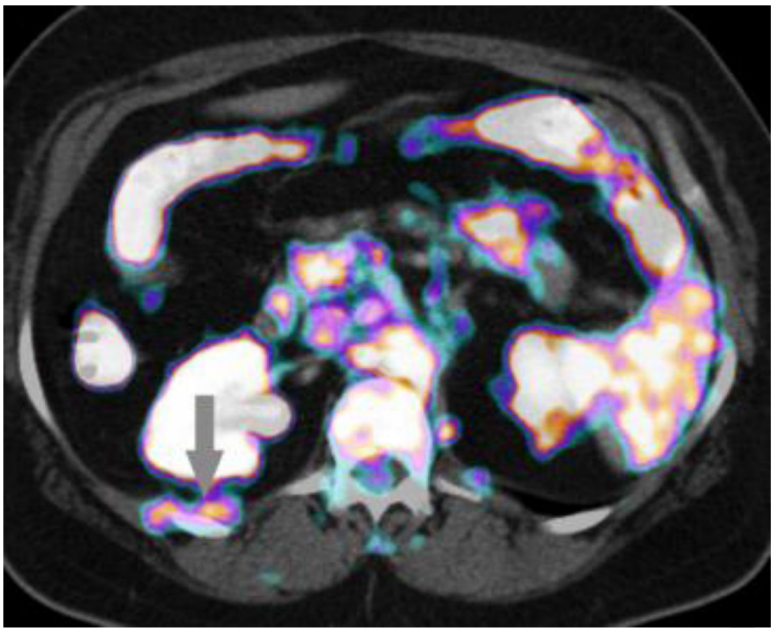

Figure 3B.

Axial PET/CT fusion image demonstrates increased 18F-FDG avidity within the lesion (arrow). The left median arcuate ligament and left diaphragmatic crus also exhibit FDG uptake without thickening seen on the contrast enhanced CT (Figure 3A).

Figure 3C.

Axial T1 gradient echo T1-weighted opposed-phase image reveals soft-tissue signal intensity nodularity and thickening (arrow) at the expected anatomic position of the right lateral arcuate ligament. The left median arcuate ligament is also mildly thickened.

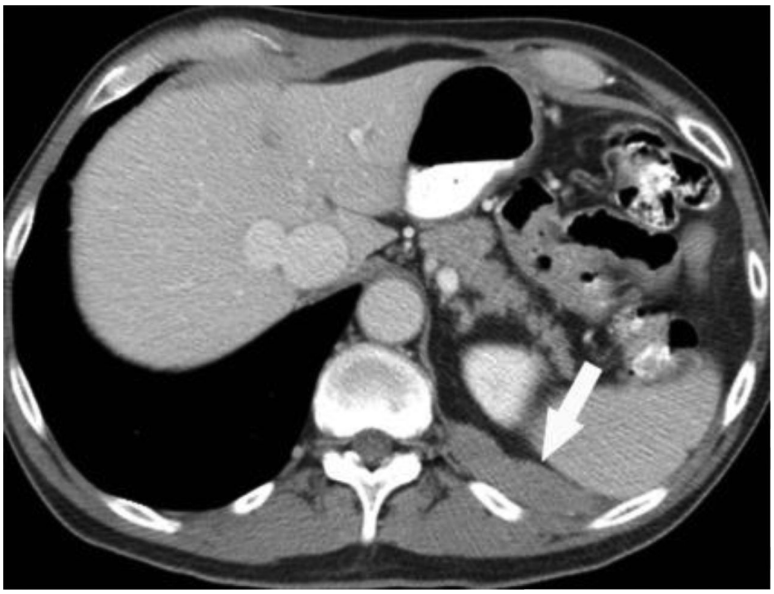

Figure 4A.

Axial contrast-enhanced CT image obtained in a 60-year-old man 7 years after neoadjuvant chemotherapy and thymectomy. Conspicuous mass-like thickening (arrow) is visible in the expected location of the left lateral arcuate ligament.

Figure 4B.
Axial PET/CT fusion image demonstrates increased 18F-FDG avidity in the lesion (arrow).

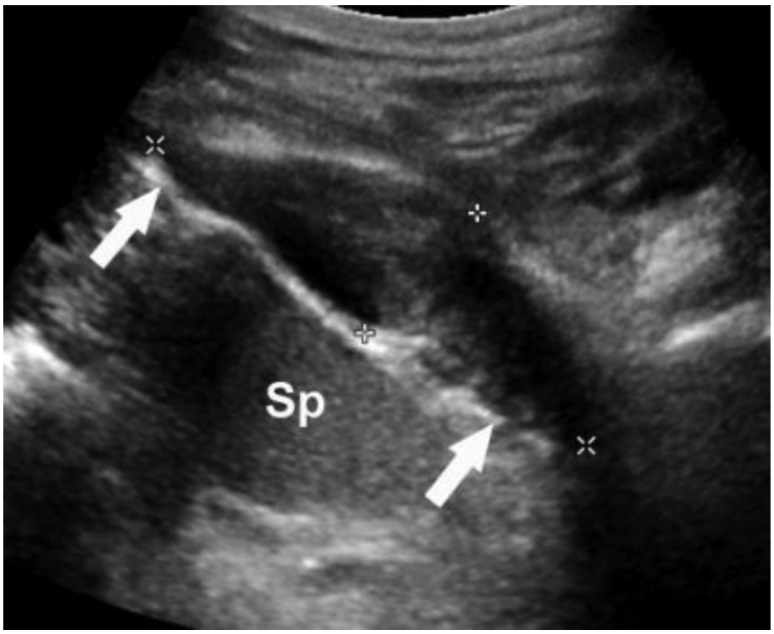

Figure 4C.
Oblique sonographic image during core needle biopsy demonstrates the lesion (calipers) is hypoechoic and superior to the diaphragm (arrows) and the spleen (Sp), consistent with a location in the costophrenic recess.