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Computed Tomographic Distinction of Perirenal Liposarcoma From Exophytic Angiomyolipoma: A Feature Analysis Study

James J. Ellingson, MD, Fergus V. Coakley, MD, Bonnie N. Joe, MD, PhD, Aliya Qayyum, MBBS, Antonio C. Westphalen, MD, and Benjamin M. Yeh, MD

Department of Radiology, University of California San Francisco, San Francisco, CA

Abstract

Purpose—To identify computed tomographic (CT) findings that distinguish perirenal liposarcomas from exophytic angiomyolipomas.

Materials and Methods—We identified CT scans of 20 patients (13 women and 7 men; mean age, 63 years) with either perirenal liposarcoma (n = 11) proven at histopathology or large exophytic angiomyolipomas (n = 9) determined by 2-year stability (n = 6) or histopathology (n = 3). Two independent readers unaware of the final diagnoses recorded the presence of the following CT findings: (1) tumoral vessel extending into the renal cortex, (2) tumoral vessel extending into the renal hilum, (3) renal parenchymal defect at the site of tumor contact, (4) intratumoral hemorrhage, (5) nonfat attenuating intratumoral nodules, and (6) calcification.

Results—A tumoral vessel extending into the renal cortex was seen only in angiomyolipomas (7 and 6 of 9 patients versus 0 and 0 of 11 liposarcomas for readers 1 and 2, respectively; $P < 0.005$ for both). A parenchymal defect was more commonly seen in angiomyolipomas (7 and 6 of 9 angiomyolipomas versus 1 and 1 of 11 liposarcomas for readers 1 and 2, respectively; $P < 0.05$ for both). Calcifications were seen by both readers in 6 of 11 liposarcomas but not in any angiomyolipomas ($P < 0.05$). The other recorded findings were not useful in distinguishing CT features ($P > 0.1$ for both readers).

Conclusions—In the evaluation of a fatty perinephric mass at CT, the presence of a tumoral vessel extending into the renal cortex or a renal parenchymal defect at the site of tumor contact strongly favors the diagnosis of exophytic angiomyolipoma, whereas calcifications suggest liposarcoma.

Keywords

angiomyolipoma; CT; retroperitoneal liposarcoma; kidney; neoplasms

Both exophytic renal angiomyolipomas and retroperitoneal liposarcomas may appear as large fat-containing perinephric masses at computed tomography (CT). Whereas renal angiomyolipomas are benign and may be treated by embolization, local resection, or surveillance, retroperitoneal liposarcomas are malignant tumors that require more extensive resection and aggressive local therapy, including irradiation.¹ The reported 5-year survival rates for retroperitoneal liposarcomas range from 23% to 46%.¹

Accurate radiological differentiation between angiomyolipoma and liposarcoma is important for patient management because the histopathological diagnosis of small tissue samples may be inaccurate (Fig. 1). Although prior studies have explored the value of CT findings for

distinguishing large angiomyolipomas from liposarcomas,^{2,3} the significance of tumoral vascular insertion relative to the renal hilum and renal parenchyma has not been studied. Therefore, we undertook this study to identify CT findings that distinguish perirenal liposarcomas from exophytic angiomyolipomas.

MATERIALS AND METHODS

Subjects

This was a retrospective single institutional study approved by our institutional review board and was compliant with requirements of the Health Insurance Portability and Accountability Act. Informed consent was not required. We performed a computerized search of our radiology information system (IDXrad, software version 9.7.1; IDX Systems, Burlington, Vt) from January 1997 to August 2005 to identify patients whose abdominopelvic CT reports (1395 examinations) contained the character strings “angiomyolipoma,” “retroperitoneal,” and “liposarcoma,” or “retroperitoneal” and “fat” and “mass.” Patients with angiomyolipomas were included in our study if the lesions satisfied all of the following criteria: (1) the lesion was larger than 4 cm, (2) there was histopathological confirmation ($n = 3$), or the lesion was stable on serial CT scans for 12 months or longer ($n = 6$), (3) the lesion was exophytic (less than 50% encompassed by renal parenchyma), and (4) the angiomyolipoma was solitary. Patients with perirenal liposarcomas were included if they had both CT imaging and histopathological proof of diagnosis ($n = 11$). All inclusion criteria were confirmed by 1 author (J.J.E.) who did not participate in further image interpretation for this study. This author reviewed all available medical records for the patients in this study for outcomes relating to the masses.

CT Techniques

Computed tomographic scans were performed using spiral CT scanners (LightSpeed [$n = 10$], HighSpeed [$n = 10$]; General Electric Medical Systems, Milwaukee, Wis). Nineteen patients received 150 mL of intravenous iohexol (Omnipaque 350; Nycomed Amersham, Princeton, NJ). Seventeen patients received 800 mL of oral diatrizoate meglumine (Hypaque; Nycomed Amersham). One patient received 250 mL of rectal diatrizoate meglumine (Hypaque). Slice thickness was 5 ($n = 17$) or 7 mm ($n = 3$). All images were contiguous. Indications for CT scanning were evaluation of known or suspected tumor ($n = 16$) and abdominal pain ($n = 4$).

Image Interpretation and Analysis

Two independent readers (B.M.Y., F.V.C.) reviewed all CT scans without knowledge of the clinical or histopathologic findings. Each reader recorded the presence or absence of any of the following:

1. renal parenchymal vascular pedicle (tumoral vessel extending into or through the renal parenchyma; Fig. 2),
2. renal hilar vascular pedicle (tumoral vessel extending into the hilum without traversing the renal parenchyma; Fig. 2),
3. renal parenchymal defect at the site of tumor contact,
4. intratumoral hemorrhage,
5. non-fat-attenuating intratumoral nodules, and
6. calcification.

The Fisher exact test was used to compare the frequency of these findings between patients with angiomyolipomas and liposarcomas. A P value of less than 0.05 was considered to be significant.

RESULTS

The CT findings of the exophytic angiomyolipomas and liposarcomas are summarized in Table 1. A renal parenchymal vascular pedicle (Figs. 2, 3) was seen in 7 of 9 patients with angiomyolipoma by reader 1 and in 6 of 9 patients by reader 2 but was not seen in any of the patients with liposarcomas ($P < 0.005$ for both readers) (Figs. 4, 6). Similarly, a parenchymal defect was more commonly seen in angiomyolipomas (7 and 6 of 9 angiomyolipomas versus 1 and 1 of 11 liposarcomas for readers 1 and 2, respectively; $P < 0.05$). Calcifications were seen by both readers in 6 of 11 liposarcomas but not in angiomyolipomas ($P < 0.05$).

Both readers identified a parenchymal defect sign in the same patient with liposarcoma. This liposarcoma engulfed the right kidney which contained exophytic cysts (Fig. 5), creating the appearance of a fat-attenuation mass arising out of the kidney. Additionally, a component of the liposarcoma exerted mass effect along the lower renal pole, creating the illusion of a parenchymal defect sign (Fig. 5). However, both readers also identified calcification in this tumor and did not identify a parenchymal vascular pedicle.

The frequency of finding non-fat-attenuating intratumoral nodules, a renal hilar vascular pedicle, hemorrhage, and additional intrarenal fatty tumors were not different between patients with angiomyolipomas versus liposarcomas ($P > 0.1$ for both readers).

One patient with a subsequently resected angiomyolipoma was misdiagnosed preoperatively as having a liposarcoma by pathologists from 2 different institutions based on a biopsy that stained negative for HMB-45.⁴ Based on the incorrect preoperative diagnosis, the patient in this case underwent preoperative radiation therapy before resection, and the resected specimen was then found to be an angiomyolipoma based on positive staining for HMB-45. Notably, at preoperative CT, the presence of prominent tumoral vessels extending into the renal cortex was observed (Fig. 1), suggesting that this tumor arose from the renal parenchyma and was a renal angiomyolipoma rather than perirenal liposarcoma.

DISCUSSION

We found that for large perirenal fatty masses, the presence of a renal parenchymal vascular pedicle (a tumoral vessel that extends into or through the renal parenchyma, as opposed a vessel extending directly into the renal hilum) suggests the diagnosis of angiomyolipoma rather than liposarcoma, and the presence of a parenchymal defect also suggests angiomyolipoma. These radiological findings of angiomyolipomas are of importance because angiomyolipomas as diagnosed by CT may be misdiagnosed at histopathology as liposarcomas because of sampling error at biopsy, as was the case for one of the patients in our series. In such cases, the CT findings may prompt appropriate reanalysis of the biopsy specimen or repeat biopsy to make the correct diagnosis. Similarly, benign angiomyolipomas may cause clinical concern because they may grow over time and raise the concern for malignancy.^{5,6} In this regard, additional CT findings that help differentiate angiomyolipomas from liposarcomas would help guide medical management and surgical approach.

Our results build upon the findings of Israel et al,² who reported the value of identifying enlarged intratumoral vessels as helpful for the diagnosis of angiomyolipoma. Our results clarify the findings of Israel et al² by showing that tracing the course of these blood vessels is also important for differentiating angiomyolipomas from liposarcomas: large intratumoral vessels that extend into either the renal parenchyma or renal sinus are highly suggestive of an angiomyolipoma, whereas vessels that course around the kidney to insert into the renal hilum or inferior vena cava are associated with liposarcoma. The association of a renal parenchymal vascular pedicle and renal angiomyolipoma is not surprising because angiomyolipomas are thought to arise from renal vascular malformations and hence would be expected to share

vasculature with the renal parenchyma. Liposarcomas, in contrast, arise from the fat around the kidney rather than from the kidney itself, so the blood supply and drainage is likely to be separate from that of the renal parenchyma.

Another sign that has been reported to determine whether a mass is arising from the kidney is the renal parenchymal defect sign.^{2,3} Although we also found this sign to be more common in exophytic angiomyolipomas than liposarcomas, our findings show that this sign should be used with caution because it may be seen in some cases of perirenal liposarcoma. Furthermore, foci of renal cortical scar or exophytic hemorrhagic cysts that abut liposarcomas may be mistaken as parenchymal defect signs (Fig. 5B).

We also found that calcifications were seen only in liposarcomas and not in angiomyolipomas ($P < 0.05$ for both readers). This finding of calcifications in association with liposarcoma has been previously noted in prior reports, but the sample sizes of those published case series were too small to achieve statistical significance.^{1,7} In this regard, the presence of calcifications should not be regarded as a sensitive finding for liposarcomas. Conversely, several benign entities are known to cause retroperitoneal calcifications as well,⁸ so the coincidental coexistence of a benign angiomyolipoma and benign retroperitoneal calcification from another etiology could potentially occur.

The propensity of angiomyolipomas to hemorrhage is well known, so evaluation of a fat-attenuation retroperitoneal mass for evidence of hemorrhage is logical. Also, Wang et al³ described non-fat-attenuation intratumoral nodules as being characteristic of liposarcoma. This is a logical expectation as liposarcomas display varied histology with areas of non-lipomatous material adjacent to or surrounded by lipomatous material.¹ However, in our patient series, neither the presence of hemorrhage nor the finding of non-fat-attenuation intratumoral nodules was useful to distinguish angiomyolipomas from liposarcomas. It is likely that the heterogeneous appearance of liposarcomas and large angiomyolipomas make such signs unreliable for tumor characterization at contrast-enhanced CT.

Our study has several limitations. The CT protocols were not standard for all patients. Although the retrospective nature of our study precluded having a set CT protocol, the imaging technique reflects that of daily evaluation. Potentially, improved CT images may allow for more sensitive depiction of secondary signs that may differentiate perirenal liposarcomas from angiomyolipomas. Another limitation is that histopathological proof of diagnosis was not available in 6 of the 9 cases of angiomyolipoma. However, these 6 lesions showed stability in size and appearance for at least 6 months and were therefore unlikely to be malignant. Our study also did not include other fat-attenuating retroperitoneal masses (myelolipoma, lipoma, or extramedullary hematopoiesis, etc), but these rarer entities do not often present as diagnostic dilemmas. Similarly, we did not evaluate fat-poor angiomyolipomas nor poorly differentiated nonfatty liposarcomas in our series because the diagnostic question in such would involve distinguishing these entities from a larger range of solid tumors.

Notwithstanding these limitations, our findings show that in the evaluation of a fatty perinephric mass at CT, the presence of a tumoral vessel extending into or through the renal parenchyma or renal parenchymal defect seems to reliably indicate the diagnosis of exophytic angiomyolipoma, whereas the presence of calcifications strongly suggests liposarcoma.

References

1. Karanikas I, Liakakos T, Koundourakis S, et al. Surgical management of primary retroperitoneal liposarcomas. *Acta Chir Belg* 1993;93:177–180. [PubMed: 8237233]

2. Israel GM, Bosniak MA, Slywotzky CM, et al. CT differentiation of large exophytic renal angiomyolipomas and perirenal liposarcomas. *AJR Am J Roentgenol* 2002;179:769–773. [PubMed: 12185060]
3. Wang LJ, Wong YC, Chen CJ, et al. Computerized tomography characteristics that differentiate angiomyolipomas from liposarcomas in the perinephric space. *J Urol* 2002;167:490–493. [PubMed: 11792904]
4. Ashfaq R, Weinberg AG, Albores-Saavedra J. Renal angiomyolipomas and HMB-45 reactivity. *Cancer* 1993;71:3091–3097. [PubMed: 8490837]
5. Lemaitre L, Robert Y, Dubrulle F, et al. Renal angiomyolipoma: growth followed up with CT and/or US. *Radiology* 1995;197:598–602. [PubMed: 7480725]
6. Steiner MS, Goldman SM, Fishman EK, et al. The natural history of renal angiomyolipoma. *J Urol* 1993;150:1782–1786. [PubMed: 8230504]
7. Tateishi U, Hasegawa T, Beppu Y, et al. Primary dedifferentiated liposarcoma of the retroperitoneum. Prognostic significance of computed tomography and magnetic resonance imaging features. *J Comput Assist Tomogr* 2003;27:799–804. [PubMed: 14501373]
8. Kroepil P, Coakley FV, Graser A, et al. Appearance and distinguishing features of retroperitoneal calcifications at computed tomography. *J Comput Assist Tomogr* 2003;27:860–863. [PubMed: 14600450]

FIGURE 1.

A 54-year-old woman with angiomyolipoma misdiagnosed at biopsy immunohistochemistry as liposarcoma. Subsequent resection showed the mass was an angiomyolipoma. A, Oral and intravenous contrast-enhanced CT scan shows a fatty mass (arrowhead) arising from the kidney (small arrow) and a tumoral vessel (large arrow) extending from the mass through the renal parenchyma (images B and C) into the renal sinus.

FIGURE 2.

Diagram of tumoral vessel insertions. A renal parenchymal vascular pedicle was considered to be present when a visible tumoral vessel extended from the perirenal fatty mass (M) into (A) or through (B) the renal parenchyma (K). In contrast, a renal hilar vascular pedicle (C) was considered to be present when a visible tumoral vessel extended from the perirenal fatty mass into a renal hilar vessel without traversing the renal parenchyma.

FIGURE 3.

A 72-year-old man with angiomyolipoma. Computed tomographic scan with intravenous contrast shows a fat-attenuation mass (arrowhead) with a parenchymal vascular pedicle (large arrow), which is a visible intratumoral vessel extending into the renal parenchyma (small arrow).

FIGURE 4.

A 65-year-old man with liposarcoma. A, Intravenous contrast-enhanced CT image above the level of the kidney shows a fat-attenuation mass (arrowhead) with a tumoral vessel (arrow) that extends caudally (B and C) into the renal hilum rather than into the renal parenchyma. This finding was termed a *hilar pedicle*.

FIGURE 5.

A 72-year-old man with a retroperitoneal liposarcoma. A, Intravenous contrast-enhanced CT shows a large fat-attenuation mass (arrowheads) associated with a renal parenchymal defect (arrow). B, More inferiorly, this mass (arrowheads) engulfs the kidney and is associated with another renal parenchymal defect (arrow) which could possibly be an incidental renal cyst enveloped by the liposarcoma but which was not described on the pathology report.

FIGURE 6.

An 82-year-old woman with a large perirenal retroperitoneal liposarcoma with a prominent intratumoral vein. This vein drained directly into the renal hilum (not shown).

Clinical and CT Characteristics of Patients With Large Exophytic Angiomyolipoma Versus Perirenal Malignant Liposarcoma

TABLE 1

CT Finding	Reader 1			Reader 2		
	Exophytic Angiomyolipoma (n = 9)	Liposarcoma (n = 11)	P	Exophytic Angiomyolipoma (n = 9)	Liposarcoma (n = 11)	P
Parenchymal vascular pedicle	7	0	<0.001	6	0	<0.005
Hilar vascular pedicle	3	3	0.99	2	4	0.64
Parenchymal defect	7	1	<0.005	6	1	<0.05
Intratumoral calcification	0	6	<0.05	0	6	<0.05
Hemorrhage	4	4	0.99	2	0	0.19
Intratumoral non-fat-attenuating nodules	5	10	0.13	4	9	0.16