Renal Angiomyolipomas (AML) with minimal fat: CT And MR Imaging patterns

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Learning objectives

To illustrate the most frequent CT and MR patterns of renal angiomyolipomas (AML) with minimal fat

To demonstrate the most effective CT and MR imaging examination techniques in the diagnosis of renal AML with minimal fat

To evaluate the fat content in renal AML with minimal fat, using Chemical-Shift MR Imaging

Background

Angiomyolipoma (AML) is the most common benign tumor of the kidney. AML is composed of fat, smooth muscle, and abnormal blood vessels (1,2,3,4)

Tipically the fat component predominates and AML can be accurately diagnosed by identifying the intratumoral fat, which shows negative attenuation on unenhanced CT images and signal loss on fat suppressed MR images (1,2,3,4)

However, intratumoral fat cannot be visualized in approximately 4.5% of all AMLs (AML with minimal fat) and can be explained by the predominance of blood vessels, muscle, or immature fat or the scattering of a small amount of fat within other components (1,2,3,4,6)

Imaging findings OR Procedure details

PROCEDURE DETAIL

We retrospectively compared the MR imaging patterns in 23 patients who performed preoperative CT or MR imaging for renal Angiomyolipomas with minimal fat

All MR examinations were performed with a 1.5T MR system (Philips Gyroscan Intera Power) using chemical shift Dual-Echo Gradient Echo (GRE) T1w axial MR images (TR=150 msec; TE=2,3/4,6 msec), Turbo Spin Echo (TSE) T2w sequences with and without fat suppression (FS) and contrast-enhanced (ce) dynamic GRE FS-T1w sequence. Post contrast GRE FS-T1w images were also evaluated before and after digital subtraction procedure

All the CT examinations were performed with a multislice CT system (Toshiba Aquilion Multi 4), using unenhanced and post-contrast axial scans, associated to multiplanar...
reconstructions. Contrast enhanced images were acquired on "Early post-contrast phase" (40" after contrast agent injection) and on "Nephrographic-phase" (120" after contrast agent injection). Multiplanar reconstructions were created with an independent workstation.

We evaluated the following parameters:

1) Morphologic characteristics (shape, densitometry (CT), signal intensity (MR), Contrast enhancement patterns) of renal AML with minimal fat

2) Quantitative measurement of fat content using Chemical-Shift dual-echo GRE MR acquisition (Signal intensity index). The Signal Intensity Index (SI) was calculated using the following formula: 

\[
\text{SI}_{\text{index}} = \left( \frac{\text{SI}_{\text{inphase}} - \text{SI}_{\text{opposed-phase}}}{\text{SI}_{\text{inphase}}} \right) \times 100.
\]

Signal Intensity Index > 25% was considered typical for AML (6)

**IMAGING FINDINGS**

**ANGIOMYOLIPOMAS WITH A PREDOMINANT FATTY COMPONENT**

Angiomyolipomas with a predominant fatty component typically showed fat attenuation on CT images (Fig. 1) and isointensity relative to fat with all MR imaging sequences (Fig. 2). On MR images their signal intensity was higher than that of the renal parenchyma on T1w images, with signal loss using frequency-selective fat-saturation techniques (Fig. 2)(1,2,3,4)

**LIPID-POOR ANGIOMYOLIPOMAS (CT)**

Lipid-poor angiomyolipomas showed medium to high attenuation on unenhanced CT images, and homogeneous and prolonged enhancement patterns (Fig. 3, Fig. 4). Lipid-poor angiomyolipomas showed different degrees of enhancement, depending on the amount of vascularized tissue components they contain. In some cases lipid-poor angiomyolipomas showed the "angular interface sign" with renal parenchima (Fig. 4) (1,2,3,4,5)

**LIPID-POOR ANGIOMYOLIPOMAS (MR)**

Lipid-poor angiomyolipomas frequently demonstrated isointensity on T1w images and homogeneous low signal intensity relative to the renal parenchyma on T2w images. The intravoxel coexistence of fat and water showed a loss of signal intensity on focal areas of the lesion or throughout the entire mass on opposed-phase images compared with in-phase Chemical-Shift images (Fig. 5,6,7,8,9,10,11). Some lesions also demonstrated "india ink" artifact at the interface of a renal mass with the renal parenchyma or within the renal mass (Fig. 5,6,7).

On ce T1w MR images Lipid-poor angiomyolipomas showed homogeneous enhancement on late CT-MR ce-images (but AML with minimal fat can show different
degrees of enhancement depending on the amount of vascularized tissue components on ce-images) (Fig. 5,6,7,8,9,10,11) (1,2,3,4,8)

In some cases lipid-poor angiomyolipomas show the "angular interface sign" with renal parenchima on TSE T2w images (Fig. 11) (8)

**DUAL-ECHO CHEMICAL-SHIFT MR IMAGING** Using dual-echo Chemical-Shift MR Imaging, all renal AML with minimal fat showed a SI index > than 25% (average SI 59.1%). The signal intensity index in the AML group was 59.1% (range 29.3%- 80.4%) Double-echo GRE chemical shift MR imaging resulted specific in the diagnosis of AML with minimal fat, using a signal intensity index of 25%. (Fig. 5,6,7) (6,7)

Images for this section:
**Fig. 1:** Angiomyolipoma with a predominant fatty component of the left kidney. The lesion showed a central area of fat attenuation on enhanced CT images (arrows) (A,B,C,D).

**Fig. 2:** Angiomyolipoma with a predominant fatty component of the upper pole of the left kidney (arrows). Lesion resulted hyperintense respect to the renal parenchima on T1w (A) and T2w image (B), with loss of signal intensity on fat suppressed T2w (C,D) and FS T1w GRE (E) and ce FS T1w GRE images (F).

**Fig. 3:** Lipid-poor angiomyolipoma of the left kidney. The lesion showed high attenuation on unenhanced CT image (A) and homogeneous vascularization on ce CT images (B,C). Lesion showed the "angular interface sign" with renal parenchima (arrows).
Fig. 4: FIG. 4 Lipid-poor angiomyolipoma of the lower pole of the left kidney. The lesion showed a nodular area (arrows) of medium attenuation on unenhanced CT image (A) and homogeneous vascularization on ce CT images (B,C), surrounded from hemorrhage.
**Fig. 5:** FIG. 5 Lipid-poor angiomyolipoma of the upper pole of the left kidney. The lesion showed low signal intensity on T2w image (A) and a loss of signal intensity on opposed-phase images (B) compared with in-phase (A) Chemical-Shift images (SI index 74.1%).

**Fig. 6:** FIG. 6 Lipid-poor angiomyolipoma of the upper pole of the left kidney. The lesion showed intermediate signal intensity on T2w image (C) and a loss of signal intensity on opposed-phase images (B) compared with in-phase (A) Chemical-Shift images (SI index 80.4%).
Fig. 7: FIG. 7 Lipid-poor angiomyolipoma of the upper pole of the left kidney. The lesion showed not homogeneous signal intensity on T2w image (C) and a loss of signal intensity on opposed-phase images (B) compared with in-phase (A) Chemical-Shift images (SI index 54.0%).
**Fig. 8:** FIG. 8 Lipid-poor angiomyolipoma of the lower pole of the right kidney. The lesion showed low signal intensity on T1w (A) and T2w (C) MR images and areas of loss of signal intensity (arrows) on opposed-phase images (B). Homogeneous vascularization on ce FS T1w MR images (D,E,F)

**Fig. 9:** FIG. 9 Lipid-poor angiomyolipoma of the lower pole of the right kidney (arrows). The lesion showed the "india ink" artifact at the interface of the renal mass with the
renal parenchyma on opposed Phase T1w image (B), low signal intensity on T2w image (B), no saturation on fat suppressed T2w (D) and T1w (E) images and homogeneous enhancement on ce FS T1w MR image (F)

Fig. 10: FIG. 10 Multiple bilateral renal angiomyolipomas (arrows). Lesions showed medium to high signal intensity on T1w (A) and T2w (D) MR images, with loss of signal intensity on opposed-phase images (B,C). Homogeneous enhancement on ce FS T1w MR images (E,F)

Fig. 11: FIG. 11 Lipid-poor angiomyolipoma of the upper pole of the left kidney (arrows). The lesion showed heterogeneous signal intensity on T2w (C,D) MR images, and a loss
of signal intensity on opposed-phase (B) compared with in-phase (B) Chemical-Shift images. Moderate enhancement on ce FS T1w MR images (F,G,H). Lesion showed the "angular interface sign" with renal parenchima on coronal TSE T2w images (D)
Conclusion

Angiomyolipomas with minimal fat (the fat-poor variant) account for less than 5% of all renal angiomyolipomas and are difficult to differentiate from other solid renal tumors (1,2,3,4).

Some authors reported findings useful in the differentiation of AML with minimal fat: (a) homogeneity of tumor enhancement (b) prolonged enhancement pattern (c) high tumor attenuation on CT unenhanced scans, (d) intratumoral calcification, and (e) loss of signal intensity on MR opposed phase images (1,2,3,4,6,7).

In our experience, the most frequent patterns were:

Medium to high attenuation on unenhanced CT images

Hypointensity on T2w MR images

Homogeneous enhancement on late CT-MR ce-images (but AML with minimal fat can show different degrees of enhancement depending on the amount of vascularized tissue components on ce-images)

Loss of signal intensity on opposed-phase images. In our experience all renal AML with minimal fat showed a SI index > than 25% (average SI 57%) using Chemical-Shift MR Imaging.

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References


3) Katabathina VS, Vikram R, Nagar AM et al Mesenchymal Neoplasms of the Kidney in Adults: Imaging Spectrum with Radiologic-Pathologic Correlation


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