Adrenal myelolipomas: Radiographic features on CT and MRI

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Learning objectives

- Describe the characteristics of adrenal myelolipomas on CT and MRI revealed putting on their most common images.
- Discuss the differential diagnosis with other benign and malignant masses.
Background

The adrenal glands are small glands located above both kidneys. Their shape is like an inverted V or T and their weight is about 5 grams each. The adrenal cortex is responsible for secreting cortisol, aldosterone and androgens; and the medulla secretes epinephrine and norepinephrine.

The adrenal glands are common sites of disease, presenting some kind of alteration in 9% of the population. Their detection has increased significantly with the increasingly frequent use of ultrasound, computed tomography (CT) and magnetic resonance (MR), in which many of these injuries are detected incidentally. The role of CT and MRI is not only important for detection but also for the characterization of lesions, differentiating between benign and malignant lesions and determining the final diagnosis in many of them. The most common injuries are the adenoma and metastasis. Besides these, other lesions can be found such as pheochromocytomas, carcinomas, lymphomas, myelolipomas, cysts and pseudocysts, hemangiomas and bruises, among others.

Adrenal myelolipoma is a rare benign nonfunctioning tumor and it is a slow growing tumor composed of fatty tissue and hematopoietic elements.

The incidence varies from 0.08 to 0.4%. They are usually discovered incidentally at autopsy, surgery or imaging studies (ultrasound or CT) performed for other reasons. They became 15% of adrenal incidentalomas.

They occur frequently between the fifth and seventh decade of life, with no sex predominance, and they have a preference for the right adrenal gland. The adrenal myelolipoma location is the most common, although there have been reports of extraadrenal location, mainly in the pelvis, preferably in the presacral region (50% of extra-adrenal myelolipomas location), although there are cases described with gastric, liver, lymph nodes or spleen skull location. They can be associated with endocrine pathology, such as obesity, Cushing's syndrome or Addison's disease. Tumors not normally exceed 5 cm in diameter and behave asymptomatic. The diagnosis is made by ultrasound or CT, usually as an incidentally diagnosis. Large tumors may have symptoms, mainly abdominal pain, constipation or vomiting. More rarely, in bigger tumors spontaneous retroperitoneal bleeding can occur.
Findings and procedure details

**STUDY**

**Computered Tomography**

It is the primary tool for the detection and characterization of adrenal masses. Its advantages: high availability, speed and excellent spatial resolution. Its disadvantages: use of ionizing radiation and intravenous iodinated contrast, lower resolution contrast when compared with MRI.

In order to get a proper viewing of the adrenal glands, the collimation must be 2.5 to 3 mm or 5 mm in multislice CT, rebuildable 2.5 mm. First cuts are performed without contrast to evaluate the density of the lesion and, depending on this result, axial scans are performed with contrast in porto-venous phase (about 60-70 seconds postcontrast) and in late phase (10 minutes postcontrast).

Tumor size, stability of size, shape, contour, density and homogeneity should be considered in order to differentiate malignant lesions from those which are benign. These are suspicious signs of malignancy: size larger than 4 cm, size changes in successive controls, irregular edges and heterogeneous density.

**Magnetic resonance imaging**

It is used as second-line test if the results of CT are not diagnostic. It is also used as the primary modality in cases of incidental findings on MRI requested for other reasons. The advantages of this method include high resolution, high contrast performance in differentiating benign from malignant lesions, inherent multiplanar capability and absence of iodinated contrast and ionizing radiation. The disadvantages are: long examination time, high cost and low availability, as well as a lower spatial resolution.

Suggested sequences are: T2 HASTE or RARE (rapid acquisition with relaxation enhancement) coronal and axial, axial fat-saturated T2, T1 gradient "in phase" and "out of phase" axial and coronal, and T1-weighted images with fat saturation pre and post-contrast with gadolinium in 4 phases (VIBE: volumetric interpolated breath-hold examination).

**MYELOLIPOMA ADRENAL**

Its main feature, which determines the diagnosis by CT or MRI, is the presence of macroscopic fat.
The complementary study of choice is CT, where the presence of a well-encapsulated neoplasm, circumscribed and with negative values in Hounsfield units due to macroscopic fat (marked hypodense, <-10 UH), mixed with areas of higher density (hematopoietic component) is observed. A common feature of these neoplasms is the detection of calcifications that may pose diagnostic doubts.

At RM, the fatty component is hyperintense on T1-weighted sequences, with intermediate signal in T2 and significant drop in signal on T1 or T2 with fat saturation.

MRI with fat suppression is the best technique to demonstrate the presence of adipose tissue, although the existence of core elements or bleeding can cause persistent areas of hyperintensity. The signal intensity of the intrallesional hemorrhage may vary depending on the age of the bleeding. The areas of greatest presence of marrow elements show higher signal intensity.

If despite of imaging diagnosis, including MRI, diagnostic doubts remain, it is appropriate to perform a biopsy guided by ultrasound or CT scan, but it carries a high risk of rupture and hemorrhage. That should be done specially if the dimensions are greater than 4.3 cm, which is when probability is higher for a malignant mass. The functionality of the neoplasm should be evaluated.

**DIFFERENTIAL DIAGNOSIS**

The differential diagnosis includes other extramedullary hematopoietic tumors, which usually associate severe anemia, myeloproliferative syndrome (mainly hepatomegaly and splenomegaly) or severe skeletal disorders, and other retroperitoneal tumors (renal angioma, adrenal adenoma, adrenal carcinoma, adrenal metastases, retroperitoneal lipoma, liposarcoma).

**Adenomas** are histologically characterized by the presence of clear cells with abundant intracytoplasmic lipid (microscopic fat) separated by fibrovascular tissue. This feature is what allows us to characterize them at CT and MRI.

At CT, adenomas are well demarcated lesions, with regular margins, smaller than 3 cm, homogeneous and hypodense relative to liver parenchyma in the cuts without contrast. This hypodensity is because the presence of microscopic adipose tissue.

With MRI, adenomas present intensity similar to the normal signal gland, especially T2-weighted sequences, unlike carcinomas and metastases which are hyperintense on T2 due to its higher water content. However, the most relevant sequence is based on the presence of intracytoplasmic lipid content in adenomas, which is the "chemical shift". This technique involves two acquisitions T1 weighted with different echo times, one in which
the protons located in water and fat are in phase, and another in which these protons are out of phase. In sequence "out of phase" there is a significant drop in signal strength of the adenomas (greater than 20%) compared with the intensity that occur in the sequence "in phase". This is the most sensitive method to differentiate adenomas from metastases.

**Metastasis:** Metastases are often bilateral, larger than adenomas, heterogeneous and irregular contours. At CT without contrast generally have a higher density 10 UH. At MRI are hypo- and hyperintense on T1-weighted sequences and T2 respectively, without significant drop in signal sequence T1 "out of phase". However, an atypical adenoma may present the same characteristics, so in many cases, for a definitive diagnosis should be performed PET or biopsy.

**Pheochromocytoma:** Its diagnosis is clinical and biochemical (elevation of plasma and urinary catecholamines) and on the other hand by imaging, either CT or MRI, which show a similar performance in detecting these tumors in the adrenal glands. They usually measure between 2 and 5 cm, are hypervascular and plenty of fluids, many with cystic areas within. At MRI are hypointense on T1-weighted sequences and markedly hyperintense on T2-weighted sequences.

**Adrenal Carcinoma:** At diagnosis, the tumor is large, usually greater than 6 cm, reaching in some cases up to 20 cm. They are heterogeneous in CT and MRI, with necrosis areas and hemorrhage areas (hypodense on CT, hyperintense on T1 and T2 MRI) with intravenous contrast enhanced in nodular form. 30% are calcified. It can be seen direct invasion of adjacent organs, renal vein and inferior vena cava. Furthermore, lymphadenopathy and distant metastasis can be observed.

**Lymphoma:** In CT and MRI it is manifested as diffuse or nodular glandular thickening and 50% of cases are bilateral.

**Cystic lesions:** Cysts endothelium coated (40%), pseudocysts (post-hemorrhage) (39%), parasitic cysts, cysts epithelium coated.

The cysts lined by endothelium are simple, hypodense on CT, hypointense on T1 and hyperintense on T2 without contrast enhancement or solid component.

**Hematoma:** At CT is a spontaneously hyperdense lesion without significant enhancement after contrast administration. MRI is the most sensitive and specific test; the sign of injury varies with the temporality of hematoma, however, usually the lesion is hyperintense on T1 and hypointense on T2 without significant reinforcement with gadolinium.
If it is impossible to determine the benign or malignant nature of a lesion by CT or MRI, there are three alternatives:

- PET can be performed to assess the degree of metabolic activity (higher metabolism lesion, the greater likelihood of malignancy).
- A second alternative, more conservative, is to control the lesion in 3-6 months.
- A third possibility is to perform a percutaneous biopsy under CT, with the patient in the lateral position to the side of the lesion in order to reduce the risk of pneumothorax.

**TREATMENT**

Treatment of adrenal myelolipoma should be individualized. Smaller adrenal myelolipoma, less than 3-4 cm and asymptomatic lesions should be followed for a period of 1 or 2 years with CT or MRI, although some professionals prefer a clinical follow without radiological studies. Surgery is indicated when patients are symptomatic, have a size greater than 5 cm or if malignancy is suspected. Asymptomatic growing tumors during follow-up must be surgically removed. According to that described in the literature, the most used technique is the laparoscopic surgical approach, with no size limit lesion to its indication. However this approach should not be used when there are adhesions or infiltration of neighboring organs.
Images for this section:

**Fig. 1:** Adrenal Myelolipoma. Axial NECT shows a right adrenal mass. Well encapsulated neoplasm, circumscribed and negative values in Hounsfield units due to macroscopic fat (marked hypodensity <10 HU).

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Fig. 2: Abdominal CT. Axial with intravenous contrast. Right adrenal myelolipoma. Hypodense mass depends on the right adrenal gland, fat sample density and some calcifications. Measured 6.5 x 8.5 cm.

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**Fig. 5:** Abdominal CT. Axial, with intravenous contrast. Right adrenal mass (Myelolipoma adrenal right) of 5.8 cm in maximum diameter, heterogeneous density with fat advertising space, punctate calcifications and areas of contrast enhancement is identified. Encapsulated and circumscribed.

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Fig. 6: Abdominal CT. Axial with intravenous answer. Adrenal myelolipoma left. Left adrenal mass 3 x 3 cm in diameter, hypodense, encapsulated, circumscribed, with calcium density images inside (hematopoietic component).

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Fig. 3: Abdominal MRI: axial cut. T1 SPGR. Right adrenal myelolipoma. Diameter 5.8 cm right adrenal mass is identified.

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**Fig. 4:** Abdominal MRI: axial cut. T1 SPGR. Right adrenal myelolipoma. Left adrenal mass of 3 x 3 cm diameter is identified.

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Fig. 7: Abdominal MRI: axial cut. T2 FSAT (fat saturation). Right adrenal myelolipoma. Diameter 5.8 cm right adrenal mass is identified.

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Conclusion

• With the large amount of incidental lesions found in the adrenal glands, it is necessary to know the radiological characteristics of the myelolipomas, to differentiate them from other entities.

• We know how to behave myelolipomas adrenal CT and MRI, in its various phases and sequences. And so to characterize properly, to opt for treatment or proper monitoring.
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