The Art Of Adrenal Lesions In Medical Imaging

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Learning objectives

The purpose of our educational exhibit is:

• To be familiar with the typical imaging findings of the adrenal lesions.

• To illustrate the commonest adrenal lesions in almost all the imaging modalities, starting with an X-ray, Ultrasound, CT scan, MRI and ending up with advanced modalities as the PET/CT.

• Describe the pitfalls specific to adrenal lesions.

• Demonstrate the role of the radiological imaging in the detection and characterization of the adrenal gland lesions.
Background

- The discovery of an adrenal lesion most of the time is incidental during imaging work-up of an unrelated disease and this is because of the unique anatomical location of the adrenal glands which make the adrenals routinely visualized in every abdominal and chest imaging as well.
- Although most of the adrenal lesions are benign, but by knowing the exact findings and the simple pitfalls in the radiological imaging modalities could help in making the differential diagnosis narrower.
- In our poster we are presenting most of the adrenal lesions with variable imaging modalities including X-ray, Ultrasound, CT and MR as well as nuclear scans.
Findings and procedure details

- The adrenal lesions cover a broad spectrum from benign to malignant entities and that is because of the increased use of imaging modalities that frequently detect the incidental lesions.
- The radiology plays a very important role in differentiation of the detected lesions and it is the mainstay of imaging for identifying and assessing adrenal lesions, for which an algorithm to aid characterization is helpful.
- Adrenal lesions are classified in many different ways as either malignant vs benign or cystic vs solid.
- In our poster we are presenting most of the solid adrenal lesions that the radiologist most of the time will face.

**Fig. 1: Adrenal Adenoma:** is the most common tumor in adrenal glands. It can be classified into lipid rich or poor. Fig 6 shows an example of a lipid rich adenoma which was incidentally discovered in a CT chest study. The figure shows in details US, CT with HU and the characteristic pattern of wash out of more than 60%. Also MRI images with In/Out phase and the drop of signal intensity due to lipid content.

**Fig. 2: Adrenal Hematoma:** can be classified in traumatic and non-traumatic. In Fig. 1 we illustrated a case of a premature baby presented with abdominal swelling. Abdominal US showed hypoechoic left supra renal mass with no appreciable intrinsic vascularity. NCECT and CECT scans showed non enhancing hypodense mass and diagnosed as hematoma in correlation also with the clinical history of being premature. Follow up after 1 week with ultrasound showed cystic degeneration of the hematoma. (The hematoma shows changing characteristics in terms of echotexture and size on sequential images as shown).

**Fig. 3: Wolman Disease:** is a rare autosomal recessive disorder of copper metabolism affecting multiple systems. Fig.3 shows a case of 1 month old baby presented with abdominal mass. AXR as initial step showed bilateral calcified enlarged adrenals. We can notice also the enlarged both splenic and liver shadows. Ultrasound study shows bilateral enlarged echogenic adrenals (due to calcifications). MRI studies re-demonstrate the enlarged adrenal with low signal intensity caused by the calcifications. Another image was added to demonstrate the hepatosplenomegaly.

**Fig. 4: Adrenal Metastasis:** which represents the most common malignant lesion involving the adrenal gland. Here is a case of an old patient, S/P right nephrectomy for RCC. Follow up CT scan showed a left adrenal lesion with heterogeneous enhancement. PET/CT scan showed an intense hyper metabolic activity in the left adrenal lesion.
impressive of metastasis. The most common primary usually arise from the lung, colorectal and breast cancer.

**Fig. 5/6: Adreno-Cortical Carcinoma:** is a rare but highly malignant neoplasm. It could be hormonally inactive or active as in this 40 years old male patient whom known to have hypertension and presented with abdominal pain. A routine CXR was done which showed normal chest findings but there was a soft tissue opacity at the left upper quadrant. CT scan then was requested. NCCT shows a left suprarenal mass, separate from the kidney with calcifications causing mass effect. Post contrast images show mild enhancement. MRI was done and showed the large left adrenal lesion of complex signal intensity with heterogeneous enhancement on the subtracted image. PET-CT preformed showing intense uptake in the large left adrenal mass. Physiological uptake and excretion is seen in the gastrointestinal and genitourinary tract. Surgical removal of the adrenal lesion was done and the histopathology result proved Adreno-Cortical carcinoma.

**Fig. 7: Adrenal Myelolipoma:** are rare benign, and usually asymptomatic unless in large sized (> 4 cm) which requires follow up and could be complicated by hemmorhage. It is characterized by the predominance of mature adipocytes. As we can notice in the following example for a patient had abdominal ultrasound study to R/O cholecystitis. Ultrasound study initially showed an incidental hyper echoic supra renal lesion. Plain and contrast enhanced CT was done and show right supra renal lesion of negative HU unit denoting fat content with minimally enhanced sot tissue. MRI was requested for further characterization and the key image is the **In/Out of phase** images which show significant signal drop denoting fat content.

**Fig. 8: Neuroblastoma:** is a tumor of neuroblastic origin, corresponding to the most common extracranial solid childhood malignancies and represents the third commonest childhood tumor. Fig. 8 is a case of a 3 years old child presented with abdominal mass. Ultrasound study show left supra renal mass of mixed echotexture with calcifications (80-90%). CECT show the large supra renal mass with calcifications encasing the adjacent blood vessels. Multi-sequential MRI images post chemotherapy cycles showed regression in size of the lesion. Nuclear MIBG study show tracer uptake in the left supra renal region. Other tracer activity in the skull as well as the femoral bone proved to be bone metastasis (most common site of metastasis).

**Fig. 9: Pseudolesions (Splenule):** 30 years old male presented with abdominal pain. CECT done and showed a small enhancing soft tissue density related to the upper part of the left adrenal gland with enhancement pattern similar to the spleen, most likely representing a splenule, but adrenal lesion cannot be totally ruled out. MRI study was done and showed The lesion displays iso-intense signal to the spleen and T1WI, T2WI, post contrast images and DWI/ADC images with signal and enhancement pattern identical to the splenic tissue a splenule.
**Fig. 10: Adrenal Calcification:** is not a rare finding and it usually occurs as a result of previous hemorrhage or infection (TB). Tumors could also occasionally have calcifications. In Fig. 10 is an example of adrenal calcifications with no underlying lesion. This calcifications most likely caused by an old infection of hemorrhage.
Images for this section:

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**Fig. 1: Adrenal Adenoma**

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**Fig. 2: Adrenal Hematoma**
Fig. 3: Wolmans Disease

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Fig. 4: Adrenal metastasis

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Adrenocortical Carcinoma

40 years old male known to have hypertension complaining of abdominal pain

CXR
Routine CXR shows normal chest findings but there is a soft tissue opacity at the left upper quadrant

Axial NECT

Coronal CECT
NCC: Left suprarenal mass, separate from the kidney with calcifications causing mass effect.
CECT: Show mild enhancement

Axial CECT

Fig. 5: Adreno-cortical Carcinoma -a

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Continued (Adrenocortical Carcinoma)

Coronal T1

Coronal T2

Axial T2 FAT/SAT

Subtracted Image

Selected MR images which show the large left adrenal lesion of complex signal intensity with heterogeneous enhancement on the subtracted image

Intense uptake in the known large left adrenal mass. Physiological uptake and excretion is seen in the gastrointestinal and genitourinary tract. Hypermetabolic left thyroid nodule for further evaluation.

Fig. 6: Adreno-Cortical carcinoma -b

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**Fig. 7: Myelolipoma**

- Ultrasound study shows hyper echoic supra renal lesion.
- Plain and contrast enhanced CT show right supra renal lesion with fat content and minimally enhanced soft tissue.
- In/Out of phase images show significant signal drop denoting fat content.
- Contrast enhanced image shows minimal enhancement.

**Fig. 8: Neuroblastoma**

- 3 years old child presented with abdominal mass.
- Ultrasound study shows left supra renal mass with heterogeneous echotexture with calcifications.
- Multi-sequential MRI images post Chemotherapy cycles showed regression in size of the lesion.
- CECT shows the large supra renal mass with calcifications encasing the adjacent blood vessels.
- Nuclear MIBG study shows tracer uptake in the left supra renal region. Other tracer activity in the skull as well as the femoral bone proved to be bone metastasis.
**Fig. 9:** Pseudolesion (Splenule)

Small enhancing soft tissue density related to the upper part of the left adrenal gland and shows enhancement pattern similar to the spleen, most likely representing a splenule, but adrenal lesion cannot be totally ruled out.

The lesion displays iso-intense signal to the spleen and T1WI, T2WI, post contrast images and DWI/ADC images with signal and enhancement pattern identical to the splenic tissue → Splenule
Fig. 10: Adrenal Calcification

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Conclusion

• Clinical imaging has a significant role that can not be underestimated, not only in the detection of the adrenal abnormalities but also in characterizing them into benign or malignant. So it is important to practice the appropriate radiologic work-up for lesions affecting the adrenal gland.

• In this poster, we have provided a comprehensive look at various adrenal masses in most of the imaging modalities (Starting from the abdominal x-ray up to the PET scan) to give a general idea about the adrenal lesions and to provides a road map to guide image interpretation.

• At the end, by knowing the exact findings and the simple pitfalls in the radiological imaging modalities could help in making the differential diagnosis narrower in correlation with the clinical as well as the laboratory findings.
Personal information

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