Avoiding Misdiagnosis: Neuroblastoma vs. Other Retroperitoneal Masses in Infancy and Childhood

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Learning objectives

This educational exhibit aims to illustrate the imaging characteristics of the most common retroperitoneal tumors in pediatric patients, with emphasis on neuroblastomas.

Furthermore, the reader will be made aware of possible and often common differential diagnosis pitfalls.

Background

Unfortunately, the pediatric population is susceptible to malignancies.

Neuroblastoma is the most common extracranial solid malignancy in children and the third most common malignancy of childhood, with only leukemia and primary brain tumors being more common. Because of its aggressive nature and late staging at presentation, it accounts for approximately 15% of childhood cancer deaths. Often presenting with nonspecific symptoms mimicking benign disease, the importance of diagnostic imaging is further emphasized. Furthermore, early detection is essential!

Neuroblastoma is a malignant tumor of primitive neuroectodermal or neural crest cells that most commonly arises in the adrenal gland. It is differentiated from its more benign counterparts, ganglioneuroma and ganglioneuroblastoma, by the degree of cellular maturation. Possessing generally immature cells - neuroblasts -, neuroblastoma is a markedly aggressive tumor with a tendency to invade adjacent structures and metastasize, most commonly, to liver and bone.

Neuroblastoma and Wilms tumors are the two common childhood malignancies which need to be differentiated. An accurate diagnosis is of the utmost importance because of the different therapeutic management for these entities.

Medical imaging is essential to detecting disease, generating a differential, supporting the surgical plan, staging, evaluating response assessment, monitoring for recurrence and predicting outcome.

Findings and procedure details

While, in recent years, survival rates for children with cancer increased, imaging technologies available have evolved to include a wide array of modalities.

Ultrasound is the first-line imaging modality in pediatrics, particularly for patients presenting with a palpable abdominal mass, therefore being the most common method of diagnosis.

On ultrasound, neuroblastomas are generally solid, occasionally with small punctate echogenic areas. However, the echogenicity on ultrasonography varies; some may be evenly echogenic, whereas others are highly heterogeneous. Acoustic shadowing behind the areas of calcification may or may not be present. The tumor mass exceptionally invades the kidney, but when it does this makes differentiation from a Wilms tumor even more difficult. Flow is often detected on color Doppler, aiding in the differential. Doppler is essential to evaluate encased and displaced IVC, aorta, celiac axis and mesenteric vessels.

Lymphadenopathy is often a feature of the tumoral mass, sometimes being difficult to discriminate between the two and furthermore misdirecting the diagnosis by suggesting a lymphomatous pathology (Fig. 1).

Although occasionally difficult, distinguishing abdominal neuroblastoma from Wilms tumor at presentation is critical, as surgical management differs significantly (Fig. 2). Both neuroblastoma and Wilms tumour occur in early childhood and typically present as a large abdominal mass closely related to the kidneys. Distinguishing between the two is essential, and a number of features are helpful, albeit none are pathognomonic. Calcification is one of the features of neuroblastoma that helps differentiate it from a Wilms tumor. The presence of fine pinpoint calcification favors neuroblastoma and is seen in 80-90% of cases. While neuroblastoma is likely to displace, compress and rotate the kidney, Wilms' tumor arises from the kidney (Fig. 3). Neuroblastoma tends to be a mass crossing the midline, encasing and displacing vessels, rather than infiltrating them, while a tumor thrombus in the renal vein or inferior vena cava is highly predictive, but not invariably diagnostic, for Wilms tumor (Fig. 4). A paravertebral mass with calcifications and intra-spinal extension advocate for a neuroblastoma.

Heterogenous lesions, the presence or absence of calcifications, displacement or invasion of vessels suggest the pathology. However, the diagnosis may be problematic by reason of often overlapping imaging features leading to misdiagnosis and, therefore, may

not be established only on the initial imaging findings, often requiring follow-up imaging and correlation with clinical history.

Although widely used and unquestionably beneficial, ultrasound as a sole imaging method is generally insufficient. The role of ultrasound is to provide the initial diagnosis, which will thus direct further imaging and investigation.

CT and MRI provide better assessment regarding the local extent of the tumor and are required as a guide to staging, resectability, prognosis and follow-up.

On CT, neuroblastomas tend to appear lobulated and to grow in an invasive pattern, surrounding and engulfing, rather than invading, vessels. The masses are often inhomogeneous secondary to hemorrhage, necrosis and calcifications. Calcifications are seen by CT in 80-90% of cases. On MRI, neuroblastoma, like most other malignancies, appears of high signal on T2-weighted images, but can also be heterogeneous (Fig. 5c). MRI is superior in detecting neuroforaminal involvement and intraspinal extension (Fig. 5d).

Typically obtained in the occurrence of skeletal pain or limping due to skeletal metastases, conventional radiographs may show a number of fortuitous findings, leading to the diagnosis. An intra-abdominal soft-tissue mass with fine calcifications may be seen (Fig. 5a) with evidence of lucent, ill-defined bony metastases (Fig. 5b). Proximity to adjacent bones may cause remodelling of vertebral bodies and, furthermore, pedicle erosion from the potential intraspinal extension may be detected, a hallmark of neuroblastoma.

Nuclear medicine studies are essential for metastatic surveillance. MIBG labeled iodine-123 shows uptake both in primary tumor and metastases. Evaluation of skeletal lesions is routinely done using technetium-99m MDP, being much more sensitive than conventional radiography in the detection of bone disease.

The role of positron emission tomography (PET) and PET/CT is still being defined.

Images for this section:

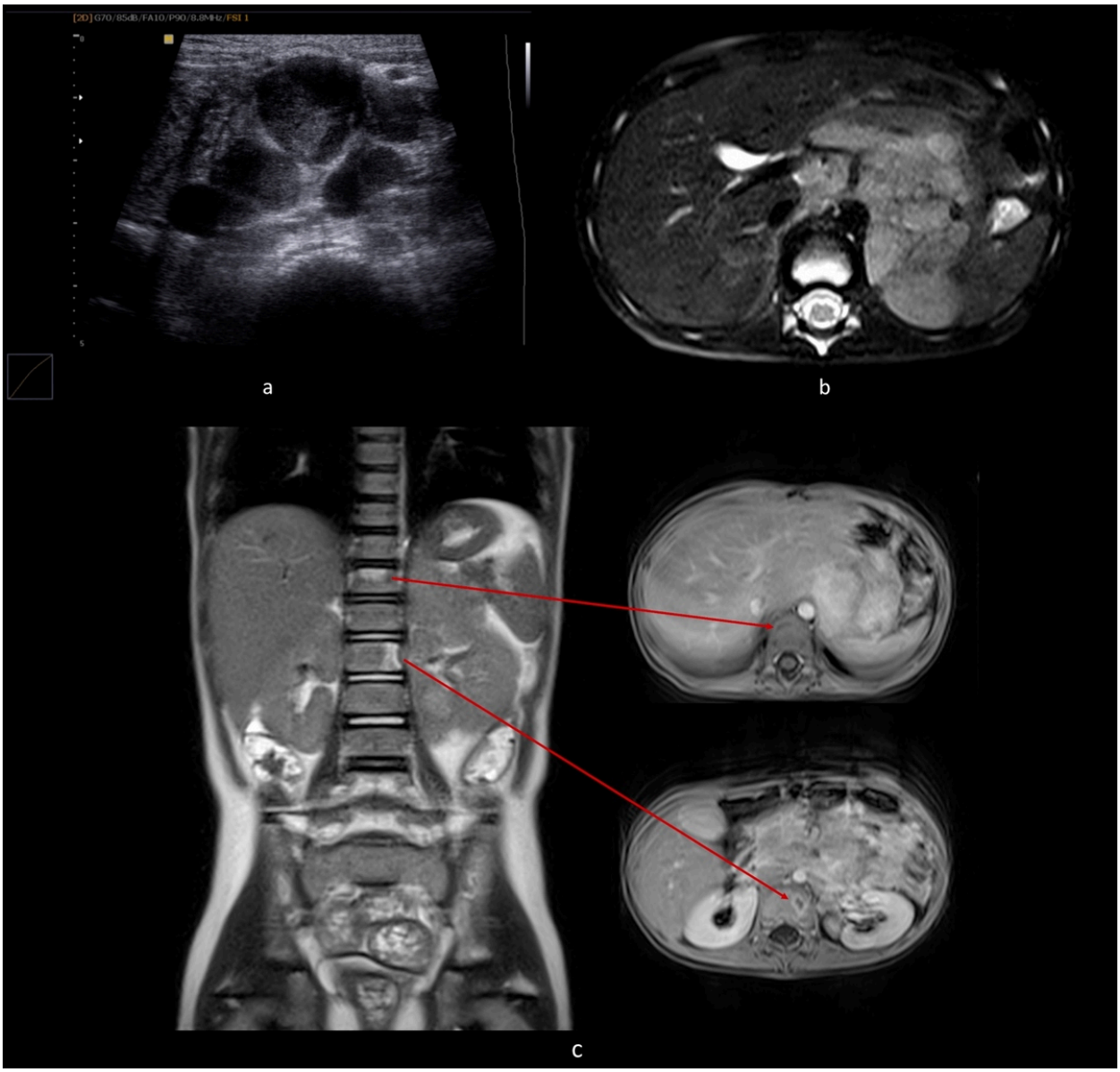

Fig. 1: Multiple retroperitoneal masses, no apparent calcifications, inconclusive lab findings. Ultrasound (a) suggests lymphomatous pathology. MRI (b) and biopsy invalidated the initial diagnosis. It proved to be a neuroblastoma. Vertebral lesions with peripheral gadolinophilia (c) evocative for metastatic deposits further worsen the prognosis.

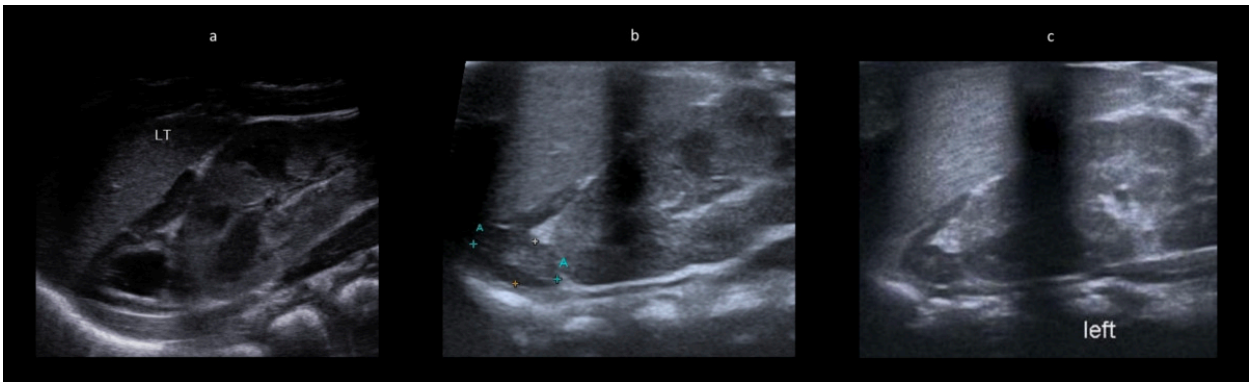

Fig. 2: Ultrasound. Cystic adrenal mass (a); negative claw-sign. Cystic neuroblastoma with favorable response to chemotherapy - tumor shrinkage (b, c).

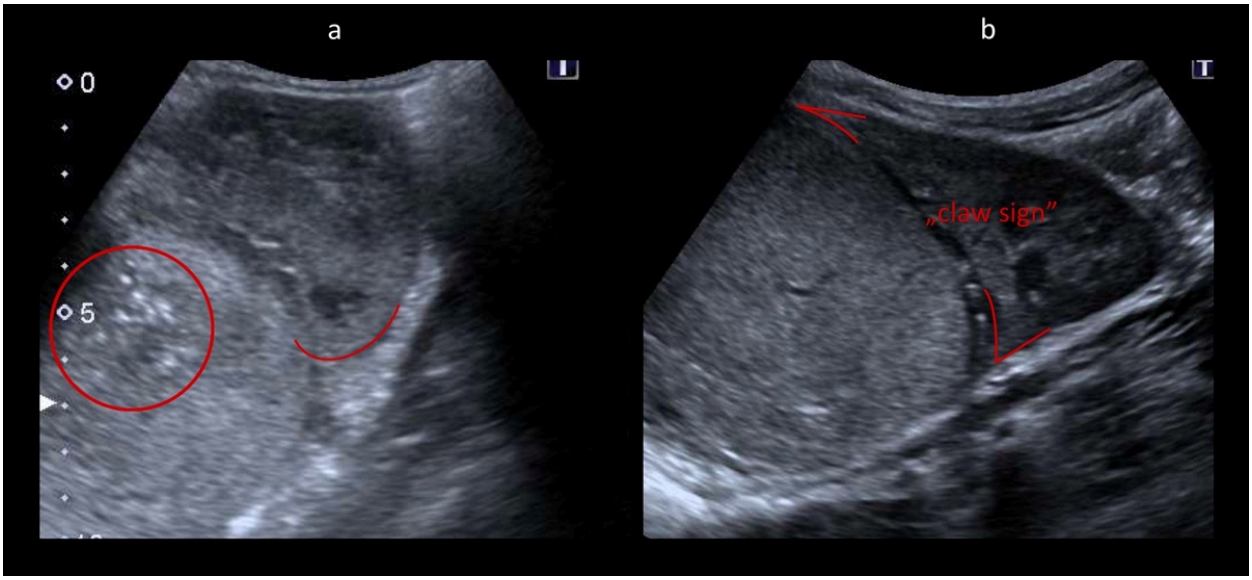

Fig. 3: Differential diagnosis: Neuroblastoma - Wilms tumor. Ultrasound. In these two cases the presence of calcifications (a) and the delineation between the masses and the adjacent organs (kidneys) validate the diagnosis - a: neuroblastoma; b: Wilms tumor.

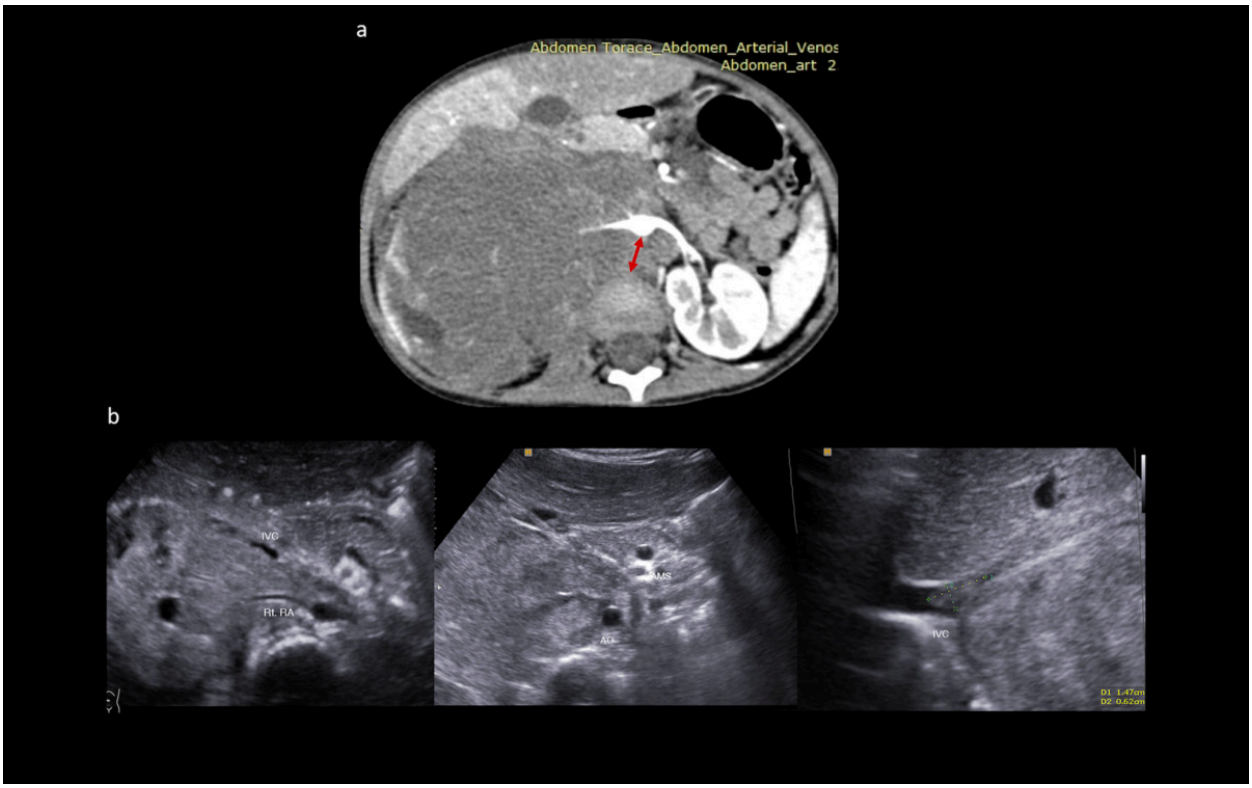

Fig. 4: Axial CECT (a). Prevertebral tumor which extends across the midline in the retroperitoneum, insinuating itself beneath the aorta, encasing and lifting it off the vertebral column; RRA direct invasion. Ultrasound (b) confirms vascular invasion, allows direct visualization of a tumor-thrombus in the IVC. Neuroblastoma mimicking Wilms tumor.

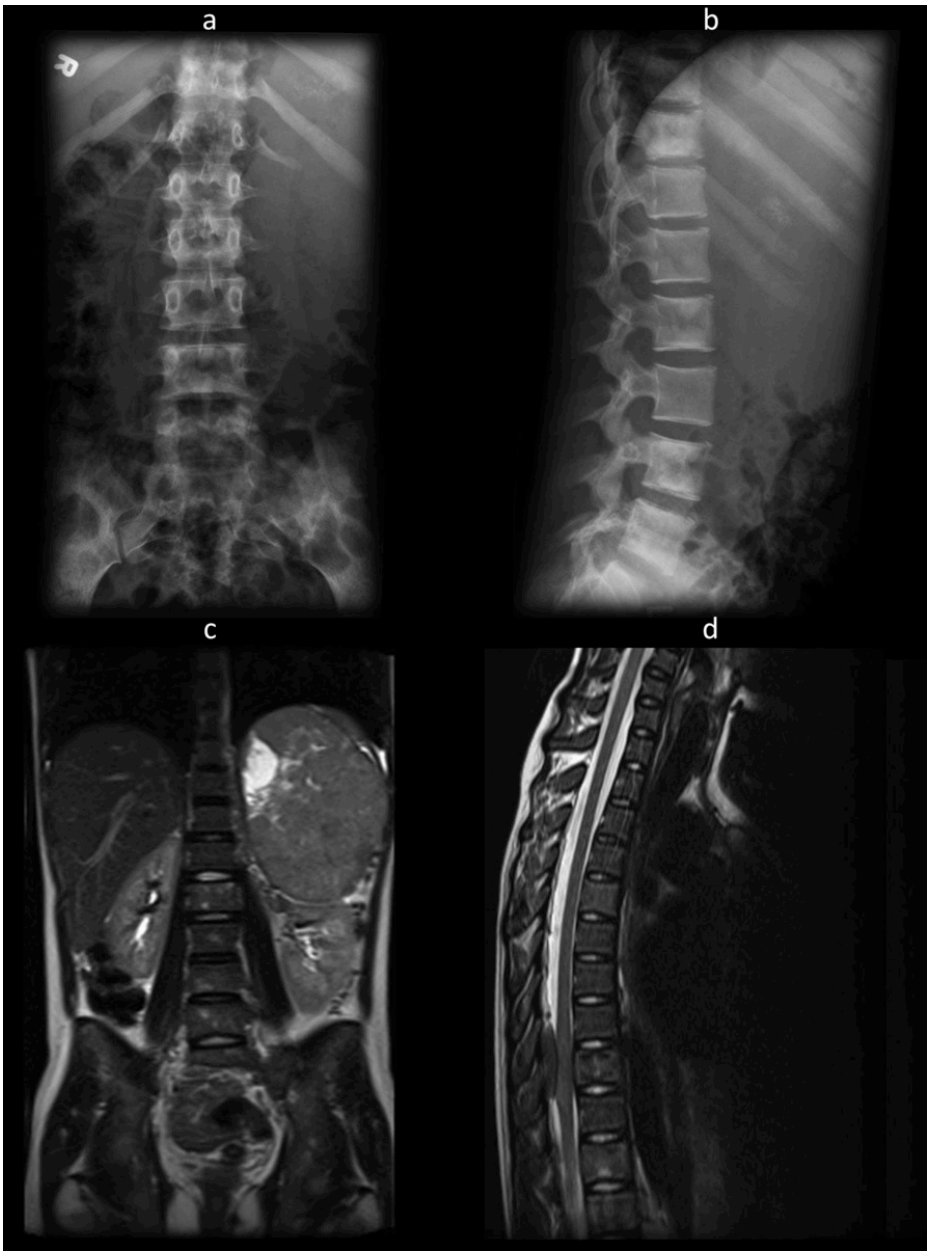

Fig. 5: Lumbar radiograph - frontal view (a). Large soft tissue mass occupying left upper quadrant with foci of calcification and displacement of small bowel gas shadows to the right of midline and to left lower quadrant. Lateral view (b). Sclerotic metastases T10, T11, L2, L4 and L5. MRI - coronal T2 (c). Large suprarenal mass with necrosis. Sagittal T2 (d). Intraspinal extension with cord compression and oedema.

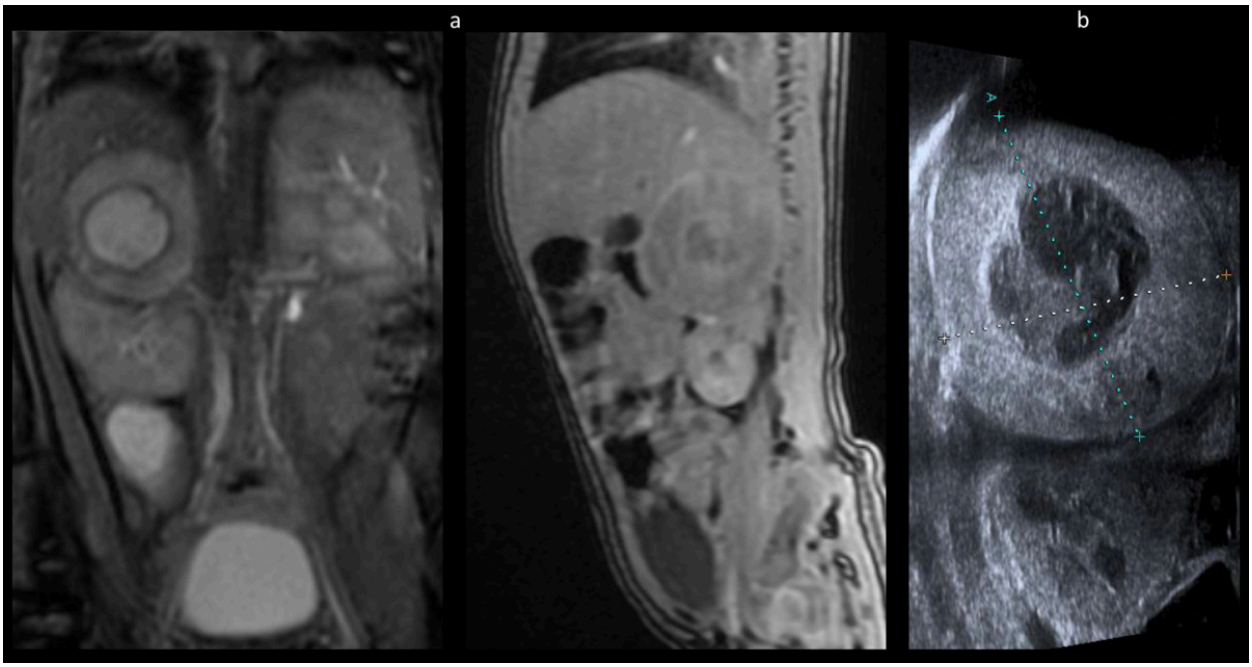

Fig. 6: Right adrenal neuroblastoma with cystic and solid components visualized on MRI (a) and ultrasound (b).

Conclusion

Knowing the typical imaging appearance is necessary, albeit insufficient, particularly regarding pediatric retroperitoneal masses.

Multidisciplinary approach and multi-imaging strategies are essential in defining the correct diagnosis.

References

1. De Bruyn R. Pediatric ultrasound. How, why and when. Elsevier. 2005: 103-127.

2. Liu W, Zheng J, Li Q. Application of imaging modalities for evaluating neuroblastoma. J Pediatr Endocrinol Metab. 2013. 26(11-12):1015-20.

3. David R, Lamki N, Fan S et-al. The many faces of neuroblastoma. Radiographics. 1989;9 (5): 859-82.

4. Lonergan GJ, Schwab CM, Suarez ES et-al. Neuroblastoma, ganglioneuroblastoma, and ganglioneuroma: radiologic-pathologic correlation. Radiographics. 22 (4): 911-34.

5. Chung EM, Graeber AR, Conran RM. Renal Tumors of Childhood: Radiologic-Pathologic Correlation Part 1. The 1st Decade: From the Radiologic Pathology Archives. Radiographics. 2016;36 (2): 499-522.

6. Dhull VS, Sharma P, Patel C, Kundu P, Agarwala S, Bakhshi S, et al. Diagnostic value of 18F-FDG PET/CT in paediatric neuroblastoma: comparison with 131I-MIBG scintigraphy. Nucl Med Commun. 2015 Jun 5.

7. Woodward PJ, Sohaey R, Kennedy A et-al. From the archives of the AFIP: a comprehensive review of fetal tumors with pathologic correlation. Radiographics. 25 (1): 215-42.

8. Lowe LH, Isuani BH, Heller RM et-al. Pediatric renal masses: Wilms tumor and beyond. Radiographics. 20 (6): 1585-603.

9. Currarino G. The Genitourinary Tract. In: Silverman FN, Kuhn JP, eds. Essentials of Caffey's Pediatric X-Ray Diagnosis. 1990: 724-9.

10. Sofka CM, Semelka RC, Kelekis NL, et al. Magnetic resonance imaging of neuroblastoma using current techniques. Magn Reson Imaging. 1999 Feb. 17(2):193-8.

11. White SJ, Stuck KJ, Blane CE, et al. Sonography of neuroblastoma. AJR Am J Roentgenol 1983; 141:465-468.

12. Goske MJ, Mitchell C, Reslan WA. Imaging of patients with Wilms' tumor. Semin Urol Oncol 1999; 17:11-20.