

Adrenal glands transabdominal ultrasonography – pictorial essay

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Abstract

Adrenal gland ultrasonography is one of the corner stones of the abdominal ultrasonography examination for many medical specialties. The adrenal areas can be easily overlooked though adrenal gland pathology is diverse. We present the normal aspects and various transabdominal ultrasonography findings of the adrenal glands, both common and rare. Even though ultrasound examination is operator and patient dependent, we consider the examination of the adrenal glands very important, due to relatively frequent incidental detection of an adrenal mass.

Keywords: adrenal glands; incidentaloma; ultrasonography

Introduction

Adrenal lesions are frequently detected nowadays by radiologic examinations, either as incidentaloma or in various symptomatic conditions. Ultrasonography (US) is able to visualize adrenal tumors or other types of lesions but is considered to be less sensitive and more operator dependent as compared to computed tomography or magnetic resonance imaging (MRI) [1]. Adrenal glands US can be a very powerful diagnostic procedure in cases of cystic lesions, pheochromocytoma, myelolipoma, or metastatic lesions. But there are many other diseases with non-specific findings which must be considered. Endoscopic US is a very important acquisition in the diagnostic armamentarium of the adrenal diseases, allowing also minimal invasive procedures in the adrenal

areas. Incidentally, discovered adrenal masses can have a different management approach, but after a complete imaging and hormonal assessment, 25-30% may have surgical indication [2]. We considered (that it is) important to present a collection of US images of various adrenal findings, both common and rare.

Normal US aspect of the adrenal glands

On the right side, the liver offers a good acoustic window for transabdominal ultrasonography (TUS) of the adrenal gland which is situated in proximity of the upper pole of the right kidney and inferior vena cava (IVC). TUS allows examination of the right adrenal gland in most of the cases (up to 99% after some authors) [3]. On the left side, the presence of the stomach, correlated with the smaller volume of the spleen compared to the liver, decreases the possibility of US visualization of the adrenal gland to 40-50% [3]. Normal adrenal glands have a shape of the letters V, Y or λ or of a seagull, with a central hyperechoic line or thin image (medulla), surrounded by hypoechoic layers corresponding to adrenal cortex and eventually a capsule (fig 1) [4,5]. Endoscopic ultrasonography (EUS) allows examination of the left adrenal in 97% of the cases, but the right side is visible in less cases (30-40%) [5,6]. EUS reveals much better the structure of

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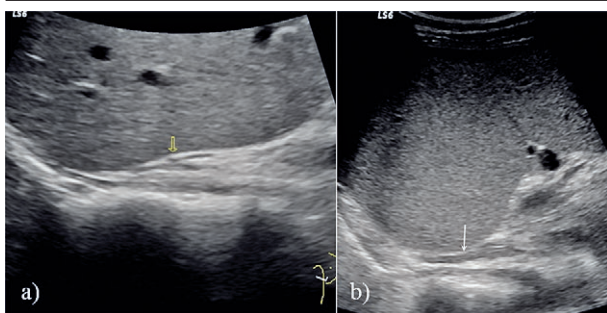


Fig 1. a) Normal image of the right adrenal gland – oblong hypoechoic image, “seagull”-like, posterior to the liver (arrow); b) Left adrenal gland – normal structure and size, posterior to the spleen (arrow).

the glands and smaller lesion as compared to TUS, but this approach is not the subject of this article.

Benign adrenal pathology

Hyperplasia

The physiological hypertrophy can be encountered in neonates and small children but it may be associated with adrenogenital syndromes in children. In adults, hyperplasia can be found most frequently in cases of hyperaldosteronism or Cushing syndrome. Hyperplastic glands show reduced or loss of differentiation between medulla and cortical areas of the adrenal glands, which also take a rounded appearance, with the thickness of the gland of more than 10 mm (fig 2). In some cases of multiple endocrine neoplasia (MEN) type 2 or von Hippel-Lindau disease the medullary hyperplasia is more prominent [7].

Adenoma

Adenoma represents the most common adrenal lesion, diagnosed mostly incidentally (>80% of the incidentaloma). Some patients with inherited disorders like MEN I, obese, hypertensive, and older patients (over 70 years the rate is around 7%) are at higher risk [8]. US common appearance of adrenal adenoma is of a well-defined solid mass, homogeneous, hypoechoic, with well-defined sharp borders. Color Doppler examination usually reveals hypovascularization (fig 3) [9]. Sensitivity of the US in detecting adrenal masses is better for the right side, and for nodules larger than 1.5 cm [10]. Rarely, there are multiple lesions, even on the same side. Atypical adenomas can show necrotic areas or hyperechogenic foci of scars or calcification. In these cases the differential diagnosis with pheochromocytoma or carcinoma is difficult.

Myelolipoma

Myelolipoma arise from adrenal cortex. They are usually unilateral but bilateral localization had also been described [11]. Usually both sexes are equally affected,

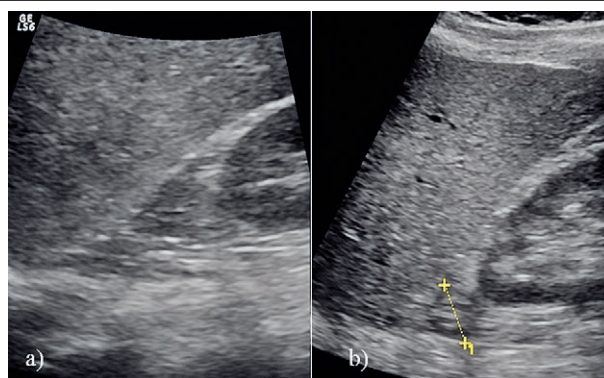


Fig 2. a) Hyperplasia of the right adrenal gland; b) Nodular hyperplasia of the right adrenal gland.

mostly between 50-70 years of age [11]. Myelolipomas have certain US features: a characteristic homogenous structure, hyperechoic, with well-defined borders, as they are characteristically small tumors [8]. Some of them can be very large – over 20 cm, with heterogeneous aspect due to the necrotic areas, displacing the adjacent organs (fig 4). In color Doppler mode myelolipoma appear hypovascularized [9].

Pheochromocytoma

Pheochromocytoma are rare tumors that arise from adrenal medulla, commonly unilateral (80%) but also bilateral (10%), extraadrenal (10%), or multiple lesions can be found [12]. Though they are usually benign tumors, there can be also malignant pheochromocytoma. Between 10-17% of the cases are asymptomatic and can be diagnosed incidentally. The lesions can have various sizes, ranging from 1.2 cm to 15 cm. When they are diagnosed, they usually measure around 5 cm and their US appearance is heterogeneous, due to hemorrhaging or necrosis (fig 5). Recognizing a pheochromocytoma-phenotype is essential in order to avoid a biopsy, with potential catastrophic complications.

Adrenal hematoma

Adrenal hematoma is a relatively rare and uncommon finding in the clinical practice, being more frequently encountered in newborns [13]. A certain vulnerability to trauma has been cited, due to the larger size and the hypervascularization in the neonatal period. In adults, usually appears especially post traumatically, in patients under anticoagulant therapy. US reveals a collection or a mixed lesion with hyperechoic clots or pseudosepta in the adrenal area (fig 6).

Adrenal cystic lesions

Adrenal cyst is considered a very rare US finding; it can be endothelial, epithelial, pseudocysts, or parasitic [14]. Rare types of adrenal cystic are: cystic pheochromocytoma, cystic lymphangioma, or teratoma. Parasitic

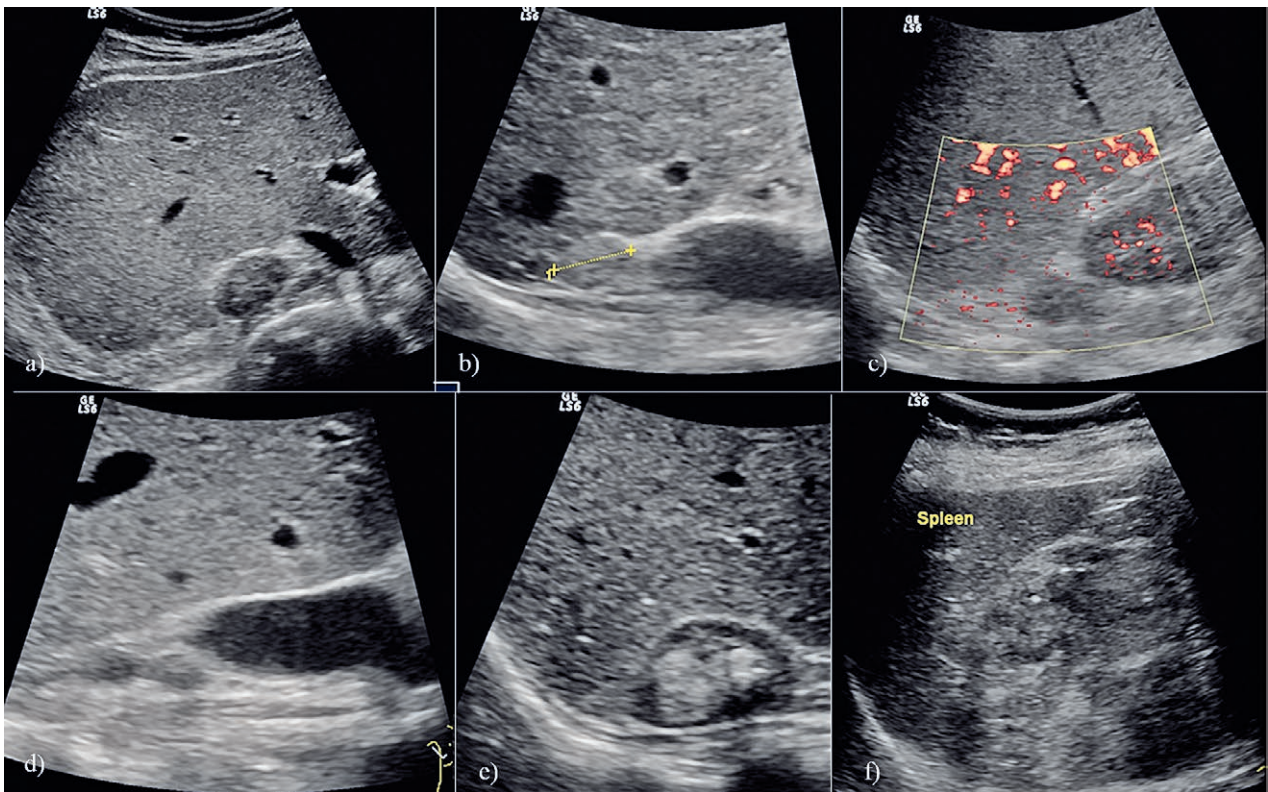


Fig 3. a) Small homogeneous ovoid shaped adrenal adenoma in the right side; b) Slight hyperechoic right adrenal adenoma; c) Left sided adrenal adenoma – hypovascular in power Doppler mode; d) Double right sided adenomas – hypoechoic well defined lesions; e) Inhomogenous right adrenal adenoma with scars and calcifications; f) Giant inhomogeneous left adrenal adenoma, with calcifications.

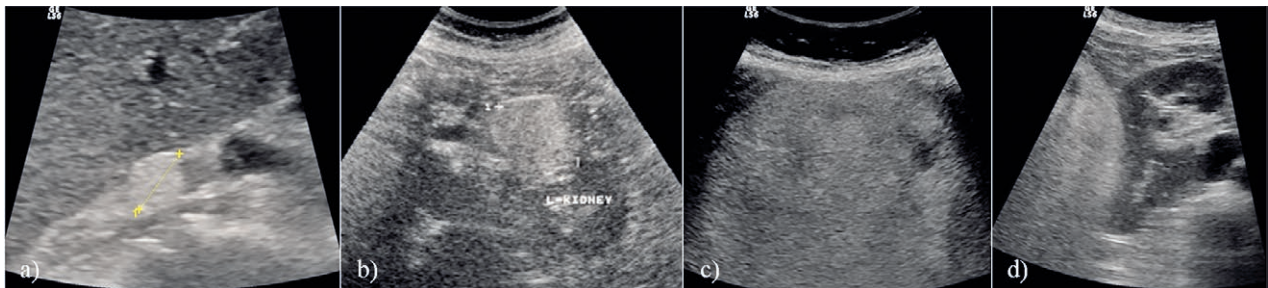


Fig 4. a) Small hyperechoic nodular myelolipoma of the right adrenal; b) Left adrenal myelolipoma with hyperechoic homogeneous appearance; c) Heterogeneous structure of the giant right adrenal myelolipoma; d) Giant right side myelolipoma dislocating the kidney.



Fig 5. a) Left adrenal ovoid tumor, slight inhomogeneous – pheochromocytoma in a patient with MEN II syndrome; b) Inhomogeneous aspect of the enlarged right adrenal gland with hyper- and hypoechoic areas in a pheochromocytoma case, sagittal view; c) Ovoid, sharp delineated, inhomogeneous adrenal tumor with cystic areas – pheochromocytoma – transvers view.

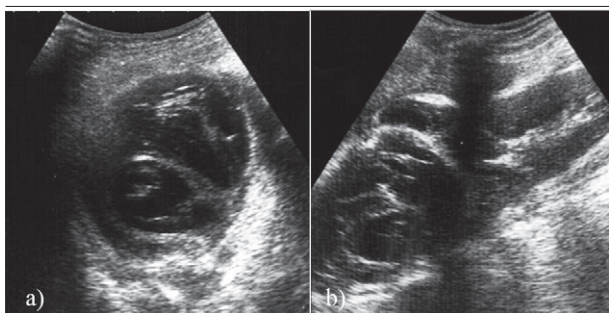


Fig 6. Post traumatic right adrenal haematoma – ovoid-shape lesion with onion-like appearance – transverse (a) and sagittal approach (b).

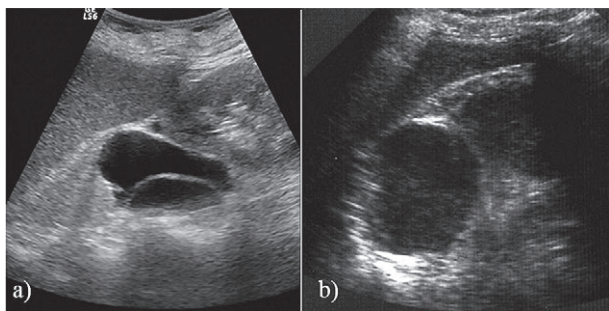


Fig 7. a) Cystic lymphangioma of the left adrenal gland – well defined anechoic lesion, with septa; b) Left adrenal cyst with minute inclusions.

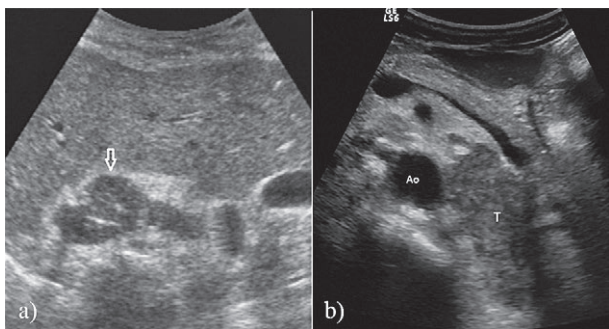


Fig 8. a) Small adrenocortical carcinoma – irregular shape, hypoechoic lesion (arrow). b) Left adrenocortical carcinoma – retropancreatic irregular shape hypoechoic tumor (T) in contact with aorta (Ao).

adrenal hydatid cysts can also be found. US appearance is non-specific, consisting in anechoic lesions, with or without septa, or floating echoes, delineated with a smooth thick echogenic wall (fig 7).

Malignant

Adrenocortical carcinoma

Primary adrenocortical carcinoma is sometimes diagnosed incidentally. About 60% are hormonally active,

most of them producing cortisol [15]. It is usually a large tumor (more than 6 cm) at the time of the diagnosis. US appearance of adrenal carcinoma is size dependent. When they are small, adrenal carcinoma can be homogeneous, hypoechoic - difficult to differentiate from adenoma. Larger lesions are heterogeneous, due to necrosis and hemorrhaging (fig 8). Adrenal carcinoma is generally a hypervascularized solid mass in color Doppler mode, and frequently already metastatic, infiltrating or invading the inferior vena cava (9-19%) or the renal vein at the time of diagnosis. There are syndromes associated with this cancers such as Li-Fraumeni, Carney complex, Beckwith-Wiedemann, and MEN I, so in these patients US examination should be even more focused on adrenal areas [16,17].

Metastases

Metastases are the most frequent malignant lesions interesting the adrenal gland. Commonly they originate from carcinomas of the lung, breast, kidney, colon, esophagus, pancreas, liver, stomach, or even from melanoma [9]. Left adrenal is a common metastatic site for lung cancer and both adrenals should be constantly assessed in these patients. Usually adrenal metastases are bilateral. Adrenal metastases may present similar ultrasonographic features to the primary tumor. While larger metastases are commonly heterogeneous, with irregular margins or sometimes pseudocystic, small lesions can be initially homogenous and well-contoured (fig 9). In some cases, compression or invasion of the adjacent structure may facilitate the diagnosis.

Lymphoma

Primary adrenal lymphoma are very rare tumors (less than 200 hundreds cases published), among them non-Hodgkin lymphomas (B-cell) being more frequent than Hodgkin's. Bilateral involvement occurs in about 50%. US features of lymphoma usually are homogeneous, intense hypoechoic lesions (fig 10). Rarely, US reveals heterogeneous lesions with mixed echogenicity. The adrenal gland can be interested also as part of lymphoma's invasion in the adjacent structures. US findings of an adrenal lymphoma may associate retroperitoneal lymphadenopathy, splenomegaly or other sites involvement [18]. US adrenal guided biopsy is essential in primary cases.

Peculiar findings

Rare histological findings of adrenal glands include neuroblastoma, ganglioneuroma, oncocytoma, other mesenchymal neoplasia, hemangioma, adrenal smooth muscles tumor or thyroid ectopia [18-20]. Enlargement or mass like appearance of adrenal glands can also occur in sarcoidosis and infectious diseases – tuberculosis, histoplasmosis, blastomycosis, abscesses, extramedullary

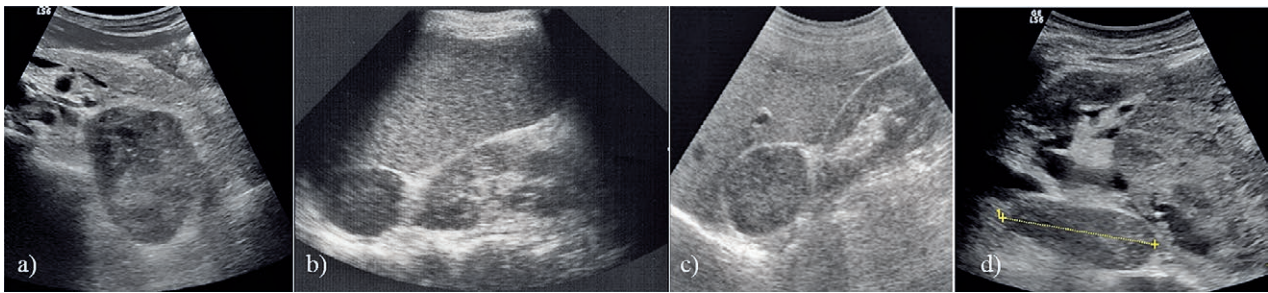


Fig 9. a) Adrenal metastasis from non-small cell lung cancer; b) Gastric cancer metastasis – ovoid hypoechoic homogeneous nodule; c) Clear renal cell carcinoma with ipsilateral adrenal metastasis; d) Right side hypoechoic adrenal metastasis from melanoma.

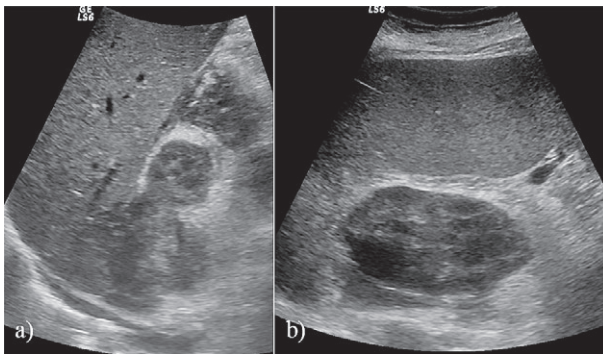


Fig 10. a) Irregular hypoechoic nodule in primary diffuse bilateral B-cell type adrenal lymphoma; b) Hypoechoic left adrenal nodules in a B-cell lymphoma patient.

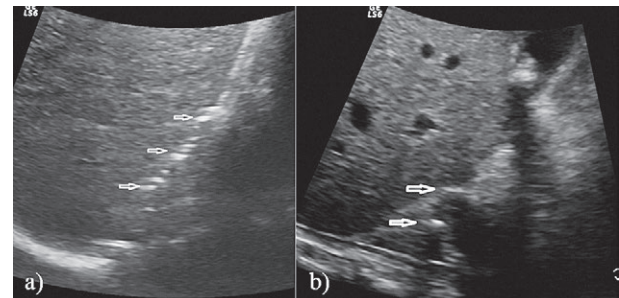


Fig 11. a) Multiple hyperechoic images in the right adrenal space (arrows) secondary to cecal retroperitoneal perforation with pneumoretroperitoneum; b) Two hyperechoic linear images in the right adrenal area (arrows) – metallic clips implanted after adrenocortical carcinoma resection.

hematopoiesis [21,22]. The differential diagnosis of the adrenal lesions must also include other types of images, such as hyperechoic images that can be rarely represented by metallic clips or gas (pneumoretroperitoneum) (fig 11). There are much more frequent anechoic lesions in the adrenal areas than cysts that one should differentiate from: renal, hepatic or pancreatic cysts, dilated splenic vessels or porto-systemic collaterals. Doppler US and a careful identification of the borders of the neighboring organs and dynamic US (deep respiration) facilitates the characterization of these lesions.

Conclusions

US examination of the adrenal glands is a highly valuable diagnostic tool, essential in every day practice, but the additional information depends on the operator's experience. It is important to recognize certain conditions – adenoma, cyst, myelolipoma and to differentiate pheochromocytoma and malignancies. It also provides the possibility of guiding subsequent interventional procedures – for example percutaneous or EUS guided biopsies.

Conflicts of interest: none

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