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Imaging functional adrenal disorders

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Technological developments in cross-sectional imaging have revolutionized the localization and characterization of functioning adrenal pathology. With effective use of modern imaging, the diagnosis of the cause and nature of functioning adrenal pathology can be reached speedily, accurately and efficiently in the majority of patients. We review the appearance of primary and secondary adrenal pathology, evaluate the diagnostic performance of imaging modalities, highlight newer technical developments, and propose a rational use of these tests in identifying functioning adrenal disease.

Key words: adrenal gland; adrenal adenoma; adrenal carcinoma; Cushing's syndromes; primary hyperaldosteronism; phaechromocytoma.

IMAGING INVESTIGATIONS

Adrenal imaging may be performed with cross-sectional imaging techniques such as ultrasound, computed tomography (CT) and magnetic resonance imaging (MRI) or with radionuclide imaging. Ultrasound is useful in the paediatric age group and clearly has the benefit of having no radiation exposure. However, CT is recognized as the mainstay of cross-sectional adrenal imaging, with good spatial resolution and the ability to characterize adrenal pathology using the tissue attenuation and enhancement

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characteristics. MRI and radionuclide imaging are predominantly used for problem-solving. When surgery is being considered, venous sampling may be required in patients with an equivocal diagnosis.

Computed tomography

CT is currently the technique of choice in detecting and evaluating adrenal pathology. It is widely available, and high-resolution images can be acquired rapidly. CT scans of the adrenal gland should be performed with narrow collimations both before and after intravenous injection of contrast medium. Such thin collimation provides high resolution and allows accurate density measurements of adrenal lesions. With the advent of multidetector CT, images can be reconstructed at 0.625 mm sections, allowing for superior reformatted images compared to single-slice CT.[1] The published data on CT and adrenal disorders currently relate to a single-slice scanner. Multidetector CT is likely to improve the visualization of adrenal pathology and provide multiplanar imaging comparable to MRI. Intravenous administration of contrast medium helps to distinguish the adrenal glands from adjacent vessels and to assess the vascularity of an adrenal mass.

Magnetic resonance imaging

MRI offers multiplanar imaging with better contrast resolution than CT or ultrasound and does not use ionizing radiation. Our imaging protocol consists of T1- and T2-weighted axial sequences through the adrenal glands with a slice thickness of 5 mm with a 1 mm interslice gap, with an anterior saturation band. If a mass is demonstrated, this is followed by axial in-phase and out-of-phase chemical-shift imaging, with a slice thickness of 6 mm and a 1 mm gap to assess for the presence of intracytoplasmic lipid. Fat-suppressed T1-weighted images following intravenous gadolinium may be performed in some cases, for example, in the characterization of a possible phaeochromocytoma.

Radionuclide imaging

Radionuclide imaging provides metabolic information so that adrenal disease can be localized despite the lack of anatomical detail. Radiopharmaceuticals can be grouped into two categories: adrenocortical imaging agents and adrenomedullary imaging agents. Radiolabelled analogues of cholesterol—such as ^{75}Se-$^{6}\beta$-selenomethylnor-cholesterol—are used in the depiction and localization of masses resulting in adrenal cortical dysfunction. Meta-iodobenzylguanidine (MIBG), an analogue of guanethidine, is concentrated in sympathoadrenal tissue and hence is used for imaging adrenomedullary disorders.[2] Studies with ^{131}I- and ^{123}I-MIBG take advantage of this ability to screen the whole body for sympathomedullary tissue.

A more recent development in radionuclide imaging is that of positron emission tomography (PET). This technique uses radioisotopes that emit positrons for imaging; 18F-fluorodeoxyglucose (18-FDG) is the commonest tracer used for PET imaging. However, new tracers targeted specifically to adrenal function—such as carbon-11 metomidate and 11C-hydroxyephedrines—are currently being evaluated.[3,4] PET images can be combined with CT images on CT–PET scanners. Similarly with conventional radionuclide tracers, a hybrid SPECT–CT (Hawkeye) system combines the advantages of SPECT functional imaging with the anatomical resolution of CT.[2,5]