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ORIGINAL ARTICLE

Optimal diagnosis of adrenal masses

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KEYWORDS

Adrenal masses;
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Abstract *Introduction:* Most adrenal gland lesions are detected by CT; however some patients are referred for MRI and PET CT, with percutaneous biopsy as the last resort.
Aim of study: To provide the role of various imaging modalities for optimal assessment of adrenal masses. Furthermore we would like to recommend a diagnostic algorithm.
Patient & methods: We studied 29 patients with 29 adrenal masses (11 adenomas, 6 metastases, 5 myelolipomas, 4 adrenocortical carcinomas, 2 pheochromocytoma & 1 cyst). CT scan was done with a dedicated adrenal CT protocol. Washout characteristics were then assessed. MRI was done in 19 patients. Qualitative assessment of the chemical shift images was done in 11 patients. Five patients underwent PET and PET CT.
Results: In CT: a mean absolute percentage washout of 83% and 41.4% while a mean relative percentage washout of 57.4% and 17.95% were found for adenomas and metastases respectively. In MRI: adenomas showed signal drop on out of phase sequences compared to in phase sequences while metastases did not. In PET CT: mean maximum SUV uptake for adrenal metastases was 7.5 compared to 2.1 in adenoma.
Conclusion: Our results confirm the evolving role of CT in detection and characterization of an adrenal mass. Further assessment by MRI & PET CT can be beneficial.

1. Introduction

Characterization of adrenal masses is essential because the nature of the mass may have a profound effect on patient's care. Also accurate characterization is important for identifying both malignant & benign lesions, because it would obviate both percutaneous biopsy & repeated interval follow-up imaging (1).

Tumors in the adrenal glands are common in humans, being present in 3% of autopsies performed in persons older than 50 years (2).

Primary tumors in the adrenals can be hyperfunctioning (producing excess hormones from the cortex or the medulla and accompanied by clinical symptoms) or nonfunctioning (3).

Adrenal lesions are often discovered incidentally at examinations performed for other purposes (4).

In patients without a known extra adrenal primary malignancy, most of these lesions are benign nonhyperfunctioning adenomas. Even in patients with a primary neoplasm, in whom an adrenal metastasis is an important consideration, most

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adrenal masses are also benign. Still, the adrenal glands are a common site for metastatic disease. Virtually any primary malignancy can spread to the adrenals. Lymphoma and carcinoma of the lung and breast account for a large proportion of adrenal metastases. Other primary cancers include melanoma, leukemia, kidney & ovarian carcinoma (5).

Large adrenal masses are often detected with abdominal ultrasound, however US depends to a large extent on operator skills. Furthermore, obesity and overlying gas are obstacles for the visualization of the adrenal glands. Not surprisingly, US does not detect adrenal masses with the same sensitivity as CT or MRI (5).

The cornerstone of adrenal imaging is CT, performed before and after intravenous injection of contrast material and acquired as 3–5 mm scans through the adrenal glands. The advent of multidetector CT (MDCT) has allowed postprocessing of the acquired data to narrow slice intervals and provides detailed reformatted images in any plane (6).

Magnetic resonance imaging of the adrenal glands can help characterizing lesions not properly assessed with CT. Multiplanar MRI allows precise localization and separation of adrenal masses from the surrounding structures, particularly the liver, spleen, stomach, pancreas and kidneys (3,6).

Generally, the ratio between the signal drop-off from T1-weighted in-phase to opposed-phase images of the adrenal mass and various organs including spleen, fat, liver, and muscle has been tested to distinguish between benign and malignant masses. If the adrenal mass-reference organ-ratio, the ratio between signal intensities of the adrenal mass and the internal standard (such as the spleen) is less than 70, the lesion is regarded as benign (5).

Radionuclide imaging is usually a second line test to clarify equivocal, inconclusive or unexpected results from anatomical imaging. Scintigraphy of both adrenal medulla and adrenal cortex is used to demonstrate the functional status of adrenal nodules or masses shown on anatomical imaging, to detect extraadrenal ectopic sites of hormone production and to detect recurrence after surgery (7).

Transcutaneous needle biopsy or FNA of adrenal mass has been advocated for the investigation of incidentally discovered adrenal masses. The biopsy is generally performed under either CT or US guidance. FNA may be helpful in the diagnostic evaluation of patients with a history of malignancy and those with a suspicious adrenal mass on imaging. Importantly, to prevent a potentially life-threatening hypertensive crisis, FNA should not be attempted before exclusion of pheochromocytoma by endocrine testing (5).

Adrenal imaging complements and assists the clinical and hormonal evaluation of adrenal tumors. It is important to reach a protocol to study the clinically suspected suprarenal masses as well as the incidentalomas.

2. Aim of the study

The aim of our study was to provide the role of various imaging modalities for optimal assessment of adrenal masses. Furthermore we would like to recommend a diagnostic algorithm.

3. Patients & methods

A total of 29 patients (18 males, 11 females; age range 19–70 years old; mean age 42.9) with 29 adrenal masses were studied in this prospective study. Most cases were referred to us from the urology and internal medicine departments in our hospital and 7 patients had their investigations done in a private hospitals (5 out of them had undergone PET and PET CT and 2 patients having neoplastic disease had undergone previous CT scan outside our institution).

Adrenal masses were found incidentally on abdominal sonography or CT done for nonadrenal related complaints (Figs. 1 and 2) such as abdominal pain, heaviness, mass, vomiting and loss of weight in 17 patients as well as during examination for an extra adrenal primary malignant tumor in 6 patients (1 brain tumor, 1 colonic cancer, 2 breast carcinoma and 2 bronchogenic carcinoma). Other inclusion criteria were adrenal masses found during the workup for endocrine and clinical manifestations raising the suspicion of adrenal affection: Two patients had clinical and biochemical evidence of Conn's syndrome (Fig. 3) such as hypertension, headache, muscle weakness and hypokalemia, elevated plasma aldosterone and suppressed plasma renin activity. Two other patients had paroxysmal attacks of hypertension and elevated urinary 24 h VMA. In one patient with known bronchogenic carcinoma and adrenal deposit (Fig. 4), follow-up and further assessment of this adrenal lesion was done.

3.1. Protocol of examination

Whenever an incidentaloma was detected usually by CT done with contrast or US, we were first inquired about possible laboratory biochemical abnormalities to exclude the presence of a hyperfunctioning adrenal lesion including the following:

- serum cortisol level, 1 mg dexamethasone suppression test,
- urine 24 h VMA, serum aldosterone and plasma renin activity,
- serum electrolytes including Na and K, complete blood count and liver function tests.

Then we asked about the availability of previous imaging studies for comparison in order to assess the course of the lesion over time. The next step was asking about a known history of primary extra adrenal malignancy.

The first imaging modality done was **CT scan** of the abdomen. However one patient did an abdominal US first. CT imaging was performed with a multidetector row helical CT scanner 4-MDCT scanner (Light Speed, GE Medical System, Milwaukee – USA). Imaging parameters included section collimation of 3–5 mm, high-quality mode, table speed of 7.5 mm/s, 50% overlap reconstruction, 120 kV and 280–380 mA.

Initially unenhanced images were obtained. Then 120 ml of contrast medium was injected intravenously. Biphasic contrast enhanced images were obtained after 75 s (portal venous phase) and delayed images were finally obtained after 10 min from the time of injection.

3.2. Postprocessing calculations

Average attenuation values in HU on the pre-contrast (preattenuation PA), contrast enhanced (early attenuation EA) and delayed contrast enhanced (delayed attenuation DA) images were recorded. A circular region of interest ROI was placed in the center of the adrenal mass on the section on which the