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EDITORIAL

Classification of Silent Adrenal Masses: Time to Get Practical

Establishing the nature of incidentally discovered adrenal masses has been a major concern in the imaging literature for more than a decade (*1–4*). Interest arises from the fact that the adrenal glands are frequently involved by metastatic disease. Benign adrenal masses are also common and are usually detected as an incidental finding on an imaging procedure performed for an unrelated diagnostic problem. The number of such masses has increased substantially because of serendipitous detection of much smaller lesions by the new generation CT systems.

Silent adrenal masses are problematic because, once they are discovered, their nature must be defined in order to exclude a metastatic lesion and, to a lesser degree, a pheochromocytoma or a primary adrenal carcinoma. As in the excellent study by Gross et al., distinction of silent adrenal masses in the imaging literature is focused on the positive identification of benign adrenocortical adenomas, which represent the most frequent incidental finding in the adrenal gland above the age of 50 (*5*).

The size of an adrenal mass has been suggested as a cost-effective prognostic criterion to separate benign from malignant disease but, as the authors indicate, fails as a single discriminator in individual patients if long-term follow-up studies are not performed. More recent criteria used on CT and MR to separate adenomas from other masses include density or intensity measurements on enhanced and non-enhanced studies and the signal intensity indexes of adrenal masses on fast low-angle shot chemical shift MR images (*6–12*). On nuclear medicine studies, discrimination is based on the accumulation of NP-59 in the adenoma productive of a concordant imaging pattern with the anatomical study (*2,13,14*). Due to the limited resolution of scintigraphy, these patterns may not be demonstrable in lesions less than 2 cm in diameter. Overall, the sensitivity of the various techniques to identify adenomas approximates 70%–80%, with a specificity of nearly 100%.

Discriminating parameters on CT, MRI and NP-59 scintigraphy for adrenal adenomas exploit the functional ability of the adrenal cortex to accumulate cholesterol esters. Adrenal scintigraphy, although not providing anatomic detail, does provide unique metabolic information in the form of the specific uptake of a radiopharmaceutical mimicking an adrenal substrate. These radiopharmaceuticals are transported in the circulation like native cholesterol bound to low-density lipoproteins (LDL), which, in turn, binds to specific LDL receptors on adrenocortical cells—following which, the cholesterol and NP-59 are internalized (*3*). In the normal adrenal cortex, both cholesterol and NP-59 are esterified and form a pool of cholesterol ester substrate from which adrenal steroid hormones are synthesized in acute situations through ACTH-mediated deesterification. An adrenal adenoma is thought to represent nontumorous overgrowth of adrenocortical cells usually from the zona fasciculata. They consist of cholesterol ester laden clear cells and are often seen at autopsy when the adjacent nonnodular cortex has become lipid-depleted as a result of the stress of dying. The composition of the lipid droplets, which no longer form a "stand-by" pool of cholesterol, probably consists of cholesterol esters in a quasi-crystalline phase, similar to cholesterol in atherosclerotic plaques (*1,3,15*).

Because of the high fat content, these lesions have a characteristic low density on CT and are easily identifiable as adrenal adenoma by this criterion alone. On MRI, the short T2 relaxation time of the quasi-crystalline phase of cholesterol esters makes these lipids generally invisible on T2-weighted spin echo sequences with long echo times. As a result, adenomas are isointense to liver on T2-weighted spin echo images and demonstrate a high fat content on chemical shift images with a short echo time. When an adenoma has a low attenuation on CT, it will have a low intensity

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on T2-weighted SE, provided that the fat has not changed its liquid crystal phase from a semi-crystalline to a liquid phase (*15*). Chemical shift MR imaging can demonstrate lipid within adrenocortical masses and thereby circumvents the theoretical problem of overlap in attenuation between adenomas with minimal fat and that of edematous or necrotic tumors on CT (*9*). However, in a practical sense, MRI does not add much to the CT findings in this category of adrenal masses.

Similar to the tissue of the fasiculata zone of the normal adrenal cortex, these adenomas are poorly vascularized and demonstrate only mild enhancement and quick washout of intravenously-injected contrast medium on dynamic CT or MRI studies. This parameter has been used to improve classification of adrenal masses on contrast-enhanced CT and fast, dynamic contrast material-enhanced MR imaging (*7,8*). Theoretically, enhancement parameters on dynamic studies could correlate with the attenuation and intensity measurements on CT and MRI, but this has not been examined in the literature yet.

Adenomas contain lipid-depleted cells from the zona reticularis that may predominate in 10%–30% of lesions (*16*). Such lesions have near isodensity to liver on CT and are hyperintense when compared to liver on T2-weighted MRI. Under such circumstances—CT and MRI attenuation—intensity and enhancement parameters are likely indeterminate. It is this category that ends up in the cohort of silent adrenal masses that need further clarification by MRI, scintigraphic evaluation or biopsy, if other morphologic parameters are not conclusive.

Benign, nonhypersecretory, nonautonomous adrenal adenomas are but one manifestation of a whole spectrum of morphological changes in the nodular adrenal cortex (*17,18*). The morphologic spectrum of adrenal nodules includes macronodules (incidentaloma), micronodules and segmental hyperplasias in an otherwise normal adrenal gland. Depending on the anatomical resolution of the images, more of the morphologic spectrum can be visualized simultaneously in the same patient, enabling a specific diagnosis in conjunction with the other discriminating parameters. The value of assessing the full spectrum of morphologic changes in nodular adrenals to clarify silent adrenal masses (instead of concentrating on the incidentaloma) has not been given much attention in the literature (*18*).

The relative roles of MRI and nuclear medicine studies for clinically silent adrenal masses detected with CT are presently under debate. Such widely ranging considerations as clinical circumstances, logistic availability, cost and time factors all play their roles in the evaluation of the three methods. In practice, the majority of adenomas can be classified with a very high specificity on the basis of CT criteria. In these patients, it is not cost-effective to verify the diagnosis with additional studies. MRI and scintigraphy with NP-59 are potentially useful in the remaining group of silent adrenal lesions that, by selection, consist of a relatively larger fraction of adrenal metastases. From this perspective, it becomes questionable whether MRI or scintigraphy should be used routinely, since they cannot make a definite distinction between a metastasis and other nonadenomatous masses.

In most institutions, scintigraphy has not gained popularity for the application described by Gross, et al. The reasons for this relate to insufficient experience with NP-59, the need for an investigational new drug approval for its use, the length of the imaging procedure (2–4 days) as well as the high costs.

In our opinion, fine-needle aspiration biopsy of silent adrenal lesions that cannot be classified as an adenoma on CT is, in general, essential and remains the most practical thing to do if a definite diagnosis (of metastatic disease) is crucial to patient management (*19*). In selected cases, however, MR imaging or NP-59 scintigraphy is useful; for instance, if a relative contraindication to fine-needle biopsy exists or when biopsy results are inconclusive in patients with a presumably benign lesion.

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(continued from page 5A)

FIRST IMPRESSIONS

Soft-Tissue Trauma to the Buttocks

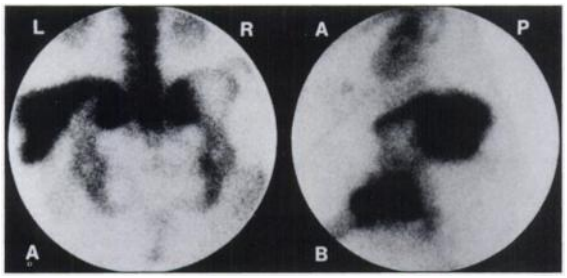

FIGURE 1

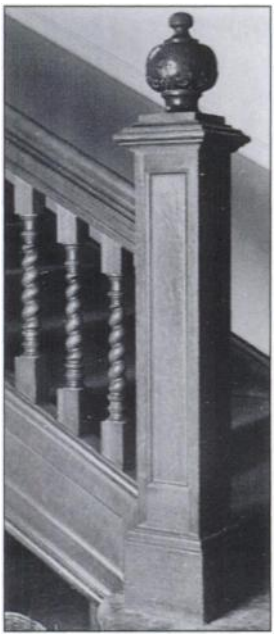

FIGURE 2

PURPOSE
Posterior and lateral bone scans show intense soft-tissue uptake of a bone agent in the patient's left buttock (Fig. 1). The patient was a 72-yr-old woman suffering from rheumatoid arthritis who refused to walk down the stairs of her home because of excruciating pain. She preferred instead to slide down her banister which ended in an ornamental cap known as a finial (Fig. 2). The constant trauma to her buttocks from sliding into the finial produced a large bruise as well as this dramatic illustration of bone radiopharmaceutical localization at the site of chronic soft-tissue trauma. Thus, this study could be referred to as a case of "finial fanny." How the patient managed to avoid climbing up her stairs is a mystery.

TRACER
Technetium-99m-MDP, 20 mCi

ROUTE OF ADMINISTRATION
Intravenous

IMAGING TIME AFTER INJECTION
2.5 hours

INSTRUMENTATION
Siemens LFOV

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