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Nuclear imaging of adrenal glands

A. Kurtaran (Vienna)

As a result of the increased use of radiological imaging modalities incidentally discovered adrenal masses ("incidentalomas") have emerged as a clinical problem. In case of hormonally hyperactive adrenal lesion(s) the most relevant question is whether one or both glands are involved. While radiological imaging procedures provide an excellent anatomical information, they may fail to give the answer in some cases. (1,2,3)

In patients having non-secretory adrenal masses, however, attention must be paid to exclude a malignancy. Once a malignancy is proven, the evaluation of regional and distant metastatic spread has to be performed. This "staging" procedure requires a whole body examination which makes nuclear imaging modalities attractive (2).

The standard nuclear imaging procedure of so-called chromaffin tumors is the iodine labeled MIBG-scintigraphy. The indications for MIBG scintigraphy are tissue characterization of incidentally detected adrenal lesion(s), the differentiation between unilateral pheochromocytoma and bilateral hyperplasia, and in case of extraadrenal disease the localisation of the underlying tumor site(s). This scintigraphic technique permits a non-invasive and accurate diagnosis of pheochromocytoma and paraganglioma, due to both its high sensitivity and specificity (1,2).

Likewise, the adrenocortical scintigraphy mostly performed with \(^{131}I\) labeled 6ß-iodomethyl-norcholesterol (NP-59), provides in vivo metabolic characterization of the adrenal glands based on the uptake of the radiotracer by functioning adrenal cortical tissue. One main indication for NP-59 scintigraphy is the in vivo depiction of the sites of abnormal hormonal secretion in case of hypersecretory adrenocortical syndromes (Cushing’s syndrome, primary aldosteronism, hyperandrogenism). In patients with primary aldosteronism, however, the adrenocortical scintigraphy should be performed with dexamethasone suppression for optimising the diagnostic sensitivity. Dexamethasone application has two important advantages: firstly, the differentiation between hyperplasia and adenoma, and secondly, the reduction of the radiation exposure to the normal adrenal gland.

The other clinical indication for performing NP-59 scintigraphy is the tissue characterisation of incidentalomas. Thereby, following relevant imaging patterns can be observed (2):

(a) "concordant" lesion: increased tracer uptake in the incidentaloma indicating a benign nature

(b) "discordant" lesion: decreased/absent tracer uptake suspicious for malignancy

Besides the traditional SPECT agents, recently a variety of PET-radiopharmaceuticals opened a new diagnostic dimension for metabolic characterisation of adrenal masses. As in oncology in general, the widely used tracer for the differential diagnosis of adrenal masses is \(^{18}F\)-FDG. Because of its relatively high sensitivity and specificity \(^{18}F\)-FDG whole body imaging is the standard PET imaging modality for detection of malignant tumor sites independent from its entity (4,5).

Apart from this meanwhile well established PET tracer, new PET radiopharmaceuticals have been introduced. One of these is C11-Metomitade, most promising to visualise masses of adrenocortical origin. While this PET technique seems to allow the differentiation between adrenocortical and non-cortical lesions, it is not appropriate to distinguish benign from malignant disease. As a consequence, FDG still remains tracer of choice for discriminating between benign and malignant lesions (5).

In patients with adrenomedullary masses PET tracers may also be useful. \(^{18}F\) DOPA PET whole body is one of these techniques which was already shown to have an even higher sensitivity over MIBG scan. The main practical advantage of \(^{18}F\) DOPA PET over MIBG scintigraphy is the lack of uptake in normal adrenal glands implicating that any \(^{18}F\) DOPA uptake in the adrenals being abnormal. The specificity of \(^{18}F\) DOPA PET seems to be similar to that of MIBG scintigraphy in those tumors (4).
References