THE ROLE OF (POSITRON EMISSION TOMOGRAPHY/ COMPUTED TOMOGRAPHY) " PET/CT " IN ADRENAL MASSES

Essay

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List of Abbreviations

ACTH .... AdrenoCorticoTrophic Hormone
BGO .... Bisthmus Germinate
FDG ....FluoroDeoxyGlucose
FOV... Field Of View
LSO .... Lutetium Oxyorthesilicate
MEN.. Multiple Endocrine Neoplasia
NAI .... Sodium Iodide
PET .... Positron Emission Tomography
PET/CT .... Positron
.... Emission Tomography/ Computerized Tomography
PMT ....Photomultiplier Tube
ROI...Region Of Interest
US... Ultrasonography

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INTRODUCTION

Incidental adrenal masses are identified in approximately 5% of abdominal CT scans and in up to 8.7% of autopsies (Boland et al., 1998).

In patients without a known malignancy, most of these masses represent adrenal adenomas. Even in patients with a known malignancy, most of the masses are benign (Mansmaun et al., 2004).

The adrenal glands are a common site of metastatic disease. Even in a patient with a known malignancy other than an adrenal malignancy, however, an adrenal lesion is still more likely to be benign than to be malignant (Blake et al., 2006).

The issue of differentiation between benign and malignant adrenal lesions on CT has been the scope of many previous articles. The presence of intracytoplasmic lipid within adenomas has been found to accurately separate adenomas from malignant lesions (Boland et al., 1998).

Despite the high specificity of CT parameters enabling diagnosis of lipid-rich adenomas with a high degree of certainty, approximately 30% of adenomas are lipid poor, with higher attenuation values overlapping those of other adrenal masses, including malignancies (Metser et al., 2006).

Since its introduction in 1998, dual-modality PET/CT imaging has received great attention in the medical community. For the first time, patients can be examined with both CT and PET in a single examination (Beyer et al., 2004).

PET/CT tomographs represent a hardware approach to image fusion by merging the components of commercially available PET and

CT tomographs into a single gantry .Patients are scheduled for a single scan and receive 2 complementary examinations (PET and CT) whenever clinically indicated (Beyer et al., 2006).

PET/CT offers a unique hybrid imaging technique that combines the attenuation and morphologic detail of CT with the metabolic information from PET. These images can be fused to allow accurate coregistration of anatomic and functional data, and the combination of the two types of images leads to more assured anatomic localization of areas of increased metabolic activity (Blake et al., 2006).

Several advantages are associated with combined PET/CT imaging compared with retrospective or prospective software-based approaches to align complementary image data. Most important, the patient undergoing a combined PET/CT examinations is not moved physically (except for the translation of the bed) between CT and PET acquisition, thus limiting misalignment from repositioning (Beyer et al., 2004).

With the advent of PET/CT imaging, the metabolic information obtained with fluorine 18 (^{18}F) fluorodeoxyglucose (FDG) PET can be combined with the morphologic information obtained with CT. With combined PET-CT, the superimposition of the precise structural findings provided by CT allows more accurate and reproducible correlation of a hypermetabolic focus seen at PET with the correct anatomic or pathologic equivalent (Kapoor et al., 2004).

There are PET-CT appearances of the major subtypes of adrenal disease, including benign neoplastic lesions, malignancy and benign mimics of neoplasia (e.g brown fat) (Elaini et al., 2007).

Although the fusion of the two independent data sets results in both a more comprehensive examination and more accurate localization of abnormalities, it also introduces some unique potential pitfalls and interpretative difficulties. Again, this situation is especially true in the abdomen and pelvis, where physiologic FDG uptake can be

misleading and CT has tissue characterization limitations, especially following surgery (Blake et al., 2006).

AIM OF THE WORK

To illustrate common benign adrenal lesions at PET CT and the use of PET-CT in the differentiation of benign from malignant adrenal lesions.

ANATOMY OF ADRENAL GLAND

The adrenal glands are, despite their small size, among the most important and vital organs in the body. Their function was quite unknown until 1855, when Addison first described the syndrome resulting from their destruction. In 1856 Brown-Scquard showed that their removal led to death in animals ***(Sutton,. And Philip J. A. Robinson 2002)***.

DEVELOPMENT

The suprarenal (adrenal) cortex is formed during the second month by a proliferation of the coelomic epithelium (***Standring et al., 2008*****).**

The adrenal gland lies retroperitoneally above each kidney. They are each enclosed within the peri-renal fascia but in a separate compartment from the kidney. The adrenal gland has an outer cortex derived from mesoderm and an inner medulla which is derived from the neural crest and is related to the sympathetic nervous system ***(Ryan et al., 2004)***.

At birth the glands are comparatively larger and are approximately one-third the size of the ipsilateral kidney. The cortex of each gland reduces in size immediately after birth and the medulla grows comparatively little. By the end of the second month the weight of the suprarenal has reduced by 50%. The glands begin to grow by the end of the second year and regain their weight at birth by puberty. There is little further weight increase in adult life ***(Standring et al., 2008)*****.**

MACROSCOPICALLY

The glands are macroscopically slightly different in external appearance .The right gland is pyramidal in shape and has two well-developed lower projections (limbs) giving a cross-sectional appearance similar to a broad-headed arrow. The left gland has a more semilunar form and is flattened in the anteroposterior plane. The left gland is marginally larger than the right. The bulk of the right suprarenal sits on the apex of the right kidney and usually lies slightly higher than the left gland, which is on the anteromedial aspect of the upper pole of the left kidney ***(Standring et al., 2008).***

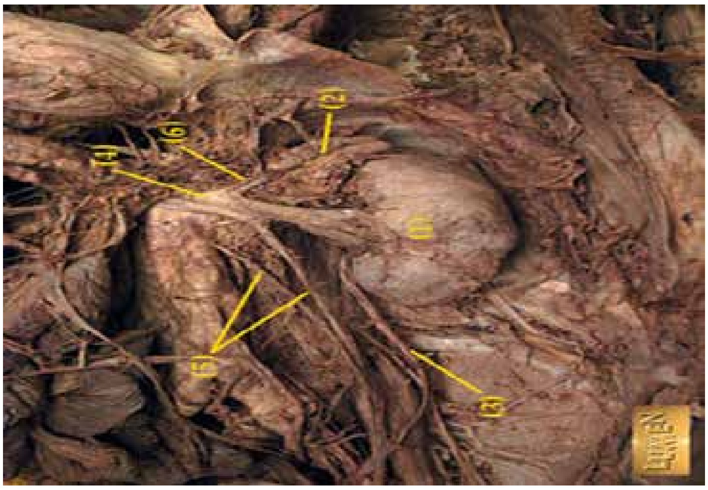

Figure 1: Normal anatomy: Kidney (1) Adrenals (2) ***(Quoted from Chandrasekhar et al., 2006)***

The suprarenal (adrenal) glands lie immediately superior and slightly anterior to the upper pole of either kidney. Golden yellow in colour, each gland possesses two functionally and structurally distinct areas: an outer cortex and an inner medulla. The glands are surrounded by connective tissue containing perinephric fat and they are enclosed within the renal fascia. They are separated from the kidneys by a small amount of fibrous tissue. In the adult the glands measure c.50 mm vertically, 30 mm transversely and 10 mm antero-posteriorly. They each weight 0.5 gm. The dimensions of the suprarenal glands *in vivo* have been defined by ***Vincent and colleagues (1994)*** using computed tomography (CT). The mean dimensions of the body of the suprarenal gland are 0.61 cm (right) and 0.79 cm (left). The mean dimensions of suprarenal limbs are 0.28 cm (right) and 0.33 cm (left). No individual suprarenal limb should measure more than 6.5 mm across ***(Standring et al., 2008).***

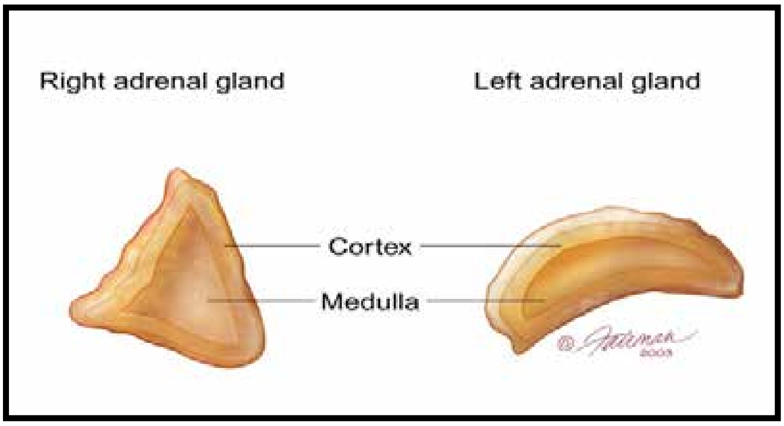

Figure 2; External appearance of adrenals ***(Quoted from www. Urology Health.org Anatomical Drawings)***

VARIANTS

Small masses of adrenal cortical tissue called Cortical Bodies are often found near the adrenal glands. These may become attached to other organs early in embryology and migrate with these organs to be found in such places as in the broad ligament of the uterus , the spermatic cord and even the epididymis ***(Ryan et al., 2004)***.

Small accessory suprarenal glands composed mainly of cortical tissue may occur in the areolar tissue near the main suprarenal glands ***(Standring et al., 2008)*.**

ARTERIAL SUPPLY

The suprarenal glands are very vascular. Each gland is supplied by superior, middle and inferior suprarenal arteries, whose main branches may be duplicated or even multiple ***(Standring et al., 2008)*.**

1. Superior suprarenal arteries

The superior suprarenal artery arises from the inferior phrenic artery, which is a branch of the abdominal aorta .It is often small and may be absent ***(Standring et al., 2008)*.**

2. Middle suprarenal arteries

The middle suprarenal artery arises from the lateral aspect of the abdominal aorta, at the level of the superior mesenteric artery. It ascends