An auxiliary ^{18}F-FDG uptake pattern clarifying equivocal adrenal gland mass after dual-tracer imaging with ^{123}I-MIBG SPECT/CT and ^{18}F-FDG PET/CT

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Abstract

Pheochromocytomas are rare catecholamine-producing neuroendocrine tumors arising from the adrenal medulla. Several studies have reported activation of brown adipose tissue (BAT) in up to 30% of patients with pheochromocytoma. Brown adipose tissue is characterized by abundant mitochondria to provide heat generation rather than energy storage. Pheochromocytoma seems to act on BAT via two parallel mechanisms. These include the trans-differentiation of white to brown adipocyte as well as the hypertrophy of existing brown adipocytes and increased glucose uptake by noradrenergic (β-AR) sympathetic nervous system stimulation [1, 2].

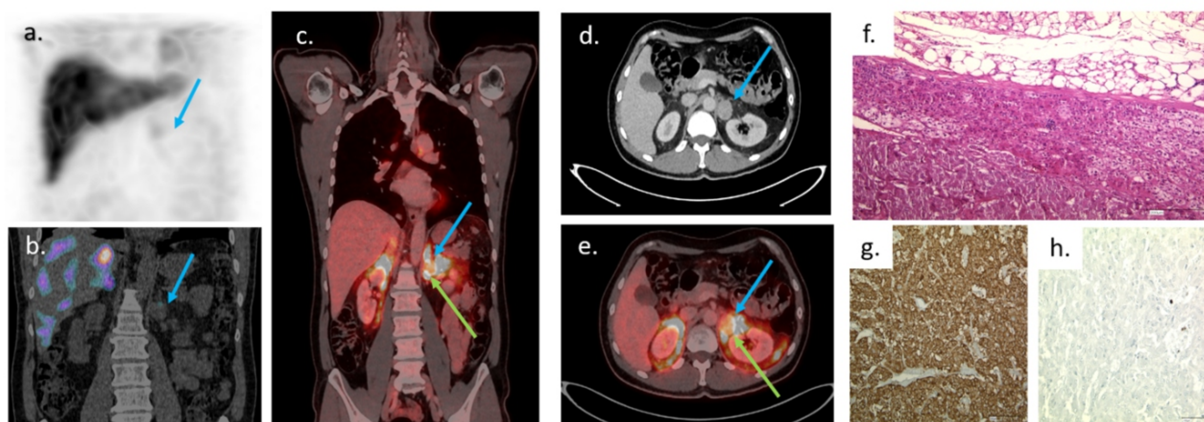

Figure 1 (a-e). Illustrates the iodine-123-metaiodobenzylguanidine (^{123}I-MIBG) single photon emission computed tomography/computed tomography (SPECT/CT) and fluorine-18-fluorodeoxyglucose (^{18}F-FDG) positron emission tomography (PET)/CT images of a 55-year-old-male patient with an equivocal left adrenal gland mass. The presenting symptom was hypertension, accompanied by an incidental, isointense adrenal mass on CT without any significant morphological change over a three-year follow-up imaging. The adrenal gland mass showed no change in the size or texture on follow-up radiological imaging. However, in view of the increased serum metanephrine levels, the patient was referred to our center for further diagnostic work-up. The 26x30x25mm-sized, adrenal gland mass showed no MIBG uptake on ^{123}I-MIBG SPECT/CT scan. The subsequent ^{18}F-FDG PET/CT scan showed, however, a mild ^{18}F-FDG uptake of the adrenal gland mass and an accompanying markedly increased diffuse ^{18}F-FDG uptake of BAT in perirenal and, to a lesser extent, mediastinal space.

Corresponding, few case reports had also reported a marked increase of ^{18}F-FDG uptake by perirenal brown adipose tissue (BAT) in patients with pheochromocytoma [3, 4]. The mild ^{18}F-FDG uptake of the adrenal gland mass (maximum standardized uptake value (SUVmax): 6.6) was not necessarily indicative of a pheochromocytoma, so that the additional assessment of the ^{18}F-FDG uptake pattern of perirenal space with an SUVmax of 12.0 provided a critical diagnostic clarity [3, 5]. Moreover, the BAT in mediastinal space revealed ^{18}F-FDG uptake with an SUVmax of 6.2. Eventually, the patient underwent a retroperitoneoscopic adrenalectomy with a histological validation of a well-differentiated pheochromocytoma (Ki-67 index <1%) (f-h). In the retrospective analysis, the predominant mechanism of this phenomenon might relay on the pathway of trans-differentiation of white to brown adipocyte.

The green arrows in the maximum intensity projection (MIP) and fused images indicate activated BAT with an SUVmax of 12.0, while the blue arrows highlight only mild to moderate ^{18}F-FDG uptake in the left adrenal tumor mass (SUVmax: 6.6). (f) here is the three layers depicted in one sample depicted, the upper layer for BAT, the middle for normal adrenal gland tissue and bottom layer for the pheochromocytoma (HE, 10x). Brown adipose tissue is characterized by an abundance of vacuole and presence of abundant mitochondria conveying its brownish color. Complementary immunohistochemical staining provided the validation of pheochromocytoma cells with synaptophysin (g) and low proliferation rate with Ki-67 index (h).

This case highlights the importance of a comprehensive interpretation of different molecular imaging modalities and their unique findings in a complementary manner to ensure significant clinical impact.

The authors declare that they have no conflicts of interest.

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Ethics Approval: *This case evaluation was performed in line with the principles of the Declaration of Helsinki and national regulations oversight by the Ethics Committee of Heinrich-Heine-University Hospital Düsseldorf, Germany.*