

¹⁸F-FDG PET-CT in Hyponatremia

¹⁸F-FDG PET-CT sheds Light on a Case of Hyponatremia

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Word Count: 1350 words

ABSTRACT

A 76-year-old man with hypo-osmolar hyponatremia of unknown origin was referred to the nuclear medicine department for an ^{18}F -FDG PET-CT to exclude a malignant cause of hyponatremia. An increased ^{18}F -FDG uptake in both adrenal glands was observed and further investigated.

KEYWORDS

^{18}F -FDG PET-CT; HYPONATREMIA; ADRENAL GLANDS

INTRODUCTION

Hyponatremia, defined as serum sodium concentration below 135 mmol/L, is usually caused by a disturbance in the urinary diluting mechanism. The algorithm for diagnostic assessment of the patient with hyponatremia is well-documented. Nevertheless, the final diagnosis can be challenging because multiple factors can contribute to hyponatremia.

Herein, we present a case of hyponatremia where nuclear imaging sheds light on the differential diagnosis.

CASE STUDY

A 76-year-old man of Caucasian ethnicity presented to the emergency department after referral by his family physician due to general discomfort, cognitive impairment and hypo-osmolar hyponatremia (sodium 112 mmol/L, osmolality 226 mmol/kg H_2O). He was euvolemic (blood pressure 114/65 mmHg, heart rate of 72 beats per minute, weight 55 kg, length 150 cm) and had no severe neurological manifestations.

Past medical history revealed chronic hyponatremia. Two weeks earlier he was admitted for a subdural hematoma due to a fall in unclear circumstances. In addition to a forty pack-year history, his medical records included arterial hypertension and peripheral arterial disease. At presentation he was

taking amlodipine (5 mg/day), metoprolol (50 mg/day), simvastatin (20 mg/day), calcium and vitamin D. Acetylsalicylic acid (80 mg/day) and ramipril (5 mg/day) were stopped during his previous admission.

Additional laboratory findings showed a normal renal function (serum creatinine 0.59 mg/dL) and serum potassium concentration. A urine sodium (102 mmol/L) with high osmolality (335 mmol/kg H₂O) was observed. Severe hypothyroidism and cortisol deficiency were excluded based on normal thyroid stimulating hormone and morning cortisol levels (respectively 1.15 mIU/L and 10.2 µg/dL). The tentative diagnosis was syndrome of inappropriate antidiuretic hormone secretion.

DIAGNOSTIC STEPS

Cranial CT scan was repeated and showed stable findings concerning the subdural hematoma. Subsequently, an ^{18}F -FDG PET-CT was performed to exclude a malignant cause associated with syndrome of inappropriate antidiuretic hormone secretion.

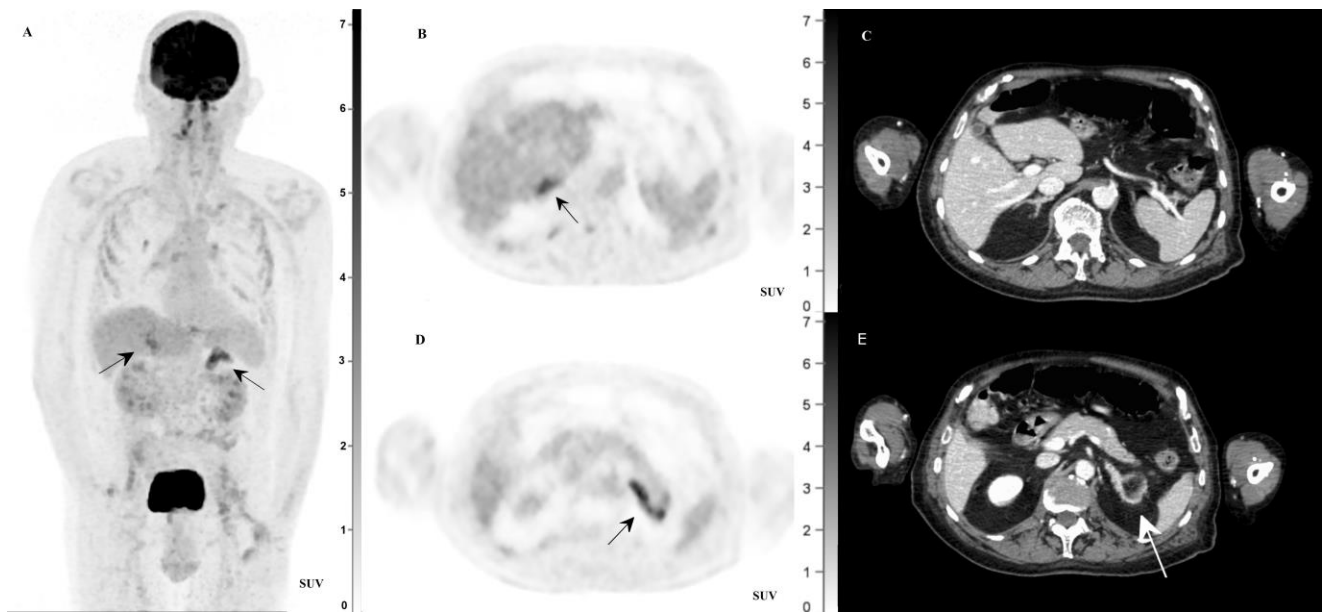


Figure 1 High ^{18}F -FDG uptake in both adrenal glands on the maximum intensity projection image (MIP) image (A). Further findings are: physiological uptake in the brain, liver, spleen, kidneys and urinary bladder. Light uptake in both shoulder joints (degenerative arthropathy), intercostal musculature and around the neck of the bilateral total hip prosthesis (inflammatory reaction). Axial images show visualisation of a hypermetabolic right (B) and left (D) adrenal gland on ^{18}F -FDG PET (small black arrows). Axial images on CT show high contrast uptake in the right (C) and left (E) adrenal gland. A myelolipoma (large white arrow) is observed within the left adrenal gland on CT (E).

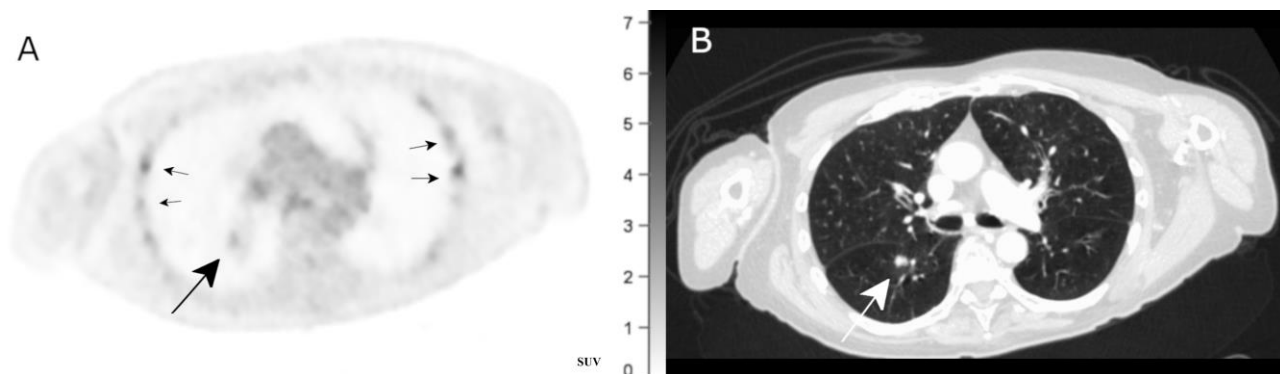


Figure 2 High ^{18}F -FDG uptake in a lung lesion (black arrow) located in the apex of the right lung lower lobe on axial ^{18}F -FDG PET, moderate uptake in intercostal muscles (small black arrows) and hilar and mediastinal lymph nodes (A). The CT-image (B) reveals a spiculated lesion with a diameter of 11 mm (white arrow).

Following up on the increased glucose metabolism of the adrenal glands an additional hormonal screening was performed (**Table 1**).

Table 1 Hormonal adrenal testing

	Values	Normal Range
ACTH (ng/L)	356.0	10.0-60.0
Cortisol (µg/dL)	7.9	6.2-18.0
Transcortine (mg/dL)	51.7	32.0-50.0
DHEAS (µg/dL)	167.0	16.2-123.0
Androstenedione (ng/dL)	578.0	40.0-150.0
17-hydroxy-progesterone (µg/dL)	6.7	0.03-0.33
Testosterone (ng/dL)	192.0	300.0-1000.0
SHBG (nmol/L)	170	24.0-55.0
Free testosterone (ng/dL)	1.0	5.0-20.0
LH (IU/L)	4.9	1.7-8.6

ACTH= adrenocorticotrophic hormone, DHEAS = dehydroepiandrosterone sulphate, SHBG = sex hormone-binding globulin, LH= luteinizing hormone

DISCUSSION

The ^{18}F -FDG PET-CT revealed hypermetabolic adrenal glands (*Figure 1*). On CT, the adrenal glands had an enlarged aspect, but were within the upper limit of the normal size range and showed high contrast uptake. A myelolipoma (well defined mass with low and higher attenuation areas with no hypermetabolism) was visualized within the left adrenal gland (*Figure 1E*). These lesions are most prevalent in patients with endocrine disorders (1). In the lower lobe of the right lung, a hypermetabolic spiculated lesion was detected (*Figure 2*). Bilateral apical pleural thickening, and slightly hypermetabolic hilar and mediastinal lymph nodes were also observed.

Laboratory findings were concordant with adrenal hyperandrogenism, hypogonadotropic hypogonadism, and low normal cortisol levels in the context of a hospitalised patient despite highly increased adrenocorticotrophic hormone (*Table 1*). The differential diagnosis was: (i) syndrome of inappropriate antidiuretic hormone secretion secondary to a subdural hematoma or a primary lung cancer with adrenal metastases (2), (ii) or a bilateral adrenal malignancy (primary/secondary) (3); (iii) or a partial primary adrenocortical insufficiency due to congenital adrenal hyperplasia.

FINAL DIAGNOSIS

Bilateral symmetric hypermetabolism together with contrast enhancement and non-nodular enlargement of the adrenal glands on the CT images was more suggestive of adrenal hyperplasia or primary adrenal lymphoma. Combined with the clinical history of the patient, we therefor did not consider adenomas, endothelial cysts or pheochromocytomas in our differential diagnosis. The latter entities usually present as nodular enlargements and often have an asymmetric or unilateral appearance (3).

Nuclear imaging combined with the clinical presentation and laboratory findings of the patient led to the final diagnosis of congenital adrenal hyperplasia (CAH). This case of CAH presented with an intermediate phenotype between the salt-wasting form and the non-classic form with increased adrenocorticotrophic hormone driven adrenal androgen production and partial insufficiency of glucocorticoid and mineralocorticoid production.

Genetic testing confirmed the diagnoses of CAH due to two heterozygote inactivating mutations in the CYP21A2 gene (pathogenic heterozygous c.290-13C>G (IVS2-13C>G) mutation and pathogenic heterozygous c.5151T>A (p.Ile172Asn) mutation) encoding for 21-hydroxylase. After substitution with hydrocortisone and fludrocortisone, the sodium levels normalised. In parallel, the adrenal hyperandrogenism decreased and testosterone and luteinizing hormone levels increased.

A follow-up CT scan revealed a decrease in volume of the pulmonary lesions, excluding a malignancy and pointing towards an inflammatory or infectious cause.

CONCLUSION

CAH is a group of autosomal recessive disorders characterized by adrenal hyperandrogenism and variably impaired cortisol and aldosterone synthesis resulting from the deficiency of one of the five enzymes required for adrenocortical steroid hormone synthesis. The most common type is 21-hydroxylase deficiency (4). The classic form is rare but clinically overt. The non-classic form represents one of the most common autosomal recessive disorders, it can, however, remain clinically occult for many years, as patients will retain some enzyme activity (4).

An ^{18}F -FDG PET-CT leading to the diagnosis of CAH at older age is rare, with only one case described in the literature (5). Our case demonstrates that bilateral increased glucose metabolism in the adrenal glands on ^{18}F -FDG PET-CT with associated hyponatremia should prompt to the biochemical screening of excess adrenal androgens and should raise suspicion of undiagnosed CAH, even in older patients.

DISCLOSURE STATEMENT

No potential conflicts of interest relevant to this article exist.

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