Thyroid Science 5(4):1-4, 2010

www.ThyroidScience.com

Case Reports

FDG-PET/CT Visualizes a Case of Primary Hyperparathyroidism in a Patient with Gastrointestinal Stromal Tumor

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Received: April 8, 2010
Accepted: April 13, 2010

Abstract. **Background.** Positron emission tomography/computed tomography (PET/CT) is used in clinical practice above all other tests to define the status of oncological disease. The predominant use of PET/CT is due to its use of ^{18}F- fluorodeoxyglucose (FDG) to map cellular glucose metabolism. Some benign clinical conditions are also detected with FDG-PET/CT. These include inflammatory or hypermetabolic processes. Parathyroid adenoma is the most common cause of primary hyperparathyroidism, and nuclear medicine is already used to locate adenomas and to guide surgery for their removal. The utility of PET/CT with ^{11}C-methionine for parathyroid disorders is well-documented in the research literature, while the usefulness of PET/CT with ^{18}F-FDG is not clear. **Case Presentation.** We reported a case of a patient without specific symptoms for primary hyperparathyroidism, with a borderline high value of parathyroid hormone and a positive finding of parathyroid disease with PET/CT using ^{18}F-FDG. **Conclusion.** PET/CT with ^{18}F-FDG is useful in identifying parathyroid adenomas, and the techniques can be used to precisely clarify the nature of suspected nodules close to thyroid gland.

Keywords • Adenoma • Computerized tomography • ^{18}F-Fluorodeoxyglucose • ^{11}C-Methionine • Oncological disease • Parathyroid hormone • Parathyroidism • Positron emission tomography

Background

The pathogenesis of primary hyperparathyroidism is due to an adenoma in 85% of cases. In a small percentage of cases, hyperparathyroidism involves multi endocrine syndrome (MEN). The diagnosis of primary hyperparathyroidism is based on hypercalcaemia and elevated levels of parathyroid hormone.

The flow-chart for concluding that parathyroid pathologies are present begins with a biochemical evaluation and thereafter with diagnostic imaging. ^{99m}Tc-MIBI-guided detection of abnormal parathyroid glands in primary hyperparathyroidism has become a popular and effective technique, especially to allow the performance of minimal surgery.[1]

Combined positron emission tomography/computed tomography (PET/CT), using ^{11}C-methionine as the alternative radio-labelled amino acid tracer agent, has already been demonstrated to play an important role in localating pathological parathyroid glands.[2-5] On the other hand, Lange-Nolde et al. [6] suggested that PET with ^{18}F-DOPA (3-,4-dihydroxy-6-(18)-F-fluorophenylalanine), another radiolabelled tracer, is not useful in the detection of parathyroid adenomas in patients with primary hyperparathyroidism. Today, however, the role of ^{18}F-FDG PET/CT in identifying parathyroid pathologies is still not clear.

Case presentation

A 37-year-old female who had a history of gastrointestinal stromal tumor and was treated with surgery in July 2009 was referred to our Department of Nuclear Medicine for evaluation of the disease state. She underwent PET/CT exam for post-surgery

evaluation. At the time of imaging, she reported hair loss, trembling hands, split nails, and irregular menstruation. The PET/CT examination performed with ^{18}F-FDG showed a small area near and posterior to the left lower pole of her thyroid gland. The small area was moderately hypermetabolic and had a maximum Semiquantitative Uptake Value (SUV max) of 6.0 (Figure 1A).

The biochemical evaluation showed a serum parathyroid hormone level of 76 ng/L (reference values 9-to-55 ng/L) and reference values of serum calcium and phosphate. For further evaluation, the patient underwent a neck ultrasound exam. This revealed the presence of an ipoechoic nodule with structural morphology similar to the parathyroid gland and in the same site.

Finally, based on clinical and diagnostic findings, a diagnosis of primary hyperparathyroidism was made. Thereafter, for the localization of the adenoma, a ^{99m}Tc-sestamibi parathyroid dual-phase scintigraphy was performed. This revealed an area with high uptake (Figure 1B) in the same place shown by the PET/CT images. These data demonstrate the utility of ^{18}F-FDG uptake in identifying the site of the adenoma.

Discussion

PET/CT with ^{18}F-FDG is an imaging modality that has been in widespread use in recent years. The procedure is used especially in the oncological field, but also in the cardiovascular and neurological fields. The increased glucose metabolism of all pathological processes can be visualized by FDG-PET.

Primary hyperparathyroidism is due mainly to adenomas of the parathyroid glands. The increased number of parathyroid cells elevates glucose metabolism. Parathyroid adenomas, as incidental findings are not often detected during PET examinations, but other incidental clinical conditions (e.g. breast cancer, thyroid cancer, colon inflammatory disease, etc.) are usually depicted.[7-9] In fact, the research literature contains only one case, by Kim et al.,[10] that demonstrated an intra-thyroidal parathyroid adenoma discovered by FDG-PET.

The patient whose case we report here had a history of GIST, a rare cancer that affects the digestive tract or nearby structures within the abdomen. Followup post-surgery evaluation was the reason the patient had an evaluation with FDG-PET/CT.

In the literature, Papillon et al.[11] reported a case of a patient with MEN-1 and associated GIST. They conjectured that the patient's GIST arose independently by a mechanism unrelated to the MEN-1 gene.

Precise identification of the location of a suspected nodule close to the thyroid gland can be useful in deciding whether or not further diagnostic tests are appropriate. Such decisions are particularly important in the management of oncological patients. The reason is that it is well known that oncological pathologies can induce a hypercalcaemia, as can parathyroid adenomas. It is necessary, then, to differentiate between oncological pathology and parathyroid adenomas as the source of patients' hypercalcemia.

Conclusion

Should ^{18}F-FDG be used as an alternative to ^{11}C-methionine to detect parathyroid adenomas? In view of the clinical flow-chart, this is questionable for two reasons,: first is the cost/benefit ratio, as PET/CT is more expensive than other imaging modalities; second is the proved diagnostic utility of scintigraphy with ^{99}Tc-sestamibi. Far more data from studies are necessary to clearly delineate the advantages of FDG-PET/CT compared to other procedures in the diagnosis of primary hyperparathyroidism. However, nowadays, FDG-PET/CT is considered the best technique for oncological evaluations, and in the near future, it may become clear that this imaging technique also could be employed in the diagnosis of other clinical conditions including parathyroid adenomas.

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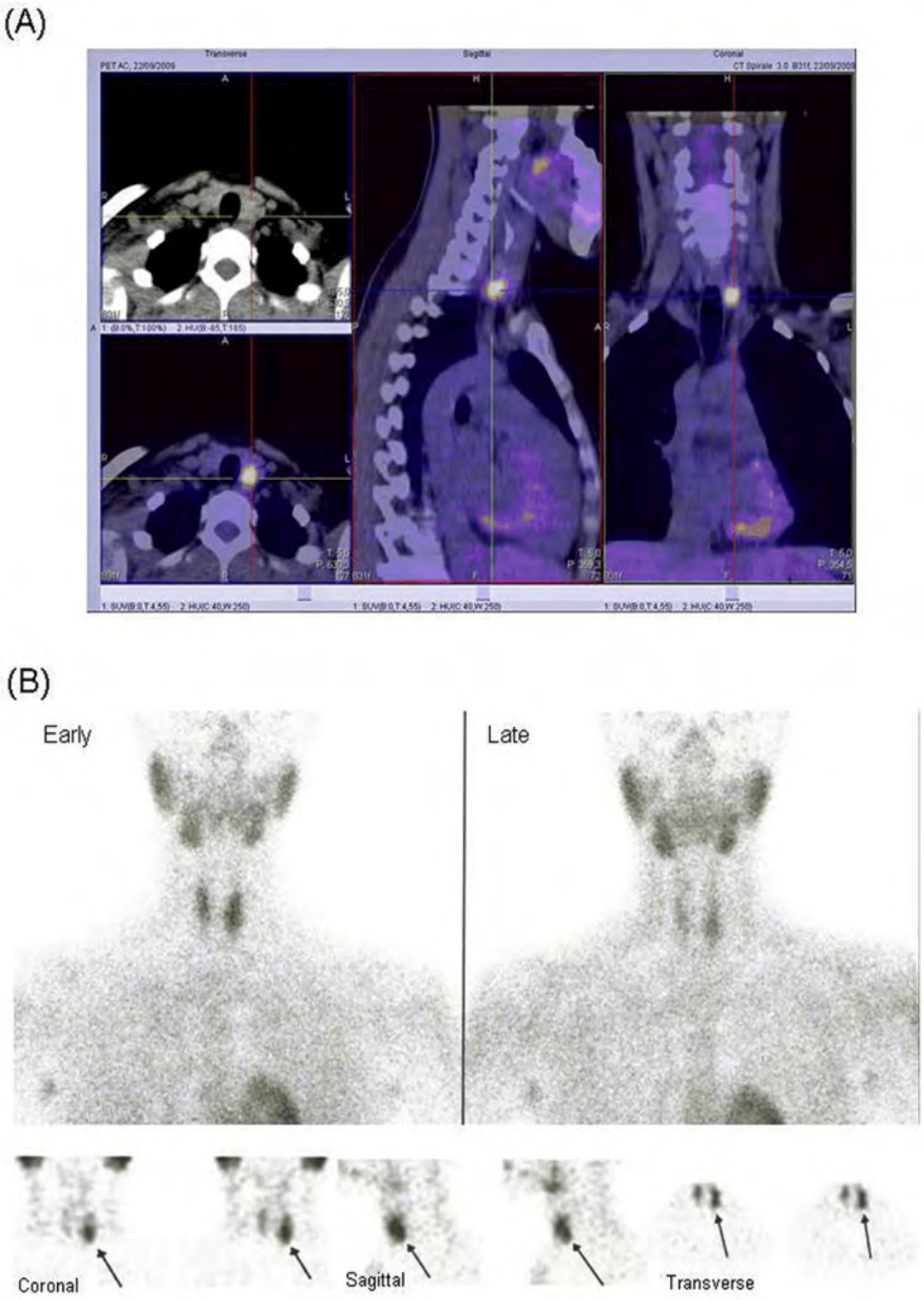

Figure 1. (A) PET/CT image with the use of ^{18}F-FDG. It shows a small area near and posterior to the left lower pole of the thyroid gland with moderate hypermetabolism. (B) Depiction of the localization of the adenoma shown by ^{99m}-Tc-sestamibi parathyroid dual-phase scintigraphy.

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