Role of PET-choline in the diagnosis of an hyperfunctioning cervical-mediastinal parathyroid adenoma: a case report of a multi-fracturative normocalcemic hyperparathyroidism

Luigi di Filippo [1], Ursola Pajoro [2], Raffaele Giubbini [1], Andrea Giustina [1]

[1] Institute of Endocrine and Metabolic Sciences, Università Vita-Salute San Raffaele, IRCCS Ospedale San Raffaele, Milan, Italy; [2] Nuclear Medicine Department, IRCCS San Raffaele Scientific Institute, Milan, Italy

ABSTRACT

Normocalcemic primary hyperparathyroidism is a recently distinguished form of Primary hyperparathyroidism and it is mostly caused by an hyperfunctioning parathyroid adenoma. It has been consistently associated with skeletal and renal complications, and, therefore, a proper radiological diagnosis of the hyperfunctioning adenoma is crucial in patients affected.

Here we report a case of a patient affected by normocalcemic primary hyperparathyroidism and a severe osteoporosis complicated with multiple fragility fractures, highlighting the role of PET-choline in the diagnosis of an hyperfunctioning cervical-mediastinal parathyroid adenoma not previously localized with conventional imaging.

KEYWORDS

PET-choline, normocalcemic hyperparathyroidism, osteoporosis, fractures, parathyroid adenoma.

Introduction

Normocalcemic primary hyperparathyroidism (NPHPT) is a specific form of Primary hyperparathyroidism (PHPT), mostly caused by an hyperfunctioning parathyroid adenoma, that has been recently distinguished and which has been increasingly detected in general population [1-4]. NPHPT is biochemically characterized by increased parathyroid hormone (PTH) levels, normal circulating levels of calcium and 25(OH) vitamin D, and preserved renal function.

Although the clinical manifestations of NPHPT can be considered milder than those of PHPT, growing evidences are reporting high rates of skeletal and renal complications even in these patients [3,4]. Although the traditional radiological techniques, including conventional neck ultrasonography (US) and 99mTc-sestamibi parathyroid scintigraphy, have improved the parathyroid adenoma localization sensitivity, novel technologies are currently recommended in patients with difficult diagnosis, such as 18F-fluorocholine and 11C-choline PET (carbon choline) scan combined with enhanced CT scan proposed to have better diagnostic accuracy [5-7]. 11C-choline is characterized by a lower half-life time as compared to the 18F-fluorocholine resulting in a significantly lower dosimetric load to the patients [8].

Here we report a case of a patient affected by NPHPT and a severe osteoporosis complicated with multiple fragility fractures, highlighting the role of PET-choline in the diagnosis of an hyperfunctioning cervical-mediastinal parathyroid adenoma.

Article history

Received 16 Jul 2023 – Accepted 6 Oct 2023

Contact

Luigi di Filippo; difilippo.luigi@hsr.it

Institute of Endocrine and Metabolic Sciences, Università Vita-Salute San Raffaele, IRCCS Ospedale San Raffaele, via Olgettina 60, 20132 Milan, Italy; ORCID number: 0009-0002-6117-0081

Case report

A 67-year-old female patient attended in our Bone Centre, IRCCS Ospedale San Raffaele, in 2022 for a re-evaluation of her osteoporosis. The patient was also affected by diverticulosis and type 2 diabetes treated with low-dose of metformin; she denied taking previous corticosteroids and did not report family history of osteoporosis. The patient was in menopausal at 49 years and was treated with hormone replacement therapy for 5 years.

The patient reported a first radial fracture at 51 years (in the 2006) after a moderate-energy fall. Subsequently, she reported further fractures at 57 years (2012) in the left fifth-toe; after 6 months a left femoral head fractures after a low-energy fall and treated with a primary total hip replacement; at the age of 58 (2013) a fracture of left patella and at 64-years-old (2019), during a road-traffic injury, she reported multiple non-severe fractures of the tibia, fibula and right patella.

After the femoral fracture (in 2012), she performed for the first-time a bone mineral density (BMD) assessment with dual x-ray absorptiometry (DXA) reporting a form of osteopenia

(spine T-score -1.1 SD, right femoral neck T-score -1.5 SD, right total hip T-score -1.1 SD), and started supplementation with cholecalciferol and treatment with Alendronate 70 mg, once a week, which, was discontinued after one year for gastric intolerance. In 2017, she performed a complete diagnostic screening for secondary osteoporosis resulting negative and inconclusive. She was also evaluated with a spine X-ray diagnosing a lumbar vertebral fracture and, therefore, she started with Denosumab 60 mg. At biochemical examinations a form of NPHPT was reported with the following values: PTH 98.5 pg/mL (15-65), 25(OH) vitamin D 55 ng/mL (30-100), total calcium 9.2 mg/dL (8.8-10.2). She performed two consecutive neck US and two 99mTc-sestamibi scintigraphy scans without any localization of hyperfunctioning parathyroid adenoma. Therefore, only a biochemical and clinical monitoring was recommended.

Then, she attended to our centre in 2022. She performed a new DXA scan observing a slightly BMD improvement; she did not report any further clinical fractures and recent biochemical examinations confirmed a NPHPT form. During the visit, we highlighted that the NPHPT was already present at biochemical evaluations performed in 2011, before the second fracture event. To complete the imaging assessment for presence of hyperfunctioning parathyroid adenoma, a 11C-choline PET scan combined with enhanced CT study was perfomed. The CT scan revealed a lesion of 12x5x6mm in the right paramedian cervical-mediastinal site, medial to the brachiocephalic artery, with a marked enhancement, and the PET scan revealed a marked and focal tracer accumulation at the level of nodular lesion described (Figure 1).

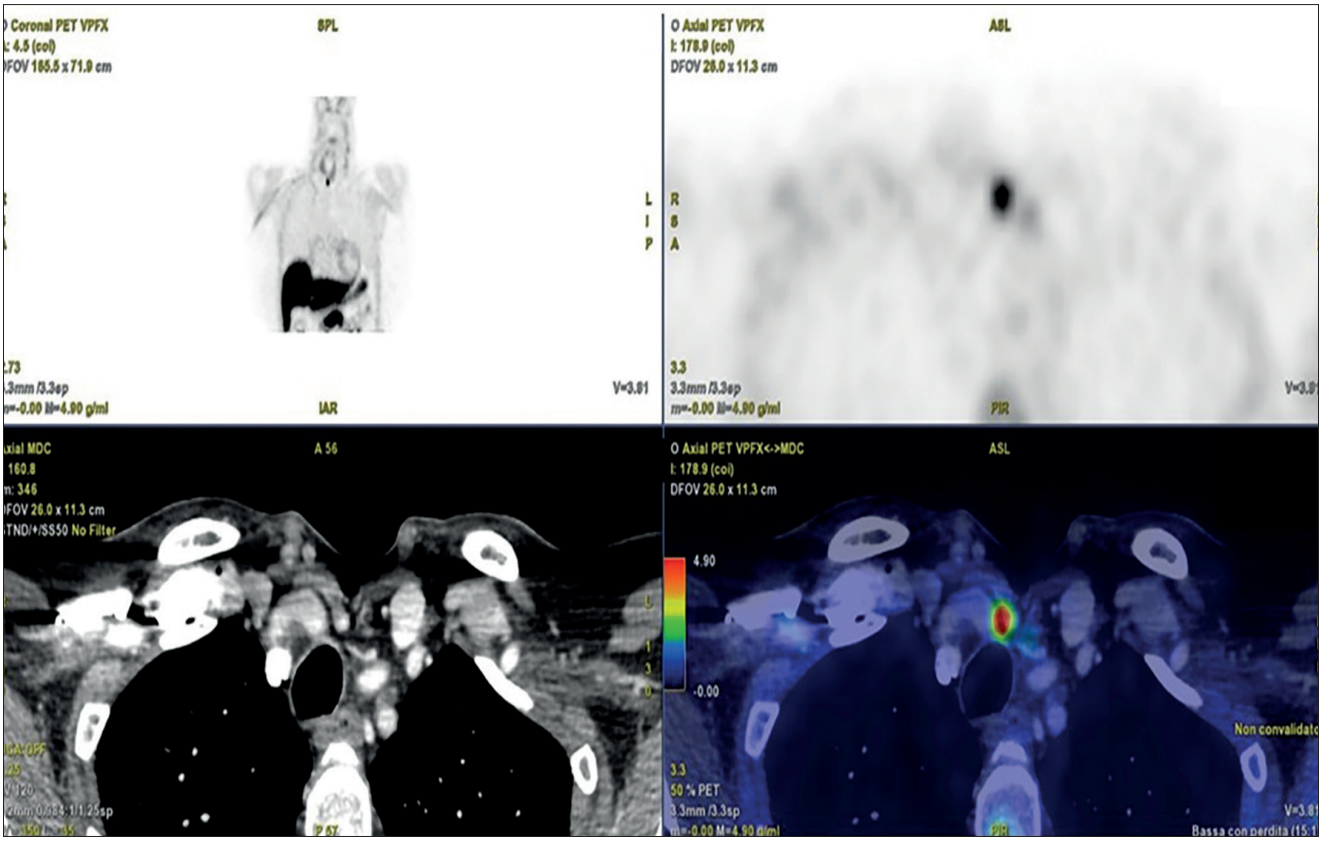
These findings were highly suggestive for the presence of an hyperfunctioning cervical-mediastinal parathyroid adenoma. The patient is now attending a multidisciplinary evaluation in order to discuss the better therapeutic option including the surgical removal of the adenoma.

Conclusion

The proper radiological localization of the hyperfunctioning adenoma is crucial in patients with asymptomatic PHPT and NPHPT who fulfil the specific criteria, proposed by the main international guidelines for management of PHTP, for surgery as first recommended therapeutic choice [9,10]. Since the current availability of multiple radiological approach in the diagnosis of PHTP, the appropriateness in correctly choosing the diagnostic tool and the more proper sequence to perform these tests is crucial and mandatory in clinical practice, especially in patients with a potential difficult localization of the adenoma.

Here we have described a case of a middle-aged patient with a long history of NPHPT complicated by multiple fractures in which only an imaging evaluation with 11C-choline PET scan combined with enhanced CT study was able to detect an hyperfunctioning cervical-mediastinal parathyroid adenoma recommending to the patient a possible definitive therapeutic surgical treatment for her disease.

Figure 1 The diagnostic study with 11C-choline PET scan combined with enhanced CT study suggestive for the presence of an hyperfunctioning cervical-mediastinal parathyroid adenoma in our patient.



References

1. Giustina A, Formenti AM, Napoli N. Malattie delle paratiroidi. Medicina Interna Sistematica - Rugarli C, Cappelli G, Cappellini MD, Perin PC, Corazza GR, Craxì A, Crea F, Fabbri LM, Ferraccioli G, Ghia P, Giustina A, Lazzarin A, Nuti R, Pardi R, Stella AP. EDRA. Ottava Edizione (2021). ISBN 8821450953.
2. Bilezikian JP, Cusano NE, Khan AA, Liu JM, Marcocci C, Bandeira F. Primary hyperparathyroidism. Nat Rev Dis Primers. 2016;2:16033.
3. Cusano NE, Cipriani C, Bilezikian JP. Management of normocalcemic primary hyperparathyroidism. Best Pract Res Clin Endocrinol Metab. 2018;32(6):837-45.
4. Zavatta G, Clarke BL. Normocalcemic hyperparathyroidism: a heterogeneous disorder often misdiagnosed? JBMR Plus. 2020;4(8):e10391.
5. Graves CE, Duh QY, Suh I. Innovations in parathyroid localization imaging. Surg Oncol Clin N Am. 2022;31(4):631-47.
6. Petranović Ovčariček P, Giovanella L, Carrió Gasset I, et al. The EANM practice guidelines for parathyroid imaging. Eur J Nucl Med Mol Imaging. 2021;48(9):2801-22.
7. Treglia G, Piccardo A, Imperiale A, et al. Diagnostic performance of choline PET for detection of hyperfunctioning parathyroid glands in hyperparathyroidism: a systematic review and meta-analysis. Eur J Nucl Med Mol Imaging. 2019;46(3):751-65.
8. Noltes ME, Kruijff S, Noordzij W, et al. Optimization of parathyroid 11C-choline PET protocol for localization of parathyroid adenomas in patients with primary hyperparathyroidism. EJNMMI Res. 2019;9(1):73.
9. Bilezikian JP, Brandi ML, Eastell R, et al. Guidelines for the management of asymptomatic primary hyperparathyroidism: summary statement from the Fourth International Workshop. J Clin Endocrinol Metab. 2014;99(10):3561-9.
10. Bilezikian JP, Khan AA, Silverberg SJ, et al; International Workshop on Primary Hyperparathyroidism. Evaluation and management of primary hyperparathyroidism: summary statement and guidelines from the Fifth International Workshop. J Bone Miner Res. 2022;37(11):2293-314.

Disclosures: *No conflict of interest to declare.*