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Visualization of Macroprolactinoma by ^{18}F-Fluorocholine PET/CT in a Patient With Multiple Endocrine Neoplasia Type 1

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The diagnostic performance of ^{18}F-fluorocholine (FCH) positron emission tomography (PET)/CT for the detection of hyperfunctioning parathyroid glands in the setting of primary hyperparathyroidism (HPT1) seems promising [1, 2]. Its interest in the surgical management of these diseases has also been reported [3].

A 32-year-old man was diagnosed with a multiple endocrine neoplasia type 1 (MEN1) syndrome as part of a family screening. A diagnosis of HPT1 was made with an elevated ionized calcium level of 1.39 mM (normal range 1.17 to 1.3 mM) and inappropriate serum parathyroid hormone level of 3.59 pM (normal range 0.48 to 4.2 pM). Further hormonal testing revealed a hyperprolactinemia of 3292 mUI/L (normal range 86 to 324 mUI/L). There was no evidence of a pancreatic neuroendocrine tumor. Parathyroid scintigraphy with metoxyisobutylisonitil labeled with technetium-99m (MIBI), including a single photon emission CT/CT acquisition, showed an abnormal focus of uptake in the upper-right quadrant of the neck (Fig. 1A). Parathyroid sonography identified a concordant-enlarged, 16-mm parathyroid gland in the same region and a second 5-mm lesion in the upper-left quadrant. To address these discordant findings, we performed a FCH-PET/CT. An increased focus of uptake was observed in two parathyroid glands, as a result of a maximum intensity projection view (Fig. 1B, blue arrows), whereas it was observed in all four parathyroid glands on a FCH-PET/CT fused view (maximum standardized uptake value at 5 and 13.1 for inferior and superior right and 2.9 and 6.8 for inferior and superior left; Fig. 1C, arrow: inferior left parathyroid). Interestingly, on a highest-intensity projection view, an increased focus of uptake was also visualized in the pituitary gland (maximum standardized uptake value at 8.7; Fig. 1B, red arrow). Gadolinium T1-weighted pituitary MRI showed a macroadenoma of 11 × 10.5 × 13 mm, compatible with diagnosis of macroprolactinoma (Fig. 1D, left). FCH-PET/MRI-fused view showed the increased focus of uptake in macroprolactinoma (Fig. 1D,

Abbreviations: FCH, ^{18}F-fluorocholine; HPT1, hyperparathyroidism; MEN1, multiple endocrine neoplasia type 1; MIBI, metoxyisobutylisonitil labeled with technetium-99m; PET, positron emission tomography.

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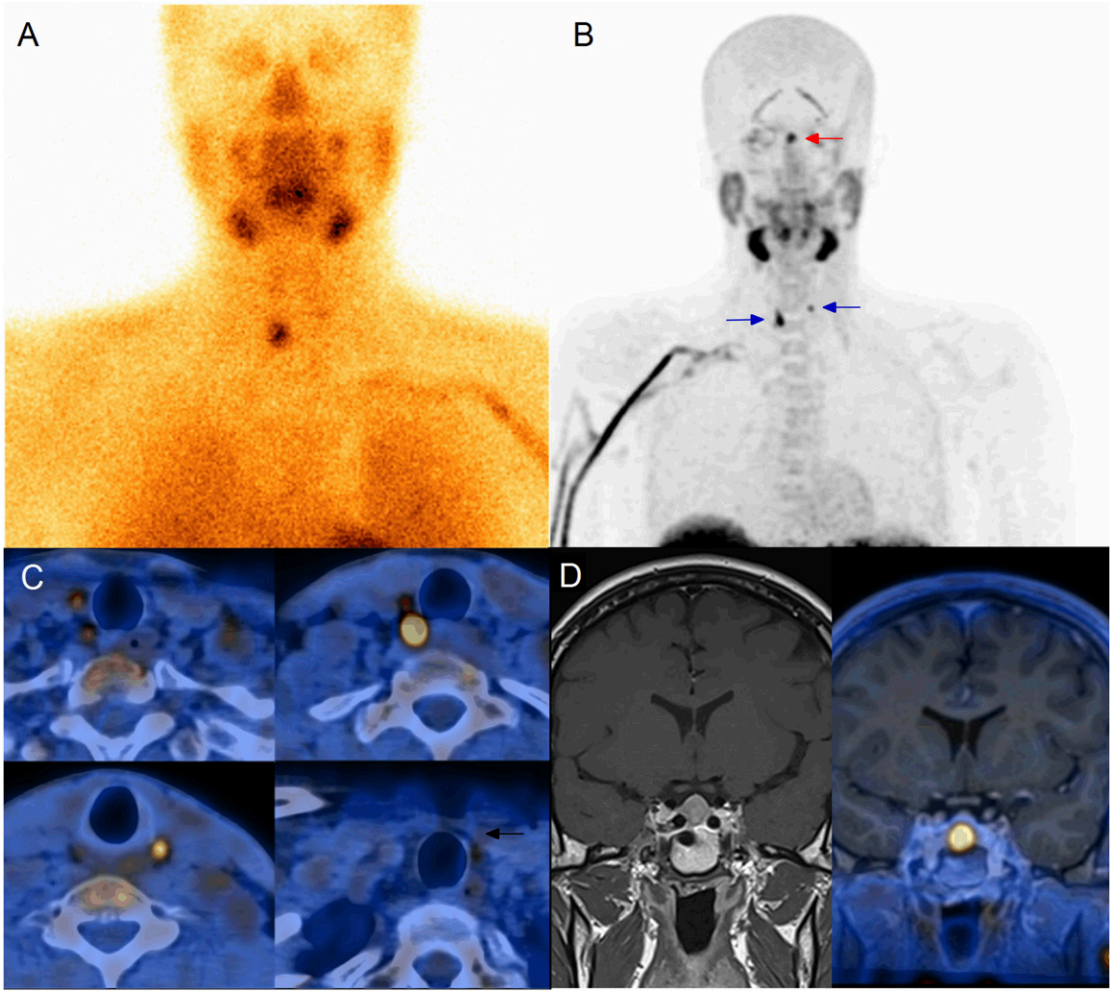

Figure 1. Macroprolactinoma visualized by 18F-Fluorocholine PET/CT. (A) Parathyroid scintigraphy with metoxyisobutylisonitil labeled with technetium-99m (MIBI) with focus of uptake in the right upper parathyroid gland. (B) Maximum intensity projection of FCH-PET visualized two parathyroid glands (blue arrows) and also a macroadenoma (red arrow). (C) FCH-PET/CT fused view showed an increase of uptake in all four parathyroid glands. Arrow shows inferior left parathyroid. (D) On the left, gadolinium T1-weighted pituitary MRI showed a macroadenoma of 11 × 10.5 × 13 mm and on the right FCH-PET/MRI fused view showed the increased focus of uptake in macroprolactinoma.

right). Pathological findings after parathyroid surgery revealed adenomas in two parathyroid glands and hyperplasia in another one. The remaining one, measured at 6 mm on FCH-PET/CT, was left in place. After surgery, the patient had hypoparathyroidism with a calcium level of 2.11 mM (normal range 2.25 to 2.6 mM) and serum parathyroid hormone level of 0.56 pM (normal range 0.48 to 4.2 pM). Cabergoline was initiated to treat prolactinoma.

In MEN1 patients, the estimated penetrances of HPT1 and prolactinoma by the age of 40 are, respectively, ~90% and ~20% [4]. Incidental detection of pituitary adenoma by FCH-PET/CT was recently reported but not in a MEN1 patient or for prolactinoma [5–7]. In our case, the prolactinoma presented an intense FCH focus of uptake compared with what is usually reported as physiologic [8], but MIBI scintigraphy did not reveal anything. Proton magnetic resonance spectroscopy studies have found that the concentration of choline-containing compounds was significantly higher in pituitary adenomas [9, 10]. MIBI avidity by tissues is related to the number of mitochondria per cell [11]. Presumably, this would explain why in our case, the prolactinonoma was positive on FCH PET/CT and negative on MIBI scintigraphy. Pituitary adenomas with an increased focus of uptake of fluorodeoxyglucose [7]

or tetraazacyclododecanetetraacetic acid-Tyr3-octreotide [12] on PET/CTs have already been reported, but these radiotracers are not relevant to explore parathyroid glands.

FCH-PET/CT needs to be evaluated in a larger number of patients with MEN1. Indeed, it could help to detect more hyperfunctioning parathyroid glands than other imaging modalities and identify other potential endocrine tumors as well.

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References and Notes

1. Lezaic L, Rep S, Sever MJ, Kocjan T, Hocevar M, Fettich J. ^{18}F-Fluorocholine PET/CT for localization of hyperfunctioning parathyroid tissue in primary hyperparathyroidism: a pilot study. *Eur J Nucl Med Mol Imaging*. 2014;**41**(11):2083–2089.
2. Kluijfhout WP, Pasternak JD, Gosnell JE, Shen WT, Duh Q-Y, Vriens MR, de Keizer B, Hope TA, Glastonbury CM, Pampaloni MH, Suh I. ^{18}F Fluorocholine PET/MR Imaging in Patients with Primary Hyperparathyroidism and Inconclusive Conventional Imaging: a prospective pilot study. *Radiology*. 2017;**284**(2):460–467.
3. Hocevar M, Lezaic L, Rep S, Zaletel K, Kocjan T, Sever MJ, Zgajnar J, Peric B. Focused parathyroidectomy without intraoperative parathormone testing is safe after pre-operative localization with ^{18}F-fluorocholine PET/CT. *Eur J Surg Oncol*. 2017;**43**(1):133–137.
4. Brandi ML, Gagel RF, Angeli A, Bilezikian JP, Beck-Peccoz P, Bordi C, Conte-Devolx B, Falchetti A, Gheri RG, Libroia A, Lips CJ, Lombardi G, Mannelli M, Pacini F, Ponder BA, Raue F, Skogseid B, Tamburrano G, Thakker RV, Thompson NW, Tomassetti P, Tonelli F, Wells SA Jr, Marx SJ. Guidelines for diagnosis and therapy of MEN type 1 and type 2. *J Clin Endocrinol Metab*. 2001;**86**(12):5658–5671.
5. Maffione AM, Mandoliti G, Pasini F, Colletti PM, Rubello D. Pituitary non-functioning adenoma disclosed at 18F-choline PET/CT to investigate a prostate Cancer relapse. *Clin Nucl Med*. 2016;**41**(10): e460–e461.
6. Sindoni A, Bodanza V, Tatta R, Baresic T, Borsatti E. Ectopic adrenocorticotropic hormone-secreting pituitary adenoma localized by 18F-choline PET/CT. *Clin Nucl Med*. 2018;**43**(1):e25–e26.
7. Albano D, Bosio G, Bertagna F. Incidental pituitary adenoma detected by 18F-FDG PET/CT and 18F-choline PET/CT in the same patient. *Rev Esp Med Nucl Imagen Mol*. 2018;**37**(4):250–252.
8. Mertens K, Ham H, Deblaere K, Kalala J-PO, Van den Broecke C, Slaets D, De Vos F, Goethals I. Distribution patterns of 18F-labelled fluoromethylcholine in normal structures and tumors of the head: a PET/MRI evaluation. *Clin Nucl Med*. 2012;**37**(8):e196–e203.
9. Usenius JP, Kauppinen RA, Vainio PA, Hernesniemi JA, Vapalahti MP, Paljärvi LA, Soimakallio S. Quantitative metabolite patterns of human brain tumors: detection by 1H NMR spectroscopy in vivo and in vitro. *J Comput Assist Tomogr*. 1994;**18**(5):705–713.
10. Kinoshita Y, Yokota A. Absolute concentrations of metabolites in human brain tumors using in vitro proton magnetic resonance spectroscopy. *NMR Biomed*. 1997;**10**(1):2–12.
11. O'Doherty MJ, Kettle AG, Wells P, Collins RE, Coakley AJ. Parathyroid imaging with technetium-99m-sestamibi: preoperative localization and tissue uptake studies. *J Nucl Med*. 1992;**33**(3):313–318.
12. Gauthé M, Sarfati J, Bourcigaux N, Christin-Maitre S, Talbot J-N, Montravers F. Pituitary adenoma recurrence suspected on central hyperthyroidism despite empty sella and confirmed by 68Ga-DOTA-TOC PET/CT. *Clin Nucl Med*. 2017;**42**(6):454–455.