False-Negative Fluorine-18-FDG PET in Metastatic Carcinoid

Hossein Jadvar and George M. Segall
Nuclear Medicine Service, VA Palo Alto Health Care System, Palo Alto, California; and Division of Nuclear Medicine, Department of Radiology, Stanford University School of Medicine, Stanford, California

Carcinoid tumors have high numbers of somatostatin receptors that allow scintigraphic imaging with the radiolabeled somatostatin analog octreotide. Experience, however, with PET using 2-[^{18}F]fluoro-2-deoxy-D-glucose (^{18}FDG) in carcinoid is very limited. In two prior studies which investigated the utility of ^{18}FDG-PET in cancer detection, three patients with small, solitary, indolent carcinoid tumors had false-negative results. We report a case where ^{18}FDG-PET imaging was false-negative in a patient with known metastatic carcinoid and a positive octreotide scan.

Key Words: carcinoid; fluorine-18-FDG; PET; indium-111-octreotide

J Nucl Med 1997; 38:1382–1383

Whole-body ^{18}FDG PET has a high sensitivity for detecting the primary tumor and metastases in a diverse group of malignant tumors (*1*). These tumors include carcinomas of the lung, breast, ovary and colon, as well as melanoma, lymphoma and osteosarcoma. Experience with ^{18}FDG-PET in neuroendocrine gastrointestinal tumors such as carcinoid, however, is very limited (*2*). In one study of 87 patients with various malignancies, two of three patients with low-grade small (<1.5 cm) carcinoid tumors did not show focal glucose uptake (*1*). In another study, a small (<1.0 cm) histologically indolent ACTH-producing bronchial carcinoid was detected by high resolution CT in one patient but was not seen on ^{18}FDG-PET imaging (*3*). In this article, we report a case where the ^{18}FDG PET scan was false-negative in a patient with known metastatic carcinoid and a positive octreotide scan.

CASE REPORT

A 48-yr-old HIV-positive man was admitted to the hospital because of abdominal pain. Initial work-up included an abdominal ultrasound that demonstrated two hyperechoic masses in the liver. Contrast-enhanced abdominal CT scan showed multiple low-attenuation hepatic lesions with the largest lesion measuring approximately 3 cm in diameter (Fig. 1). CT also demonstrated a large mass in the terminal ileum, also measuring approximately 3 cm. Fine-needle biopsy of one of the hepatic lesions indicated carcinoid tumor. The 24-hr urine 5-hydroxyindoleacetic acid (5-HIAA) level was elevated. The diagnosis was carcinoid tumor of the terminal ileum with hepatic metastases.

An ^{111}In-octreotide scan was obtained for further evaluation. Anterior and posterior whole-body (15 min) and spot view (5 min) planar images were obtained at 4 and 24 hr after intravenous injection of 5.7 mCi ^{111}In-octreotide. The scan showed the primary carcinoid tumor in the distal ileum as well as several hepatic metastases (Fig. 2). An ^{18}FDG-PET scan was performed 5 wk after the octreotide scan. A two-bed position emission scan of the abdomen was acquired over 14 min approximately 40 min after intravenous injection of 13.3 mCi ^{18}FDG. The emission scan was immediately followed by a 14-min ^{68}Ga transmission scan of the same area for attenuation correction. A second emission scan from the top of the head to mid-thighs was obtained in six bed positions over 36 min. Images were reconstructed in transaxial, sagittal and coronal planes. PET did not show the primary tumor or the hepatic metastases (Fig. 3). The patient had a right hemicolectomy with resection of the terminal ileum. Intraoperatively, there was a large exophytic mass in the terminal ileum with adjacent mesenteric lymphadenopathy. Pathology confirmed an ileal carcinoid tumor

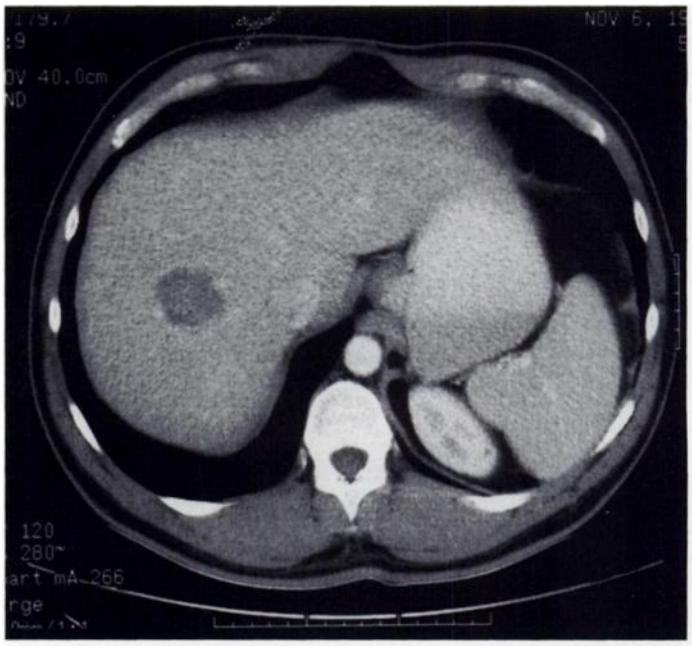

FIGURE 1. Axial contrast-enhanced CT image of the liver shows a 3-cm low-attenuation lesion due to metastasis in the right hepatic lobe. Multiple smaller lesions were seen in other regions of the liver (not shown).

FIGURE 2. An ^{111}In-octreotide scan of the anterior abdomen shows multiple hepatic metastases and the primary tumor in the terminal ileum.

Received Aug. 28, 1996; revision accepted Jan. 27, 1997
For correspondence or reprints contact: George M. Segall, MD, Nuclear Medicine Service 115, VA Palo Alto Health Care System, 3801 Miranda Ave., Palo Alto, CA 94304.

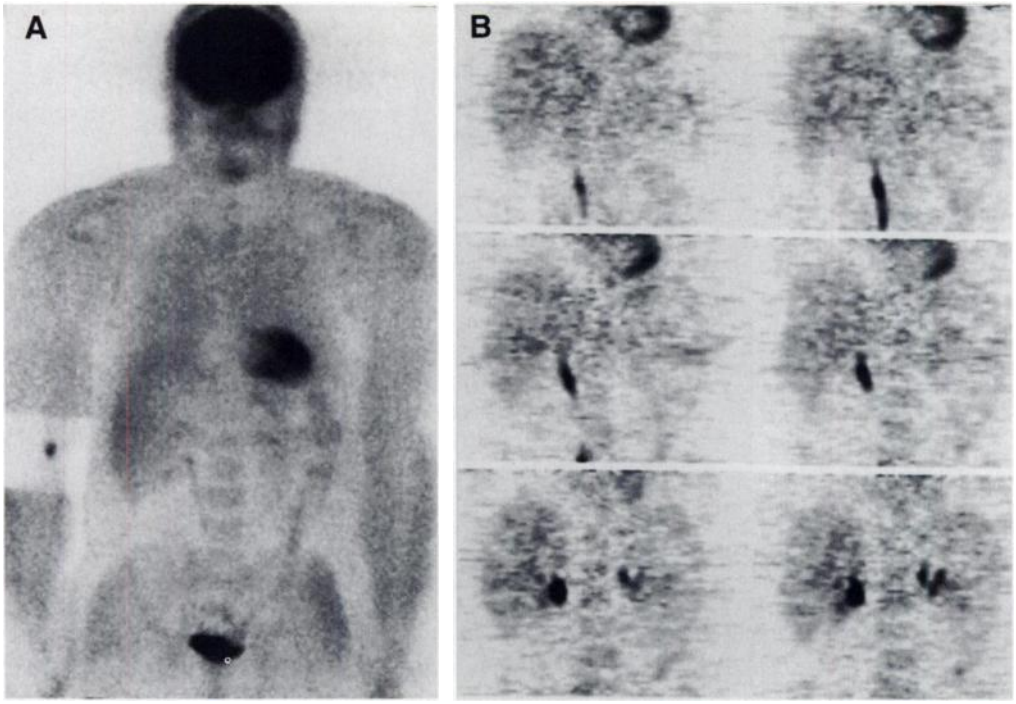

FIGURE 3. An anterior projection ^{18}FDG PET emission scan (A) and series of attenuation-corrected coronal images of the liver (B) do not show any abnormal glucose uptake in the liver or in the right lower quadrant.

extending into the serosa with metastases in four of nine lymph nodes.

DISCUSSION

Neuroendocrine tumors constitute about 2% of all malignant gastrointestinal tumors (*4*). These tumors include gastrinomas, islet cell carcinomas, insulinomas, glucogonomas and carcinoid. In vitro and in vivo assays have demonstrated somatostatin receptors in 88%–96% of carcinoids (*5*). Scintigraphic imaging with ^{111}In-octreotide has a sensitivity of 86% for detection of carcinoid tumors (*6*). PET imaging with ^{18}FDG is based on increased glucose uptake by tumors which is partly due to enhanced activity of hexokinase in cancer cells (*7*). The explanation for low glucose uptake by carcinoid tumors is unknown. Indolent form of the tumor is defined by localization to one site without regional lymph node involvement, invasion of adjacent structures or metastatic spread (*2*). This was the case for the two prior studies reported. The negative ^{18}FDG PET scan in those cases may have been a consequence of the indolent nature of the tumor. The aggressive form of the carcinoid tumor is defined by presence of nodal or distant metastases as in our patient. However, the negative ^{18}FDG PET scan was also negative.

CONCLUSION

We have reported on a false-negative ^{18}FDG PET scan from a patient with metastatic carcinoid. More studies are needed to determine the utility of ^{18}FDG PET in the diagnosis of carcinoid tumors.

REFERENCES

1. Hoh CK, Hawkins RA, Glaspy JA, et al. Cancer detection with whole-body PET using 2-[^{18}F]fluoro-2-deoxy-D-glucose. *J Comput Assisted Tomogr* 1993;17:582–589.
2. Eriksson B, Bergstrom M, Lilja A, et al. PET in neuroendocrine gastrointestinal tumors. *Acta Oncol* 1993;32:189–196.
3. Rege SD, Hoh CK, Glaspy JA, et al. Imaging of pulmonary mass lesions with whole-body positron emission tomography and fluorodeoxyglucose. *Cancer* 1993;72: 82–90.
4. Oberg K. Biology, diagnosis and treatment of neuroendocrine tumors of the gastrointestinal tract. *Curr Opin Oncol* 1994;6:441–451.
5. Krenning EP, Kwekkeboom DJ, de Jong M, et al. Essentials of peptide receptor scintigraphy with emphasis on the somatostatin analog octreotide. *Semin Oncol* 1994;21(suppl 13):6–14.
6. Krenning EP, Kwekkeboom DJ, Bakker WH, et al. Somatostatin receptor scintigraphy with [^{111}In-DTPA-D-Phe^{1}]- and [^{123}I-Tyr^{3}]-octreotide: the Rotterdam experience with more than 1000 patients. *Eur J Nucl Med* 1993;20(8):716–731.
7. Rempel A, Mathupala SP, Griffin CA, et al. Glucose catabolism in cancer cells: amplification of the gene encoding type II hexokinase. *Can Res* 1996;56:2468–2471.