Exposing the Evil in the Dark

The Usefulness of Delayed-Phase FDG PET Scan to Enhance the Detectability of Tiny Residual Skull Base Osteosarcoma Initially Concealed by Adjacent High Physiological Brain Activity

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Abstract: A 50-year-old man had an osteosarcoma in the skull base after surgery and adjuvant chemotherapy. Residual malignancy in the skull base was still suspected 6 months after the anticancer therapy. An FDG PET/CT was performed and a special abnormal finding in the prior skull base lesion site was noted. The abnormality was not found in the early phase scan but appeared in the delayed phase scan. The subsequent biopsy of the abnormality confirmed the presence of residual malignancy.

Key Words: FDG PET/CT, delayed-phase, osteosarcoma, skull base

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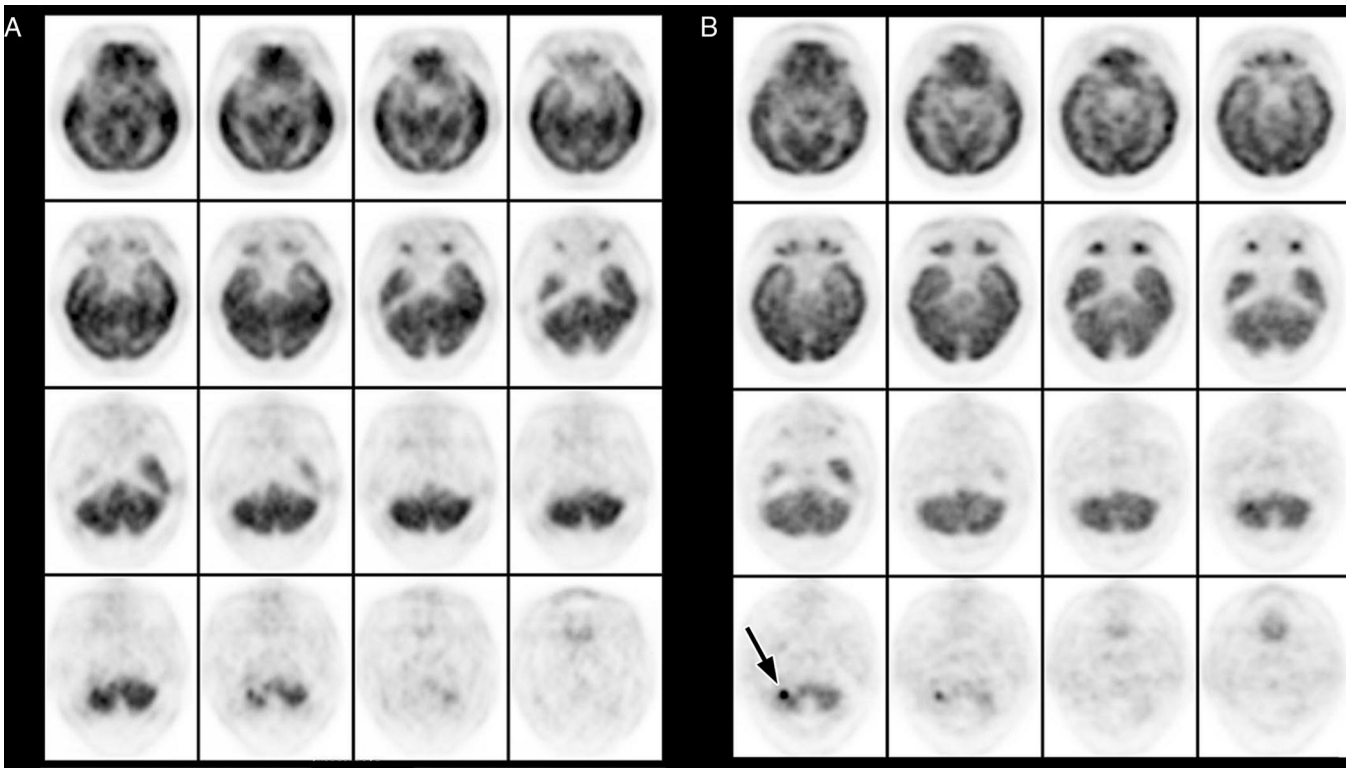

FIGURE 1. A 50-year-old man had an osteosarcoma in the right occipital bone near the jugular foramen, and had been treated with surgical removal of the tumor and subsequent adjuvant chemotherapy. Six months after the treatment, residual tumor was still suspected during the clinical follow-up. His attending clinician asked for an FDG PET/CT scan for further evaluation. After 50 minutes of the intravenous administration of 444 MBq (12 mCi) FDG, an early phase PET/CT scan was acquired using a General Electric Discovery LightSpeed PET/CT hybrid imaging scanner. There was no obvious abnormal FDG radioactivity in the right occipital bone region, but relatively normal physiological distribution of the adjacent brain radioactivity on the early phase images (**Panel A,** representative transaxial slices). For tumor survey, a routine delayed-phase scan of the head (**Panel B,** representative transaxial slices) was acquired at 180 minutes after the administration of FDG. Surprisingly, a distinct small area of focal intense radioactivity emerged from the prior normal-looking right occipital bone/adjacent brain area (black arrow).

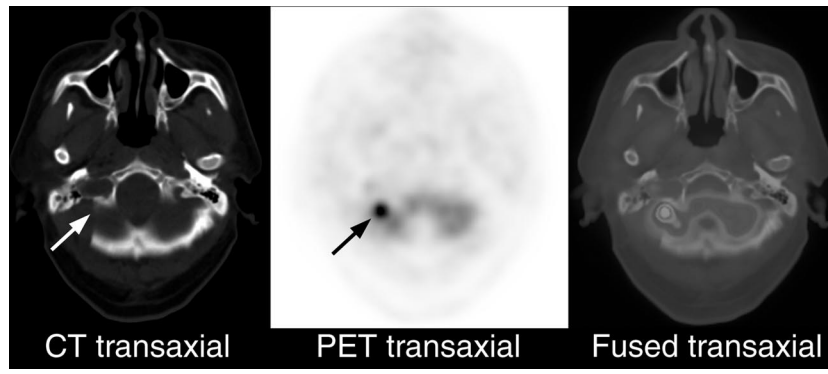

FIGURE 2. The fused FDG PET/CT images of the delayed-phase scan revealed that the focal intense FDG radioactivity (black arrow) was at the edge of the bone defect (white arrow) caused by the previous operation. Residual malignancy was highly suspected. The subsequent biopsy of this area proved the presence of residual osteosarcoma. Previous studies have suggested the potential uses of FDG PET for osteosarcoma, including staging and grading of the tumor,[1–3] monitoring the neoadjuvant therapy response,[4–6] and differentiating viable sarcoma from post-treatment changes.[7,8] Many authors have proposed to use dual-time point scans to differentiate malignant and benign lesions because the FDG uptake of a malignant lesion tends to reach its peak several hours later, but the time to peak radioactivity of a benign lesion is usually within an hour.[2,9,10] Previous studies[11,12] have described the usefulness of routine FDG PET scan without mention of delayed-phase images to detect skull malignancies and giant cell tumor, because of the sufficient high contrast between the tumors and physiological tissues in their reports. However, unlike our case that seems concealed by the adjacent high physiological brain activity, the lesions in their reports have characteristic protruding radioactivity beyond the brain tissue, which may be a more important feature to recognize these lesions. On the contrary, the lesion in our case was only recognizable on the delayed-phase images. However, because the lesion site is directly related to the prior tumor, this finding still prompts subsequent proof of malignancy via biopsy. Although we have carefully reviewed the corresponding area in the early phase scan, we still cannot find a suspicious abnormality that can be confidently interpreted as malignancy. The reason why we can only note the lesion on the delayed-phase scan is possibly due to a combined effect of the interference of the adjacent abundant brain activity and the limited spatial resolution of the PET scan for such a tiny lesion. Finally, this case again emphasizes the importance and usefulness to use an additional delayed-phase FDG PET scan to enhance the detectability for the survey of cancers, even though the lesion may be "invisible" in the early phase scan.