Split-Dose ^{18}F-FDG PET/CT–Guided Microwave Ablation for Liver Metastasis Recurrence with Immediate Treatment Assessment

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A 48-y-old man with a history of colon cancer presented with recurrent hepatic metastasis along a prior microwave ablation bed. Split-bolus, intraprocedural ^{18}F-FDG PET was performed to guide repeat microwave ablation and immediately confirm complete treatment. PET-guided ablation is highly accurate for targeting and treating malignant hepatic lesions and feasible for nonspecialized tertiary care hospitals without an onsite cyclotron.

Key Words: ^{18}F-FDG PET/CT; PET/CT-guided ablation; liver metastasis

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For detection of local cancer recurrence or progression after therapy, ^{18}F-FDG PET/CT is a powerful imaging tool (*1*). In particular, it can detect progression after thermal ablation of liver metastases with sensitivity of 92%–95% and specificity of 100% (*2*). Ryan et al. (*3*) showed that PET/CT can be used as an intraprocedural technique for targeting of anatomically occult lesions, with immediate confirmation of treatment success.

CASE REPORT

A 48-y-old man with a history of colon cancer underwent combined CT- and ultrasound-guided microwave ablation of an unresectable liver metastasis. Five months later, his carcinoembryonic antigen level was elevated and trended upward despite a lack of correlation on serial CT. Because of prior treatment effects, the lesion could not be identified by follow-up ultrasound and CT (Fig. 1A), precluding repeat ablation using standard guidance. Seven months after ablation, PET/CT identified an ^{18}F-FDG–avid recurrence along the ablation bed (Fig. 1B). Based on a novel technique from Memorial Sloan Kettering Cancer Center (*3*), split-dose ^{18}F-FDG PET/CT was selected for lesion targeting and immediate assessment of treatment.

Doses of ^{18}F-FDG were obtained from a local radiopharmaceutical supplier. The first (targeting dose) was calibrated for 148 MBq (4 mCi), and the second (treatment efficacy dose) was calibrated for 296 MBq (8 mCi) 3 h later. This interval was based on a 45-min uptake time for the targeting dose and an estimated 195 min for the ablation. Using a similar timeline and 30-min uptake period for the second dose, Memorial Sloan Kettering Cancer Center showed that approximately 90% of the postprocedural PET image is derived from the postablation dose, thereby reflecting the tumor's posttreatment metabolic state (*3*).

The initial targeting PET/CT was obtained using a limited field of view, low-dose CT, and a 1-min PET scanning time per bed position (Fig. 2A). Using 3 serial CT scans fused with the initial targeting PET scan, the microwave ablation antenna was advanced into the ^{18}F-FDG–avid lesion (Fig. 2B). The procedure was completed in 127 min, versus the planned 195 min; therefore, the treatment efficacy dose was reduced to 296 MBq (8 mCi) by removing the excess activity. Repeat limited PET/CT showed a complete lack of ^{18}F-FDG avidity (Fig. 2C), confirming therapeutic success.

DISCUSSION

Ablative therapy is commonly used for oligometastatic hepatic lesions. However, small lesions or recurrence near previous treatment beds may be difficult to target by CT or

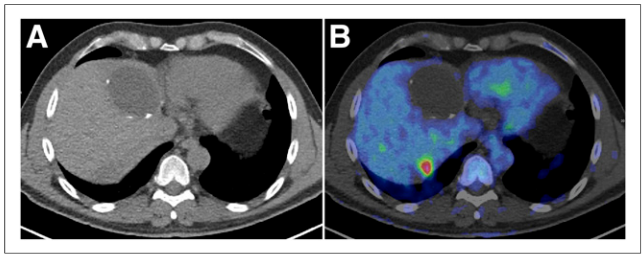

FIGURE 1. CT (A) and PET/CT (B) show ill-defined, hypodense region of hepatic segment 7, representing anatomically stable ablation bed of previously treated lesion. Fused image reveals metabolically active tumor along ablation bed. Anterior hypodense, metabolically quiescent lesion represents chronic asymptomatic biloma.

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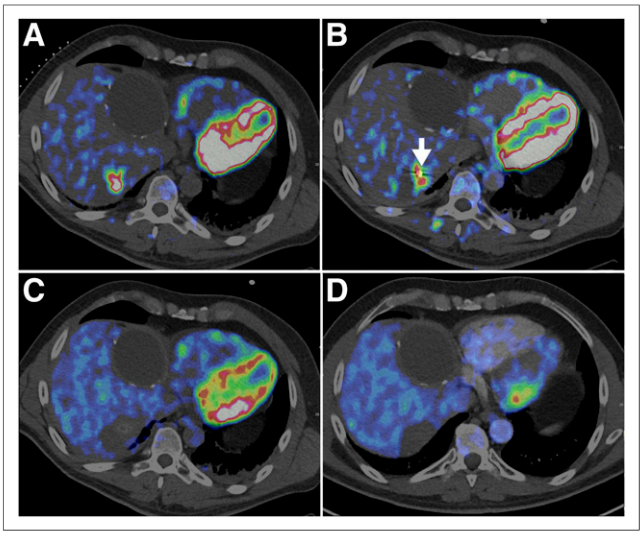

FIGURE 2. (A and B) Images before (A) and during (B) PET/CT-guided microwave ablation of metastasis using split-bolus approach. Arrow in intraprocedural image denotes microwave antenna. (C) Image immediately after ablation shows resolution of ^{18}F-FDG avidity, confirming treatment efficacy. (D) PET/CT 1 mo after ablation demonstrates no focal PET avidity.

ultrasound. PET can delineate the metabolically active focus for ablation, thereby minimizing the likelihood of undertreatment. Furthermore, our experience shows that split-dose, PET-guided microwave ablation is feasible in a nonspecialized tertiary care hospital using commercially procured ^{18}F-FDG.

CONCLUSION

Intraprocedural PET can guide and confirm ablation of hepatic lesions that are otherwise occult on CT and ultrasound.

DISCLOSURE

No potential conflict of interest relevant to this article was reported.

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Erratum

In the article "Pharmacology, Part 3A: Interventional Medications in Renal and Biliary Imaging" by Currie (*J Nucl Med Technol.* 2018;46:326–334), information from an additional guideline was inadvertently left out of the "Sincalide (Kinevac; Bracco Diagnostics Inc.)" section. The corrected paragraph and additional reference appear below. The author regrets the error.

Proper Use and Dose Administration. The patient should have fasted for a minimum of 4 h and a maximum of 6 h to ensure that gallbladder filling of the radiopharmaceutical is not impeded by residual endogenous cholecystokinin (45-min half-life) contracting the gallbladder or a full gallbladder due to absence of any endogenous cholecystokinin for a long period (*1*). *The traditional dose of sincalide is 0.02 μg/kg intravenously over 3–5 min (1,12,15,17,18).* A larger second dose of 0.04 μg/kg diluted in 10 mL of saline administered intravenously over 5 min may be used if gallbladder contraction is not achieved with the first dose (*1,12*). *The short duration administration produces greater variability in the normal gall bladder ejection fraction, and the current SNMMI guideline advises a 30–60 min infusion of 0.02 μg/kg or over 3 min for sphincter of Oddi dysfunction. More recent studies by Ziessman et al. recommend the use of an infusion 0.02 μg/kg over 60 min to reduce variability in response.*

Additional reference:

Ziessman H, Tulchinsky M, Lavely W, et al. Sincalide-stimulated cholescintigraphy: A multicentre investigation to determine optimal infusion methodology and gallbladder ejection fraction normal values. *J Nucl Med.* 2010:51: 277–281.