



Real-Time Fusion Imaging Proves Successful in Liver Interventions

Virtual Navigator Real-Time Ultrasound Fusion Imaging with Positron Emission Tomography for Liver Interventions

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Summary and Methods

In this feasibility study, the authors evaluate the practicality of fusion imaging between real-time ultrasound (US) and positron emission tomography (PET) data sets for precise localization and treatment of recurrent liver metastasis. Virtual Navigator (NV) software (MyLab™ Twice, Esaote S.p.A. Italy), VirtuTRAX™ and Ultra-Pro 3™ (CIVCO Medical Solutions, Kalona, Iowa, US) are used to locate, plan, and carry out thermal ablation therapy (AMICA, HS Hospital, Italy).

Discussion and Results

Five non-surgical patients with a history of colon cancer and resection underwent follow-up PET, computed tomography (CT), and US imaging of the liver. Focal lesions were identified including solitary hepatic metastasis in 3 patients and focal post ablation activity in the remaining 2 patients.

Twenty-four hours prior to the procedure, each patient underwent an additional PET/CT with 2-minute acquisition. A CT portal phase was taken of the liver for use during the fusion imaging pre-procedure planning. The liver cells that demonstrated a greater uptake on PET than the remainder of "normal" liver cells were targeted for US-guided percutaneous thermal ablation.

On the day of the procedure, fusion imaging was performed between real-time US and the newly acquired PET/CT data using Esaote MyLab Twice ultrasound system and probe with reusable tracking bracket and sensor mount. Care was given to ensure proper anatomical registration between the CT portal phase and the US. Vascular landmarks identified on both modalities were used to fine tune accuracy. Next, an overlay of the PET dataset and US image was completed to obtain a virtual fusion of PET and US. Thermal ablation was performed using a 14GA internally cooled microwave needle-like antenna and AMICA RFA generator. Software provided by the US system and electromagnetic sensor within the VirtuTRAX general purpose sensor worked together to provide a Virtual Navigation (VN) tool for the procedure. The on-screen graphics predicted the needle path and enabled planning for each ablation technique. During the ablation, the tracked needle tip remained virtually visible independent of the overlying gas artifact generated from the procedure. Post ablation contrast enhanced ultrasound (CEUS) was performed to assess the ablation outcome.

Conclusions

Fusion imaging between PET and real-time US imaging for targeted thermal ablation is successful when using portal phase CT as an intermediate tool to establish accuracy. Visualization of the expected needle path during pre-procedure planning, in-plane needle visualization during the early phase of the procedure and virtual needle tip visibility independent of the developed gas enables successful thermal ablation under real-time US.

Author Commentary

"This was very helpful to select the best path to reach the target, the percutaneous access point and the antenna angulation; moreover to track the needle tip position also during ablation, when gas developed by heating completely blocked target visibility on the US.¹"



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