In-depth Multicenter Workflow Analysis of Liver Tumor Ablations for the Development of a Novel Computer-aided Software Tool

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BACKGROUND

Radiofrequency ablation (RFA) is a percutaneous procedure for cancer treatment, which belongs to the minimally invasive and image-guided techniques. Cancer cells are heated up and destroyed by focusing energy in the RF spectrum through a needle. Thus, needle placement and the right amount of energy play the crucial roles for a therapeutic success. However, there is no standardized practice for needle guidance, which can depend on the equipment, or personal preferences (like 2D/3D Ultrasound (US) or CT-guidance). The aim was to assess the clinical feasibility of a common multicenter workflow of thermally induced liver lesions for the development of a novel computer-aided RFA software tool.

EVALUATION

RFAs of primary liver tumors where observed at four different clinical centers around Europe and discussed between medical and technical partners. As primary imaging modalities, CT scanners from the major manufactures (GE, Philips, Siemens and Toshiba) have been used. For needle placement, several navigation techniques were applied: CT-guidance, 2D US guidance, CT-US fusion; although the final needle position was always confirmed by a CT scan. Thus, a heat simulation can be used to prepare patient-specific ablation protocols, especially for cases where other organs like the diaphragm are close by. In addition, a study among 269 patients showed that the safety margin around the ablated tumor is the only independent factor that influenced tumor recurrence. Thus, we developed a bivariate visualization and a levels-of-detail-based distance algorithm supporting radiologists in both: RFA planning and monitoring. The algorithm has been evaluated by 13 interventional radiologists within multiple tasks of an official approved Visual Saliency study, showing a significant improvement of 42% (3.8 ± 0.8 vs 5.4 ± 0.4).

DISCUSSION

Needle placement and RF simulation are crucial factors for a complete and successful ablation of liver tumors, which can be assisted by a software tool that results from studying the interventions of several experts.

CONCLUSION

Reliable computer-aided support of the complex procedure of liver RFAs by study multicenter workflows to lay the foundation for a novel software tool.

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