UNIVERSITÄT BERN
ARTORG CENTER
BIOMEDICAL ENGINEERING RESEARCH

Vessel Segmentation for Ablation Treatment Planning in Liver Tumors

Background

Percutaneous thermal ablation is a targeted treatment method for primary and metastatic liver malignancies in selected patients. This therapy aims to encompass the tumor and a 5–10 mm safety margin of tissue around it for complete destruction of the tumor tissue [1]. The success of the ablation coverage is dependent on many factors such as tumor size and pathology, location, hepatic blood flow, ablation probe positioning, and equipment selection. When ablation is applied near large blood vessels, a cooling effect from the blood flow can disrupt the growth of the thermal ablation zone, known as the "heat sink effect". If the desired safety margin between tumor and ablation is not achieved, the chance of local recurrence increases. In microwave ablations, the heat sink seems to have a minimal effect, but little is known about how the nearby vasculature affects the ablation zone [2]. However, most of these studies were performed on ex-vivo livers or phantom set-ups [2]. Understanding the effect of nearby blood vessels in microwave ablations may improve the planning and the efficacy of the treatment.

Aim

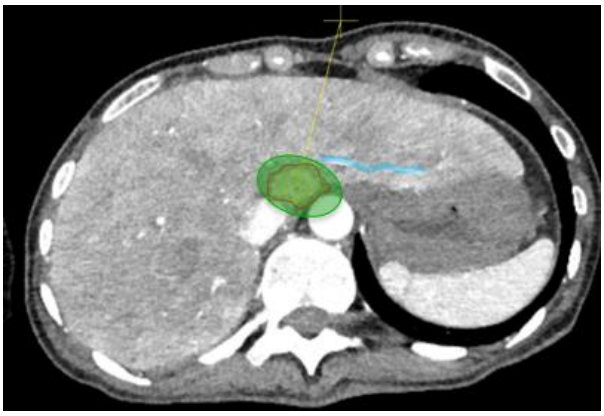
To develop tools for investigating the effect of the size and proximity of blood vessels to the tumor on the outcome of the ablation area.

Materials and Methods

The candidate will work with a large amount of real patient datasets. An initial ground truth for hepatic blood vessels will be extracted from 3D Liver Models. The candidate will investigate existing semi-automatic and automatic methods for segmentation of blood vessels from CT images. The results will be correlated with the clinical outcome. Additionally, segmentation tools for intra-operative planning will be implemented into the navigation software.

Work shares of the Thesis

- Data Mining: 10 %
- Image Processing: 40%
- Software Development: 30%
- Data Analysis: 30%



Skills and interests of thesis candidate

- Programming in C++/Python
- Image processing
- Machine Learning

References

[1] D. A. North et al., "Microwave ablation for hepatic malignancies: a call for standard reporting and outcomes," Am. J. Surg., vol. 208, no. 2, pp. 284–294, Aug. 2014.

[2] K. Pillai et al., "Heat sink effect on tumor ablation characteristics as observed in monopolar radiofrequency, bipolar radiofrequency, and microwave, using ex vivo calf liver model," Medicine (Baltimore), vol. 94, no. 9, p. e580, Mar. 2015.

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