UNIVERSITÄT BERN
ARTORG CENTER
BIOMEDICAL ENGINEERING RESEARCH

Tissue impedance spectroscopy to guide resection of brain tumors

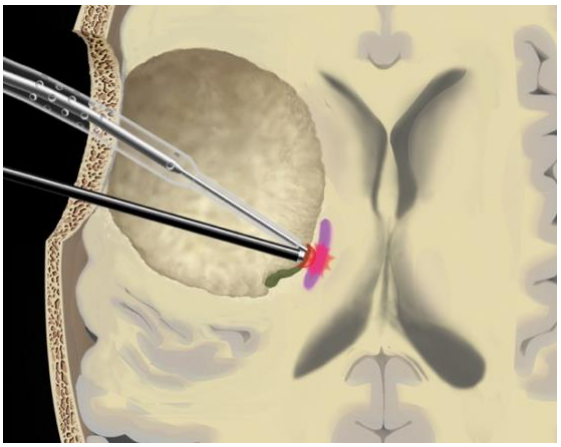
Background Tumor boundaries are non-visible for the surgeon during brain tumor resection. Many efforts have been made to optimize the extent of resection, such as introduction of fluorescence guided surgery (5-ALA), intraoperative magnetic resonance imaging (MRI) and ultrasound (US). Nevertheless, all these methods have important limitations, for example lack of fluorescence in low grade gliomas. Therefore, new technologies to classify tissue at tumor borders as cancerous or non-cancerous are desirable. Other teams have tried impedance spectroscopy (e.g. validation of glioma in rats) [1-2]. Our approach is to use impedance spectroscopy for cancerous tissue identification in clinical routine. The ultimate goal would be to improve the extent of resection and thereby overall survival rate of such patients.

Aim To explore the accuracy and reproducibility of impedance spectroscopy to classify different types of tissues during brain tumor surgery (i.e. tumor, infiltration zone, healthy tissue).

Methodologies The student will adapt a commercially available electrical impedance spectroscopy system (e.g. ScioSpec, ISX-3) to enable safe tissue measurement in the operating room. Existing hardware and software interfaces will be further developed for utilization of different type of measuring electrodes (e.g. nerve stimulation for neurosurgery). A laboratory verification set up will be developed to verify: 1) safety compliance (IEC 60601) of the adapted measuring system, and 2) for characterization of the electrical properties of measuring electrodes. An study in collaboration with clinicians from the University Hospital (Inselspital, Neurosurgery) will be carried out to characterize the electrical properties of different brain tissues via retrospective analysis of the spectral information.

Work shares of the Thesis

- Electrical integration & verification: 30%
- Software development: 10%
- Experimental study: 30%
- Data analysis: 30%



Skills and interests of thesis candidate

- Electronics (practice & theory)
- Medical device industry (e.g. IEC 60601)
- Bioelectricity
- Data analysis
- Clinical practice

References

[1] Organ L, Tasker RR, Moody NF. Brain tumor localization using an electrical impedance technique. J Neurosurg. 1968 Jan;28(1):35–44.

[2] Jahnke H, Heimann A, Azendorf R, Mpoukouvalas K, Kempski O, Robitzki AA. Biosensors and Bioelectronics Impedance spectroscopy — An outstanding method for label-free and real-time discrimination between brain and tumor tissue in vivo. Biosens Bioelectron. 2013;46:8–14.

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