Fluorescence-guided surgery

There is a growing body of nuclear contrast agents that are repurposed for fluorescence-guided surgery. New contrast agents are obtained by substituting the radioactive tag with or adding a fluorescent cyanine to the molecular structure of antibodies or peptides. This enables intra-operative fluorescent detection of cancerous tissue, leading to more complete tumor resection. However, these fluorescent cyanines can have a remarkable influence on pharmacokinetics and tumor uptake, especially when labeled to smaller targeting vectors such as peptides.

Molecular fluorescence-guided surgery

Molecular fluorescence-guided surgery

5-aminolevulinic acid guided resection

see 5-aminolevulinic acid guided resection.

Fluorescein sodium guided resection

see Fluorescein sodium guided resection.

Fluorescence guided surgery of glioma

see Fluorescence guided surgery of glioma.

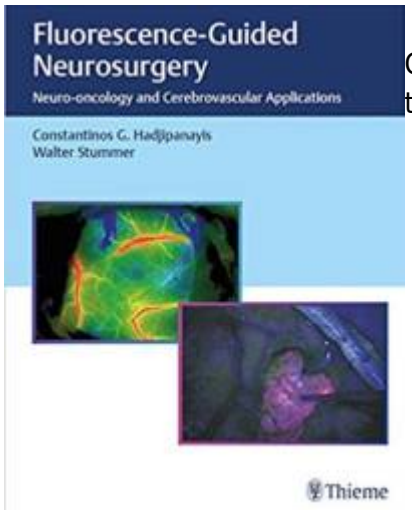
The first use of fluorescence for brain tumour surgery was in 1948 by G.E. Moore [1)] using fluorescein sodium.

Achieving a maximal safe extent of resection during brain tumor surgery is the goal for improved patient prognosis. Fluorescence-guided surgery using 5-aminolevulinic acid (5-ALA) induced Protoporphyrin IX has thereby become a valuable tool enabling a high frequency of complete resections and a prolonged progression free survival in glioblastoma patients.

Erkkilä et al., from the Center for Medical Physics and Biomedical Engineering, Medical University of Vienna, Advanced Development Microsurgery, Carl Zeiss Meditec AG, Christian Doppler Laboratory for Innovative Optical Imaging and Its Translation to Medicine, Medical University of Vienna, Institute of Neurology, Department of Neurosurgery, General Hospital and Medical University of Vienna, presented a widefield fluorescence lifetime imaging device with 250 mm working distance working under similar conditions like surgical microscopes based on a time-of-flight based dual tap CMOS camera. In contrast to intensity-based fluorescence imaging this method is invariant to light scattering and absorption while being sensitive to the molecular composition of the tissue. They evaluated the feasibility of lifetime imaging of Protoporphyrin IX using the system to analyze brain

tumor phantoms and fresh 5-ALA labeled human tissue samples. The results demonstrate the potential of this lifetime sensing device to go beyond the limitation of current intensity-based fluorescence-guided neurosurgery [2].

Books



Fluorescence-Guided Neurosurgery: Neuro-oncology and Cerebrovascular Applications September 10, 2018 The definitive textbook on state-of-the-art fluorescence-guided neurosurgery

Advances in fluorescence-guided surgery (FGS) have resulted in a paradigm shift in neurosurgical approaches to neuro-oncological and cerebrovascular pathologies. Edited by two of the foremost authorities on the topic, Fluorescence-Guided Neurosurgery: Neuro-oncology and Cerebrovascular Applications encompasses the depth and breadth of this groundbreaking, still nascent technology. The book reflects significant contributions made by world renowned neurosurgeons Constantinos Hadjipanayis, Walter Stummer, and esteemed contributors on the growing uses of 5-aminolevulinic acid (5-ALA) and other FGS agents.

The European Medicine Agency approved 5-ALA in 2007, heralding the birth of FGS globally. In 2017, the U.S. Food and Drug Administration approved 5-ALA (Gleolan) as an imaging agent to facilitate realtime detection and visualization of malignant tissue during glioma surgery. In the two decades since Dr. Stummer’s initial description of 5-ALA FGS in a human patient, major strides have been made in its practical applications, leading to improved resection outcomes. As FGS is increasingly incorporated into neurosurgical practice, it holds promise for future innovations. Generously-illustrated and enhanced with online videos, this textbook is the definitive resource on the subject.

Key Features

The improved efficacy of 5-ALA for resecting high- and low-grade gliomas, recurrences, meningiomas, brain metastases, spinal cord tumors, pediatric brain tumors, and other adult tumors The future of fluorescence, including potentially powerful new fluorophores molecularly targeted specifically to tumors The use of the fluorescent agent indocyanine green (ICG) for brain tumors, cerebral aneurysms, AVMs, and cerebral vascularization Special topics such as fluorescein, illuminating tumor paint, confocal microscopy, Raman spectroscopy, and integrating FGS with intraoperative imaging and brain mapping This single accessible reference presents the current state-of-the-art on this emerging, exciting surgical technology. As such, it is a must-have for neurosurgical residents, fellows, and practicing neurosurgeons.

1)
Moore GE, Peyton WT, French LA, Walker WW (1948) The clinical use of fluorescein in neurosurgery;

the localization of brain tumors. J Neurosurg 5:392–398
2)

Erkkilä MT, Bauer B, Hecker-Denschlag N, Madera Medina MJ, Leitgeb RA, Unterhuber A, Gesperger J, Roetzer T, Hauger C, Drexler W, Widhalm G, Andreana M. Widefield fluorescence lifetime imaging of protoporphyrin IX for fluorescence-guided neurosurgery: an ex vivo feasibility study. J Biophotonics. 2019 Jan 12. doi: 10.1002/jbio.201800378. [Epub ahead of print] PubMed PMID: 30636030.