Fluorescence-guided multiple sampling

Fluorescence-guided multiple sampling using 5-aminolevulinic acid (5-ALA) is a technique commonly employed in neurosurgery for the diagnosis and treatment of brain tumors, particularly gliomas. Here's an explanation of the key components of this process:

5-Aminolevulinic Acid (5-ALA):

5-ALA is a substance that is administered to patients before surgery. It is a precursor in the synthesis of heme, a component of hemoglobin. When 5-ALA is administered, it is preferentially taken up by rapidly dividing cells, such as cancer cells in gliomas. Fluorescence-Guided Surgery:

After the administration of 5-ALA, glioma cells metabolize it to produce a fluorescent molecule called protoporphyrin IX (PpIX). PpIX emits a characteristic red fluorescence under certain wavelengths of light. During surgery, neurosurgeons use a specialized microscope equipped with a fluorescence filter to visualize the fluorescence of PpIX in real-time. Multiple Sampling:

The use of 5-ALA fluorescence allows surgeons to identify and differentiate tumor tissue from normal brain tissue more accurately. In the context of multiple sampling, this means taking multiple tissue samples from different areas within and around the tumor. The goal is to obtain a comprehensive and representative sampling of the tumor and its margins. Biopsy Guidance:

The fluorescence-guided approach helps guide the neurosurgeon in determining the boundaries of the tumor. By identifying fluorescence, surgeons can perform biopsies or resections with greater precision, aiming to remove as much tumor tissue as possible while minimizing damage to healthy brain tissue. Tumor Margin Assessment:

The fluorescence also assists in real-time assessment of tumor margins. Surgeons can visualize areas where fluorescence is present, indicating the likelihood of tumor cells. This information is crucial for making decisions during surgery, such as whether to continue resection or whether the remaining tissue appears to be normal. Enhanced Tumor Visibility:

5-ALA fluorescence enhances the visibility of tumor tissue that might be challenging to detect under standard white light. This is particularly valuable for infiltrative gliomas, which may have diffuse boundaries with normal brain tissue. Postoperative Assessment:

The samples obtained during surgery, guided by 5-ALA fluorescence, are sent for pathological examination to confirm the presence of tumor cells and assess the tumor grade. This information is critical for treatment planning, prognosis, and follow-up. Fluorescence-guided multiple sampling with 5-ALA is an example of how molecular imaging techniques can be integrated into surgical procedures to improve the precision and outcomes of tumor resection. It has become a valuable tool in the field of neurosurgery, contributing to more effective and targeted treatment strategies for brain tumors.

Of the many factors influencing the survival of patients with High-grade gliomas, proximity to the subventricular zone (SVZ) is one of the key influencers. In this context, 5-aminolevulinic acid Fluorescence-guided multiple sampling (FGMS) offers the prospect of understanding patient-to-patient molecular heterogeneity driving the aggressiveness of these tumors. Using high-resolution liquid chromatography-mass spectrometry (MS)/MS proteomics for HGGs from seven patients (four SVZ-

associated and three SVZ nonassociated), this study aimed to uncover the mechanisms driving the aggressiveness in SVZ-associated (SVZ+) HGGs. Differential proteomics analysis revealed significant dysregulation of 11 proteins, of which 9 proteins were upregulated and 2 were downregulated in SVZ+ HGGs compared to SVZ-non-associated (SVZ-) HGGs. The gene set enrichment analysis (GSEA) of the proteomics dataset revealed enrichment of MYC targets V1 and V2, G2M checkpoints, and E2F targets in SVZ+ HGGs. With GSEA, we also compared the pathways enriched in glioma stem cell subpopulations and observed a similar expression trend for most pathways in our data. In conclusion, this study reveals new and emerging insights on pathways that may potentially contribute to greater aggressiveness in SVZ+ HGGs. Future studies using FGMS in larger cohorts are recommended to help uncover the proteomics and molecular basis of aggressiveness and stemness in HGGs [1)].

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Ghantasala S, Bhat A, Epari S, Moiyadi A, Srivastava S. High-Grade Gliomas from Subventricular Zone: Proteomic Drivers of Aggressiveness Using Fluorescence-Guided Multiple Sampling. OMICS. 2023 Dec 7. doi: 10.1089/omi.2023.0124. Epub ahead of print. PMID: 38055199.