## Fluorophore

A fluorophore (or fluorochrome, similarly to a chromophore) is a fluorescent chemical compound that can re-emit light upon light excitation. Fluorophores typically contain several combined aromatic groups, or planar or cyclic molecules with several  $\pi$  bonds.

Fluorophores are sometimes used alone, as a tracer in fluids, as a dye for staining of certain structures, as a substrate of enzymes, or as a probe or indicator (when its fluorescence is affected by environmental aspects such as polarity or ions). More generally they are covalently bonded to a macromolecule, serving as a marker (or dye, or tag, or reporter) for affine or bioactive reagents (antibodies, peptides, nucleic acids). Fluorophores are notably used to stain tissues, cells, or materials in a variety of analytical methods, i.e., fluorescent imaging and spectroscopy.

Fluorescein, by its amine reactive isothiocyanate derivative FITC, has been one of the most popular fluorophores. From antibody labeling, the applications have spread to nucleic acids thanks to (FAM (Carboxyfluorescein), TET,...). Other historically common fluorophores are derivatives of rhodamine (TRITC), coumarin, and cyanine.

Newer generations of fluorophores, many of which are proprietary, often perform better, being more photostable, brighter, and/or less pH-sensitive than traditional dyes with comparable excitation and emission.

Senders et al., systematically review all clinically tested fluorescent agents for application in fluorescence guided surgery (FGS) for glioma and all preclinically tested agents with the potential for FGS for glioma.

They searched the PubMed and Embase databases for all potentially relevant studies through March 2016.

They assessed fluorescent agents by the following outcomes: rate of gross total resection (GTR), overall and progression free survival, sensitivity and specificity in discriminating tumor and healthy brain tissue, tumor-to-normal ratio of fluorescent signal, and incidence of adverse events.

The search strategy resulted in 2155 articles that were screened by titles and abstracts. After full-text screening, 105 articles fulfilled the inclusion criteria evaluating the following fluorescent agents: 5 aminolevulinic acid (5-ALA) (44 studies, including three randomized control trials), fluorescein (11), indocyanine green (five), hypericin (two), 5-aminofluorescein-human serum albumin (one), endogenous fluorophores (nine) and fluorescent agents in a pre-clinical testing phase (30). Three meta-analyses were also identified.

5-ALA is the only fluorescent agent that has been tested in a randomized controlled trial and results in an improvement of GTR and progression-free survival in high-grade gliomas. Observational cohort studies and case series suggest similar outcomes for FGS using fluorescein. Molecular targeting agents (e.g., fluorophore/nanoparticle labeled with anti-EGFR antibodies) are still in the pre-clinical phase, but offer promising results and may be valuable future alternatives. <sup>1)</sup>.

## 1)

Senders JT, Muskens IS, Schnoor R, Karhade AV, Cote DJ, Smith TR, Broekman ML. Agents for fluorescence-guided glioma surgery: a systematic review of preclinical and clinical results. Acta

Neurochir (Wien). 2017 Jan;159(1):151-167. doi: 10.1007/s00701-016-3028-5. Review. PubMed PMID: 27878374; PubMed Central PMCID: PMC5177668.

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