Photosensitizer

- Enhancing skull base tumor management: the combination of 3D printing technology and endoscopic surgical techniques
- Recent advances in NIR-II photothermal and photodynamic therapies for drug-resistant wound infections
- 5-ALA Assisted Surgery of Human Glioblastoma Samples Reveals an Enrichment of T Cells Expressing PD-1 and CD103 in the Intermediate and Marginal Layers
- Targeted suppression of glioma by ultralow-dose x-ray-induced photodynamic therapy and gold-based nanoclusters in preclinical models
- Carbon Dot-Based Nanoparticles: A Promising Therapeutic Approach for Glioblastoma
- Radiation Therapy Combined With 5-Aminolevulinic Acid: Effect on Primary Human Meningioma Cells
- Synergic Effects of Curcumin, Licorice, and Endoscopic Photodynamic Therapy Against Helicobacter Pylori by Modulating the NF-Kb Signaling Pathway
- 5-Aminolevulonic Acid, a New Tumor Contrast Agent: Anesthesia Considerations in Patients Undergoing Craniotomy

Photosensitizers are used in a medical technique called photodynamic therapy (PDT), which can have applications in various fields of medicine, including neurosurgery. In neurosurgery, PDT involving photosensitizers is primarily used for the treatment of brain tumors and certain neurological conditions. Here's how it works:

Selection of Photosensitizer: A photosensitizer is a compound that can absorb light energy and then transfer it to oxygen molecules in its vicinity, leading to the generation of reactive oxygen species (ROS), such as singlet oxygen. These ROS can damage or destroy nearby cells. In neurosurgery, a suitable photosensitizer is selected based on its ability to target specific cells or tissues.

Photosensitizer Administration: The selected photosensitizer is administered to the patient, typically through intravenous injection. The photosensitizer accumulates in the target tissues, such as brain tumors, over a period of time.

Light Activation: After a sufficient amount of time has passed for the photosensitizer to accumulate in the target tissue, a specific wavelength of light is applied to the area. This light activates the photosensitizer.

ROS Production: Once activated by light, the photosensitizer generates ROS. These highly reactive molecules can cause damage to nearby cells, including tumor cells.

Targeted Tissue Destruction: The ROS generated by the photosensitizer primarily affect the tissue where the photosensitizer has accumulated. In neurosurgery, this can be used to selectively destroy cancerous or abnormal cells, such as those in brain tumors.

Minimizing Damage to Healthy Tissue: One advantage of PDT is that it can be relatively selective, primarily damaging the tissue where the photosensitizer has concentrated while sparing healthy surrounding tissue.

Real-Time Monitoring: In some cases, PDT in neurosurgery may involve real-time monitoring using imaging techniques to ensure that the treatment is targeting the intended areas accurately.

Recovery and Follow-Up: After PDT treatment, patients undergo a period of recovery. Follow-up

assessments are conducted to evaluate the effectiveness of the treatment and the patient's condition.

The use of photosensitizers in neurosurgery offers several potential advantages, such as the ability to precisely target and treat tumor cells within the brain while minimizing damage to healthy brain tissue. However, the success of PDT in neurosurgery depends on factors such as the choice of photosensitizer, the accuracy of light delivery, and the specific condition being treated. It is a technique that continues to be studied and refined for its potential benefits in the field of neurosurgery

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Quinoline-fused BODIPYs are promising candidates for use as photosensitizers. Photosensitizers are compounds that can absorb light energy and convert it into reactive species, often used in medical and environmental applications, particularly in the context of photodynamic therapy and pollution control.

The study of Li et al. describes the synthesis of quinoline-fused BODIPY compounds with distinct twisted conformations and various desirable properties, making them potentially useful as photosensitizers in applications where heavy-atom-free compounds are preferred [1].

The second near infrared (NIR II) type I photosensitizer has the intrinsic advantages in photodynamic/photothermal therapy (PDT/PTT) of some malignant tumors (MTs) with deep infiltration, large size, complicated location, and low possibility of surgery/radiotherapy. Herein, three chalcogen-elements based donor-acceptor (D-A) type semiconducting polymers (PTS, PTSe, and PTTe) have been synthesized and fully characterized, demonstrating strong absorption in near infrared (NIR) II region. Upon adjusting the chalcogen elements, the intramolecular charge transfer (ICT) characteristics and the heavy atom effect are tuned to enhance the intersystem crossing rate, improving the photodynamic effect. Moreover, the energy levels and Gibbs free energies are tuned to facilitate the type I photodynamic process. As a result, PTTe NPs produce superoxide anion radicals (O2 •-) more efficiently and demonstrate higher photothermal conversion efficiency than PTS and PTSe NPs upon a NIR II (1064 nm) laser irradiation, exhibiting unprecedented NIR-II type I PDT/PTT performance in vitro and in vivo. This work provides ideas for achieving high performance NIR-II type I PDT/PTT SPs for hypoxic oncotherapy [2].

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Li W, Gong Q, Wu Q, Guo L, Guo X, Guo D, Jiao L, Hao E. Pictet-Spengler synthesis of twisted quinoline-fused BODIPYs as heavy-atom-free photosensitizers. Chem Commun (Camb). 2023 Sep 27. doi: 10.1039/d3cc04460b. Epub ahead of print. PMID: 37753618.
2)
Wen K, Tan H, Peng Q, Chen H, Ma H, Wang L, Peng A, Shi Q, Cai X, Huang H. Achieving Efficient NIR-II Type I Photosensitizers for Photodynamic/Photothermal Therapy upon Regulating Chalcogen Elements. Adv Mater. 2021 Dec 21:e2108146. doi: 10.1002/adma.202108146. Epub ahead of print. PMID: 34935224.