A new generation of cancer markers and drug transport

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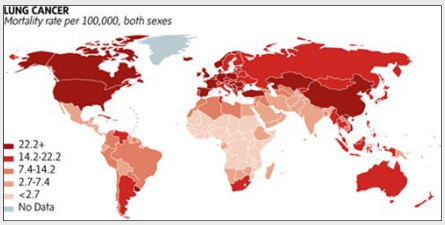
Motivation – cancer - related diseases



https://www.theglobeandmail.com/life/health-and-fitness/health/five-maps-that-put-cancers-global-spread-into-focus/article16679285/

8.2 million people die from cancer worldwide every year. We urgently need new early detection methods to reduce death rate. Lungs and brain cancer is one of the most common and difficult to treat.

We observe a rapid increase in cancer incidence (confirmed cases) for a long time. In countries such as Poland, this increase is partly related to high contamination of the natural environment. Despite medical advances, the cancer curability is still 50% or even lower. It is estimated that it is possible to improve the curability statistics (by about 30%) if tumors are detected early enough. **For this purpose, we have developed a new generation of markers based on wide-gap metal oxides (mainly ZnO, ZrO_2) activated with rare earth ions (Eu, Er, Tb) for use as fluorescent markers.** These markers are used for early detection of tumors. It has been shown that these markers penetrate the area of tumors. In the case of lung tumors, the method was 100% selectable.

In the currently conducted works, oxide matrices with scintillation properties have been selected to stimulate by X-ray radiation of emission of rare earth ions. Such markers can be used not only for the detection of tumor-related changes, but also for therapy by local stimulation of porphyrin compounds used in photodynamic cancer therapy. The stimulated porphyrin compounds generate highly reactive singlet oxygen, destroying tumor cells. The modified markers can also be used as a safer contrast in magnetic resonance imaging (MRI).

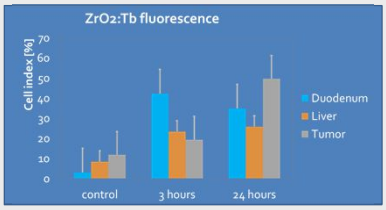
The possibility of targeted drug transport through markers to the area of lesions has also been demonstrated. Markers can cross the blood-brain barrier, which opens up new perspectives for detection and treatment, including the treatment of neurodegenerative diseases.

The new generation of biocompatible markers allows not only an early detection of cancers via characteristic fluorescence but also using.

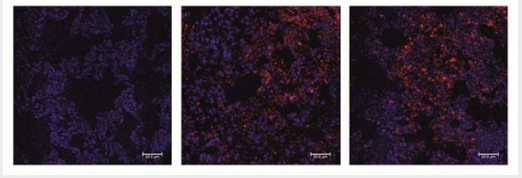
Technology of markers is protected by several our patents and patent applications.

Bio tests of new generation of markers

To eliminate nanoparticles (NPs) accumulation they are introduced intra-gastric (IG) (alimentary uptake).

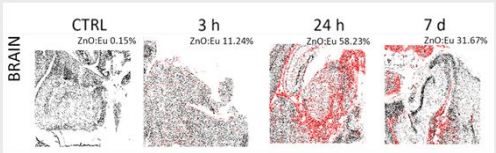


Performed tests confirm NPs accumulation (after IG administration) in tumours. They act as efficient fluorescence labels or MRI contrast.

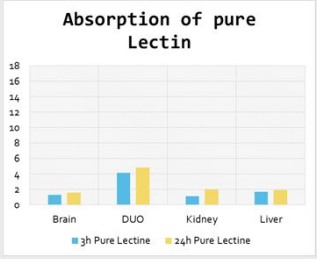


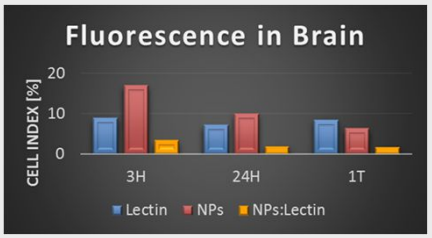
New generation of biocompatible markers allows an early detection of cancers (via characteristic fluorescence or MRI). In the case of lung cancers 100% selectivity was demonstrated by us, i.e., markers enter and accumulate only in area of tumour affected cells.

New generation of nanoparticles used as drug transport agent



NP pass most of the barriers in living organisms! They can penetrate blood-brain barrier! When recognized as foreign objects NPs are removed from brain area!





Recent our investigations indicate that markers allow also transport of drugs, importantly also directly to brain, increasing efficiency of therapy. Lectin was used for tests. Absorption of pure lectin is very small, but when transported by NPs lectin can be released in a brain area.

Conclusions

We developed a new generation of fluorescence markers and contrasts used in MRI. The key of invention (patented) is also eco-friendly production of biodegradable conjugates of oxide nanoparticles with drugs. The final product is optimized for uptake after oral application and direct transfer to tumors (including brain tumours). The developed markers passed tests for their biocompatibility. Large efficiency and selectivity was proven in tests performed on animals. Two methods were developed by us to use markers for therapy – as transport agents of selected medicines and for PDT therapy.