Fluorescence imaging of quantum dots

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Quantum dots (QDs) are small semiconductor nanoparticles with excellent optical and electronic properties. QDs exhibit high quantum yield with narrow and size tunable spectra. Quantum dots can be employed in different applications and currently they are often utilized as fluorescence labels in bioassays. Quantum dots can establish a bond with specific biomolecules, like antibodies, enzymes or oligonucleotides. These enable specific targeting with a sensitive optical detection. Quantum dots show also great potential for immunosensing. Since they are more stable than organic fluorophores, their application allows multiplex immunoassays and/or fluorescence resonance energy transfer (FRET). In contrast to functionalization with ligands, bioconjugation of QDs is more complicated, restricted with a size of the molecule used for conjugation [1].

For the targeted therapy to the tumour tissue, the active targeting by receptor-specific ligands (folic acid, carbohydrates, proteins, or peptides) can is the most advantageous. The aim is the maximal cumulation in target location and reduction of the interaction with non-target biomolecules. The fast growing tumour is nourished through pathological angiogenesis. This phenomenon results in enhanced permeability and retention effect (EPR) that enables passive targeting [2]. In can be useful in accumulation of PEGylated Ag_2S quantum dots in tumorous site. PEGylated Ag_2S quantum dots seem to be promising fluorescence nanoprobe for in vivo imaging, due to a high accumulation in mice model. Instead of the tumor, the quantum dots were detected in reticulo-endothelial system especially in liver and spleen. Blood circulation of this complex was 3.66 hours [3]. For the better distribution, the quantum dots were coated by silica and PEGylated. Intriguingly, this coating did not provide quenching of fluorescence. After their application into the tail vein of mouse, it was possible to detect the highest concentration in the liver, low fluorescence of quantum dots was also detected in spleen and lungs [4]. For the targeted delivery of quantum dots, it is also possible to use anaerobic bacteria Bifidobacterium bifidum. It was observed, that the bacteria culture accumulate in solid tumours, the reason is probably hypoxic microenvironment of solid tumors. The vascular cut off size is between 1.2 and 2 μm, which is enough for this bacteria. Moreover; the modification with folic acid improved the tumor targeting [5].

Quantum dots are nanoparticles with very good fluorescence properties and could be used in the drug distribution studies and the tumor detection and in vivo imaging.

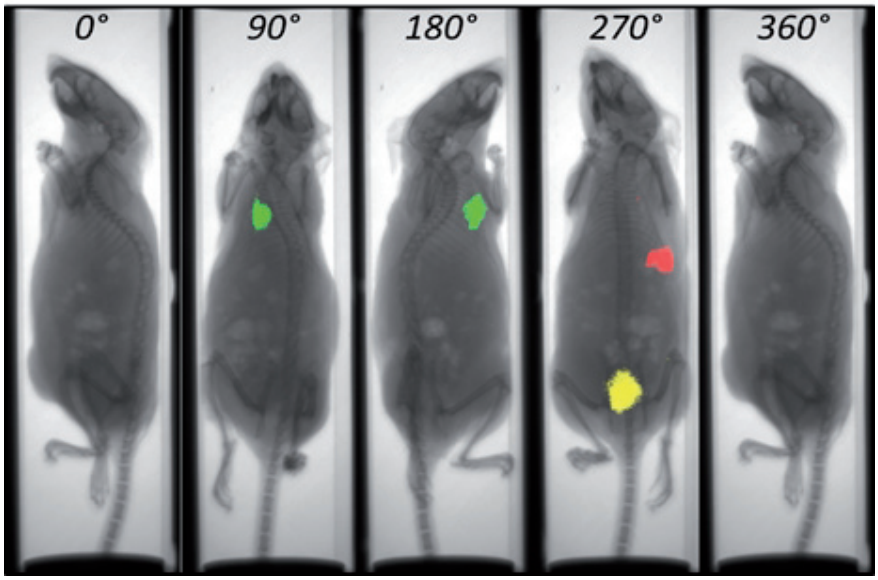

Figure 1: Quantum dots fluorescence (various sizes - various emission maxima) in body of laboratory rat. Scans were obtained in different angles (0º, 90º, 180º, 270º and 360º respectively). For detection was employed Multimodal Animal Rotation System, Rochester, USA).

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