In Vivo Monitoring the Enhanced Permeability and Retention Effect in Tumor Site by Synchrotron X-ray Microscopy

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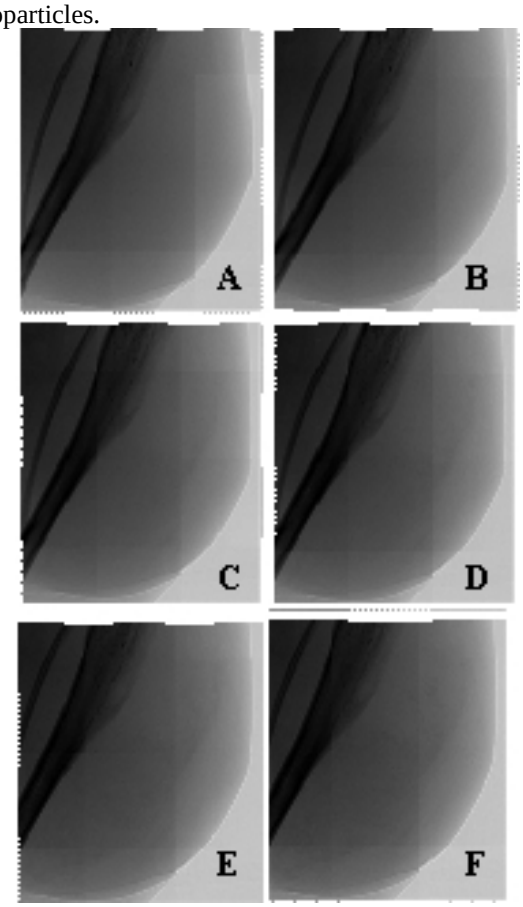
Nanoparticles found wild applications in medicine; the most highlighted was its application as drug delivery carriers. The surface of nanoparticels can be modified or conjugated with specific antibodies or fluorescence dyes to identify proteins or label the tumor cells. Most of the imaging techniques, such as MicroCT(computed tomography) or PET(positron emission tomography), can only measure the distribution of nanoparticles in animal certain amount of time after injection. The temporal and spatial resolutions were greatly compromised and insufficient to trace the circulation and deposition of nanoparticles in real time. The Synchrotron Radiation (SR) based microradiology we developed offers very higher temporal and spatial resolution (<1 ms and <1 μm) and we demonstrate in this work that it is ideal to study in vivo the circulation and accumulation of the gold nanoparticles.



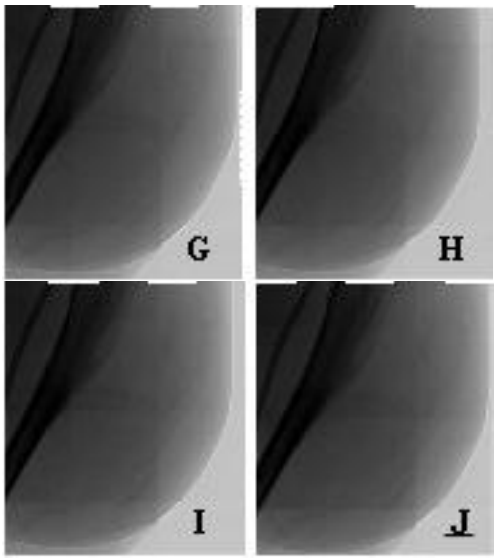


Fig. 1: After injected bare-Au solution of the images, the enhaced permeability and retention (EPR) effect is presented. 0, 60, 90, 120, 150, 165, 210, 240, 270 and 360 min. A, B, C, D, E, F, G, H, I and J. Bar is 1 mm.

Synchrotron x-ray microscopy allows us to image the circulation of gold nanoparticles and other types contrast agent in real time. The shortest capturing time can catch fast movement of heart and lung. The shortest exposure time and the smallest vessel size can be detected shorter than 3ms and smaller than 10 μm vessels in lung, kidney and *in vivo*.

This technique also enabled us to identify different circulation and uptake behavior of different kind of nanoparticles or solution. Specifically, different solutions shows different local deposition behavior which is very useful for the further development of nanoparticle as drug delivery and therapy vehicles. Synchrotron x-ray possess very short capturing time and ultra high resolution, therefore it could directly image the accumulation of the gold nanaoparticles in the mouse. In the future radiotherapy can apply high Z materials to enhance the effect.