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# Non-invasive and Fast Imaging Tumors by SQUID Biosusceptometry and Magnetic Nanoparticles

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**ABSTRACT 1. Dual *In-Vivo* and *Ex-Vivo* Imaging of Tumor cells** For intraoperative imaging in operating theaters or preoperative imaging in clinics, compact and economic integration rather than large and expensive equipment is required to coregister structural and functional imaging. However, current technologies, such as those integrating optical and gamma cameras or infrared and fluorescence imaging, involve certain drawbacks, including the radioactive biorisks of nuclear medicine indicators and the inconvenience of conducting measurements in dark environments. A novel dual-imaging model system integrating an optical camera and magnetic scanning superconducting-quantum-interference device (SQUID) biosusceptometry (SSB) was proposed. The simultaneous coregistration of low-field magnetic images of MNP distributions and optical images of anatomical regions enabled the tumor distribution to be determined easily and in real time. To simulate targeted MNPs within animals, fewer reagents than the injected dose were contained in a microtube as a sample for the phantom test. The positioning and discrimination of liver tumors implanted on the backs and livers of rats were verified by conducting in vivo and ex vivo tests. The results of tissue staining verified the feasibility of using this method to determine the distribution of liver tumors.

**2. Dual Magneto-Immunohistochemistry** After a needle biopsy, immunohistochemistry is generally used to stain tissue slices for clinically confirming tumours. However, the observation must be performed by experienced pathologists, and producing a qualitative analysis is time consuming. Therefore, this study proposes a SSB and the dual modalities of fluorescent and magnetic reagent. Tissue slices were rapidly imaged using the developed SSB for obtaining coregistered optical and magnetic images. A traditional observation

methodology entailing the use of a fluorescence microscope was also performed as the gold standard. This study determined high consistency between the fluorescent and magnetic spots in different regions of the tissue slices, demonstrating the feasibility of the proposed approach, which will benefit future clinical pathology.

***Keywords:*** *Magnetic nanoparticle, tumor, superconducting-quantum-interference device*

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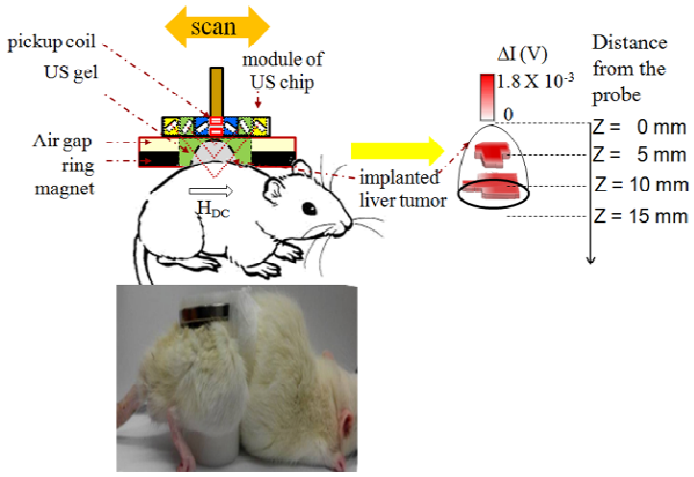


Figure 1. Animal model: the red spots of magnetic tomography at depths of 5 and 10 mm within tumors were apparent but seldom appeared at a depth of 15 mm. [3].