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(G*) Comparing the Cellular Detection Limits of Magnetic Particle Imaging and Bioluminescence Imaging

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Molecular imaging techniques can be used to track tumour cell proliferation, metastasis, and viability. Tumour cells labelled with superparamagnetic iron oxide (SPIO) and transfected with a luciferase reporter gene can be dually tracked using magnetic particle imaging (MPI) and bioluminescence imaging (BLI). MPI is highly sensitive as signal is generated directly from SPIO. This allows for direct quantification of iron mass and cell number. BLI specifically detects live cells. In this study, we directly compared the cellular detection limits of BLI and MPI in vitro and in vivo for the first time. Murine 4T1 cancer cells were labelled with SPIO and transfected with luciferase. For the in vitro study, cells were serially diluted at a 1:2 ratio from 51,200 to 100 cells. BLI images were acquired until each sample reached peak radiance (20 min scan). MPI images were then acquired using a 2D high sensitivity scan (5.7 T/m gradient strength, 20 mT drive field amplitude, 2 min scan). For samples that could not be detected with 2D MPI, 3D images were acquired (30 min scan). For the in vivo study, 6400 cells were injected subcutaneously on the back of three nude mice. Each mouse was imaged with BLI until peak radiance was reached (30 min scan). Then, each mouse underwent 2D and 3D MPI using the high sensitivity scan mode. In vitro, we detected as few as 100 cells with BLI and as few as 3200 cells with 2D MPI. 3D imaging improved the in vitro MPI detection limit to 800 cells. In vivo, 6400 cells were detected using both modalities. However, tissue attenuation prevented the detection of 6400 cells with BLI when mice were imaged in the supine position. Although BLI detected fewer cells in vitro, MPI sensitivity is expected to improve over time with the development of MPI-tailored SPIO. Future work will aim to further assess the in vivo cellular detection limits of BLI and MPI by using lower cell numbers.

Keyword-1

Molecular Imaging

Keyword-2

Magnetic Particle Imaging

Keyword-3

Cell Tracking

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