AbstractID: 13410 Title: Advancing an integrated Overhauser-enhanced MRI (OMRI) - prepolarized MRI (PMRI) system toward quantitative longitudinal studies of tumor hypoxia and redox status

**Purpose:**
To advance the imaging performance of an integrated Overhauser-enhanced MRI (OMRI) - prepolarized MRI (PMRI) system to enable quantitative longitudinal imaging studies of multi-faceted tumor environment by using both electron paramagnetic resonance (EPR) and nuclear magnetic resonance (NMR).

**Method and Materials:**
A field-cycled OMRI-PMRI system was further developed to achieve the sensitivity that identifies radiobiological hypoxia and redox status. A dedicated 5-cm saddle coil delivered 154-MHz EPR radiofrequency (RF) pulses to induce the Overhauser effect with a high EPR B1 efficiency. A 3-cm 5.5-MHz NMR Litz-wire saddle coil concentric to the EPR coil achieved high signal-to-noise ratio with an efficient filling factor. B0 was at 5 mT, 0.13 T, 0.5 T for EPR irradiation, NMR readout, NMR prepolarization respectively. Gradient echo and multi-spin echo pulse sequences were implemented using a custom MRI console to acquire images with minimal phase distortion. Trietyl phantoms were prepared under normoxic and anoxic environment for pO2 calibration. Various amounts of ascorbic acid (AsA) were injected to the mixtures of trietyl and nitrooxide (3-carbamoyl PROXYL) phantoms to characterize the redox sensitivity.

**Results:**
Oxygen resolution of 4.1 torr and 3.5 torr were obtained from 4-min double power (0.3, 32 W) spin-echo OMRI (TR/TE 1600/30 ms) for pure deoxygenated 1-mM and 2-mM trietyl phantoms. Trietyl radicals were not reduced by AsA, and did not alter the reduction decay rate of the nitroxides (-0.07/min, -0.13/min for 5, 10-mM AsA). Saturation factor measurements at various EPR RF power levels indicated a feasibility of accurate pO2 calibration for the mixtures of trietyl and nitrooxide radicals.

**Conclusion:**
Our OMRI-PMRI system is capable of multi-parametric imaging sensitive to pO2, redox status, proton T1 and T2. The imager is ready to acquire physiological information in small animals accurately co-registered with diagnostic quality anatomic NMR images.