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Development of New Magnetic Resonance Imaging Technique and Visualization of Oxidative Stress-Related Diseases

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Proton Magnetic Resonance Imaging (MRI) has provided significant clinical utility in the diagnosis of diseases. Overhauser enhanced MRI (OMRI), which is a double resonance technique, creates highly-resolved images of free radical distributions in small animals by enhancing the water proton signal intensity via the Overhauser Effect. We developed new-sequence for OMRI and succeeded in simultaneous dual images by using nitroxyl radicals labeled with ^{14}N and ^{15}N nuclei and changing the external magnetic field for ESR irradiation in OMRI. This technique can visualize individual redox processes and individual redox statue of inner and/or outer cells in a dose-dependent manner.

The large difference of gyromagnetic ratio between electron and proton spins restricted ESR excitation and the proton detection fields. We have developed a prototype of OMRI scanner with circular-transport-system, in which the sample object was transported between ESR to MR magnets circularly, which were operated at 1.5 T and 20 mT for MR detection and ESR excitation, respectively. Phantom images of nitroxyl spin-probe were successfully obtained with the OMRI system. The physical resolution of the OMRI image for the phantom object was less than 0.2 mm. The developed OMRI system would have a significant advantage for for imaging *in vivo* redox state. These techniques also offer significant applicability to simultaneous imaging between inner and outer cell membranes, and assessment of independent redox processes in oxidative stress-related disease models.