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Comparative study of magnetic properties and anticancer effect of superparamagnetic and ferromagnetic iron oxide nanoparticles in the nanocomplex with doxorubicin

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Mechano-magneto-chemically synthesized magnetic nanocomplex (MNC) of superparamagnetic iron oxide Fe3O4 nanoparticles (NP) and anticancer drug doxorubicin (DR) had significantly lower saturation magnetic moment and magnetic hysteresis loop area as compared to the MNC of ferromagnetic NP. However, the last was characterized by lower coercivity. MNC of superparamagnetic NP and DR had g-factors of 2.00, 2.30 and 4.00. MNC of ferromagnetic NP and DR had the g-factor of 2.50, and the integrated intensity of electron spin resonance signal was 51% greater. Superparamagnetic iron oxide Fe3O4 NP in MNC with DR initiated greater antitumor effect during magnetic nanotherapy of animals with carcinosarcoma Walker-256 as compared to the MNC composed of ferromagnetic NP and DR. In the future, superparamagnetic iron oxide Fe3O4 NP as a part of nanocomplex with DR can be used in theranostics – a methodology that combines magnetic resonance diagnostics and magnetic nanotherapy using MNC both as therapeutic and diagnostic agents.

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Brain imaging – From molecular imaging to connectivity by ultra-high field (7.0T) PET-MRI

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New imaging system, the Brain dedicated PET-MRI, using High resolution PET and Ultra High Field 7.0T Magnetic Resonance Imaging (MRI) and their applications to Brain Research, especially to the areas of neuropsychiatry, neurosurgery and neuroscience will be discussed. Among the interesting topical areas, applications of the high resolution brain PET (HRRT) and the ultra high field MRI (7.0T) will be highlighted. Especially for the *in-vivo* Human brain imaging with ultra-high field MRI, such as the 7.0T MRI, one can now visualize the substructures of the thalamus and brainstem *in-vivo* as well as tractography hitherto unable to do with existing MRI systems. Together with molecular imaging using Positron Emission Tomography (PET) that is the brain dedicated PET-MRI fusion system developed recently, now, it is possible to visualize molecular mechanisms quantitatively in our human brain *in-vivo* as well as their connectivity. Lastly, Ultra-high field MRI also began to provide excellent tractographic images delineating fine fibers such as medial forebrain bundles and internal medullary laminars in the thalamo-limbic areas suggesting future potential applications of these fibers to, among others, such as the DBS (Deep Brain Stimulation). Some recent results of brain PET-MRI fusion system as well as the new tractographic images obtained with 7.0T will be discussed and highlighted.

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