

European Network on NMR Relaxometry

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What FFC-relaxometry can do to get more insight into the issues related to Gd-retention in the brain

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Gadolinium-based contrast agents (GBCAs) are routinely used in many clinical magnetic resonance (MR) imaging studies. Despite the fact that these chemicals are considered to be extremely safe for human clinical use, recently, a renewed interest on the possibility they may cause adverse effects, came out because a number of studies reported the occurrence of an unexpected hyperintensity in unenhanced T1-weighted MRI of the brain in patients that have been previously administered with multiple doses of GBCAs. In the cases where post-mortem histology studies have been carried out, it has been established that the observed hyperintensity correlates well to the presence of gadolinium.

The assessment of the chemical forms Gd is present in the brain tissues is of paramount importance to get more insights into the potential toxic effects as well on the possible interventions to promote its removal. The amount of intact complexes appears not sufficient to account for the observed signal enhancement in the T_{1w} MR images. One may speculate that the observed hyperintensity is the result of the intact Gd-complex and additional soluble Gd-containing species. Likely, the latter species may be characterized by relatively high relaxivity values in order to justify the observed SI, to which the insoluble Gd-containing materials do not contribute. One possibility is to think of species endowed with a reduced rotational mobility formed upon the transmetallation of the administered Gd-complex.

In principle, from the in vitro relaxometric characterization of the possible species in which Gd can be retained in vivo (intact Gd-complex, dechelated Gd bound to macromolecular structures such as proteins, sugars or natural polymers) it might be possible to extract information that relates the observed relaxivity field dependence to the occurring molecular structures. Based on this information, by comparing the Signal Intensities obtained in T1w MR images at 1.5 and 3T, it could be possible to get some insights on the speciation of the Gd-containing species, in particular, it will allow to establish whether the detected hyperintensity receives contribution from small-sized or macromolecular Gd-containing species.

References

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