Multicolor 19F-MRI for in vivo Imaging of immune cells activity in a model of multiple sclerosis

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MRI is a suitable imaging tool for in vivo investigation and using fluorine nanoparticles (19F-NPs) is possible to detect active inflammation without signal background. We extended MRI towards multicolor imaging using two formulations of 19F-NPs containing distinct fluorocarbons in order to monitor the dynamics of inflammation in the experimental autoimmune encephalomyelitis (EAE), a model of multiple sclerosis (MS). In vivo experiments were performed on a 7T-MRI scanner, in healthy and pathological mice. EAE was induced in C57BL/6 mice immunized with MOG peptide**.** Both fluorine formulations showed the same ability to label immune cells in vivo. Indeed in mice treated simultaneously with both 19F-NPs, fluorine signal overlapped. Immunofluorescence on spinal cord collected from EAE mice supported MRI data, showing a co-localization of both tracers with a prevalence of leukocytes positive for 19F-NPs. 19F-multicolour MRI was investigated to track different stages of immune cells activity in EAE. For this purpose, 19F-NPs were administered at different phases of disease. MRI showed a greater 19F signal in the CNS of animals with a high disease severity. 19F signal correlated with the expected increment of leukocytes infiltration in the CNS, as measured by FCM confirming that the 19F-uptake was proportional to the disease severity. 19F-uptake was especially high with NPs administrated after EAE onset and monocytes and neutrophils were the primarily 19F-labeled cells. This proposed tool allows to perform a follow-up of all organs simultaneously. In conclusion, our results demonstrates the potentiality of multicolor 19F-MRI to track immune cells activity in vivo during neuroinflammation. These 19F-NPs could be extended also to therapeutic cells to monitor their efficacy and localization over time. Thus multicolor 19F-MRI could be of great interest to label both therapeutic cells and the circulating immune cells with the aim to monitor the effects on inflammation.