MR Contrast Media at 7Tesla - Preliminary Study on Relaxivities

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Purpose/Introduction: Contrast media are a powerful tool to improve the diagnostic value of MRI. The relaxivities have been determined for the currently routinely used magnetic field strengths. Recently, 7 Tesla magnets have been introduced for whole body imaging. It is well known that T1 and T2 of tissues and contrast media are dependent on the magnetic field strength (1,2). The aim of the study was the determination of the relaxation rates and relaxivities of eleven commercially available contrast media in physiologic saline solution and whole blood at 7 Tesla.

Subjects and Methods: *In vitro* measurements were performed at a 7-Tesla-whole body-MRI-scanner (Magnetom 7T, Siemens Medical Solutions, Erlangen, Deutschland) in physiologic saline solution and whole blood. Eleven commercially available contrast agents were measured in dilutions of 0.1, 0.25, 0,5, 1 und 2 mmol/l. The tubes had an axial diameter of 1cm. For the determination of T1, Inversion Recovery-Sequences with inversion times from 0 to 2500 ms were used. For T2 measurements, Multi-Slice-Multi-Echo- Sequences with increasing echo times between 8 and 800 ms were performed. Mean value, standard deviation and pixel count were determined by region of interest measurements (fig.1). The relaxation rates R1 and R2, and the relaxivities r1 and r2 were calculated.

Results: In preliminary calculations, the relaxivities r1 and r2 in physiologic saline soluton at 37°C were lower at 7 Tesla than has been described in the literature for lower field strengths. For most agents, the values increase with higher concentrations of the contrast agents. The values for blood were also calculated. Figure 2A shows typical T1 signal intensity time dependence for different contrast agent concentrations. Figure 2B shows an example of T2 exponential decay for different concentrations. It is apparent that the higher concentration is associated with the faster relaxivity as known from 3T. Tables 1 and 2 show the concentration dependent relaxivities of contrast agents at 7 Tesla, with r1 values given in table 1 and r2 values provided in table 2.

Discussion/Conclusion: The preliminatry *in vitro* study results at 7 Tesla show that r1 and r2 relaxivities differ from those known for lower field strenghts. This has to be taken into account, when using contrast agents at 7Tesla.

References:

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2. Pintaske J, Martirosian P, Graf H, et al. Relaxivity of Gadopenteteate Dimeglumine (Magnevist), Gadobutrol (Gadovist), and Gadobenate Dimeglumine (Multihance) in Human blood Plasma at 0.2, 1.5, and 3 Tesla. Investigative Radiology 2006; 41: 213-221.

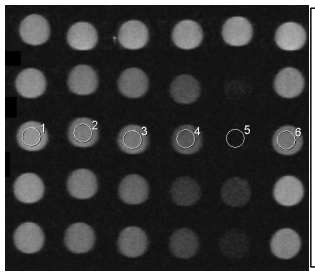

Figure 1

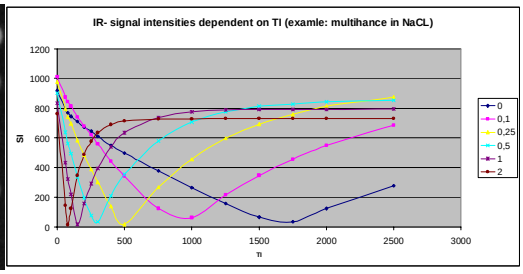

Figure 2A

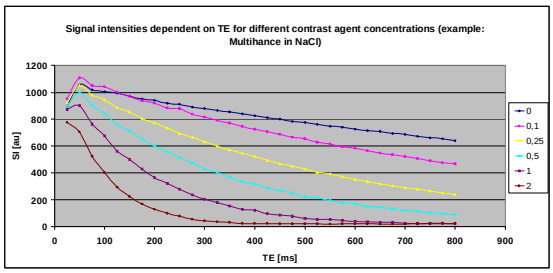

Figure 2B

contrast agent [mmol/L]	Omniscan	Magnevist	MultiHance	Dotarem	ProHance	Resovist	Vasovist	Primovist	Teslascan	Gadovist	Endorem
0.1	2.80	2.62	2.73	2.76	2.24	0.80	5.19	4.97	1.49	2.65	2.35
0.25	3.23	3.10	3.89	3.05	2.14	0.77	5.45	5.15	1.22	3.19	0.69
0.5	3.36	3.32	4.03	2.95	2.39	1.26	5.69	5.13	1.17	3.38	0.95
1	3.33	3.33	4.24	3.18	3.11	1.51	5.79	5.33	1.46	3.34	1.63
2	3.41	3.46	4.26	3.20	3.26	1.97	5.77	5.37	1.60	3.49	2.15

Table 1

contrast agent [mmol/L]	Omniscan	Magnevist	MultiHance	Dotarem	ProHance	Resovist	Vasovist	Primovist	Teslascan	Gadovist	Endorem
0.1	3.09	3.46	3.94	3.19	3.04	19.52	4.42	5.16	4.15	3.31	18.68
0.25	3.54	3.65	4.54	3.21	3.20	45.06	5.45	5.51	3.08	3.53	28.94
0.5	3.74	3.88	4.90	3.55	3.39	62.08	6.21	5.88	2.76	3.82	50.50
1	4.08	4.08	5.14	3.73	3.68	87.70	7.05	6.61	2.67	4.18	57.57
2	4.41	4.49	5.63	4.08	4.07	54.40	7.66	7.01	2.60	4.59	

Table 2