Comparison of gadobenate dimeglumine (Gd-BOPTA) with gadopentetate dimeglumine (Gd-DTPA) for enhanced MR imaging of brain and spine tumors in pediatric subjects

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Synopsis: Sixty-three pediatric subjects with confirmed brain or spine tumors underwent MR imaging before (T1w- and T2wSE sequences) and after (T1wSE sequences only) injection of either Gd-BOPTA (n=29) or Gd-DTPA (n=34) at a dose of 0.1 mmol/kg BW. Blinded qualitative evaluation revealed significant superiority for Gd-BOPTA for contrast enhancement (p=0.06) and lesion border delineation (p=0.018). Quantitative comparison revealed superiority for Gd-BOPTA over Gd-DTPA for lesion-to-brain contrast, contrast-to-noise ratio and percent enhancement. The superior contrast enhancement may be clinically advantageous in pediatric subjects for the detection and diagnosis of small or poorly enhancing CNS tumors.

Background: Gadobenate dimeglumine (Gd-BOPTA, MultiHance®, Bracco Imaging SpA, Milan, Italy) is a paramagnetic contrast agent whose T1 relaxivity *in vivo* (r1=9.7 mmol•$L^{-1}s^{-1}$) is approximately twice that of Gd-DTPA and other available gadolinium agents due to a capacity for weak and transient interaction with serum albumin (1,2). In adult subjects Gd-BOPTA provides significantly greater contrast enhancement of enhancing intra-axial brain tumors when compared to that achieved with Gd-DTPA (3), Gd-DOTA (4) and Gd-DTPA-BMA (5). A prospective inter-individual study in 174 pediatric subjects with known or suspected CNS abnormalities recently demonstrated comparable safety and efficacy for Gd-BOPTA and Gd-DTPA (6). The present study qualitatively and quantitatively compares the enhancement achieved after Gd-BOPTA and Gd-DTPA in a sub-population of 63 pediatric subjects with confirmed brain or spine tumors.

Methods and Materials: Sixty-three pediatric patients with confirmed tumors of the brain or spine received an 0.1 mmol/kg BW dose of either Gd-BOPTA (n=29; 18 M/11F, mean age 7.5±4.8 years) or Gd-DTPA (n=34; 13 M/21F, mean age 7.9±4.7 years). MR images were acquired before (T1w- and T2wSE sequences) and within 10 min (T1wSE sequences only) of contrast injection. Blinded unpaired (pre- and post-dose images evaluated separately) and paired (pre- and post-dose images evaluated together) qualitative assessments of technically adequate images in which lesions were found both pre- and post-contrast (Gd-BOPTA: n=24; Gd-DTPA: n=31), were performed to compare pre- to post-dose changes in border delineation, visualization of internal morphology, and contrast enhancement by means of 4-point scales from 1 (poor) to 4 (excellent). Qualitative evaluations were performed by patient and by lesion (25 and 39 lesions for Gd-BOPTA and Gd-DTPA, respectively). Quantitative evaluation of intra-axial brain tumors (22 lesions for Gd-BOPTA, 25 lesions for Gd-DTPA) compared changes in lesion-to-background ratio (L/B), contrast-to-noise ratio (C/N) and % enhancement (%En). Statistical comparison between groups was performed using t-tests at $p<0.05$.

Results: The results of the unpaired qualitative assessment by patient are shown in Table 1. The pre- to post-dose changes were significantly superior for Gd-BOPTA compared to Gd-DTPA for border delineation (p=0.018) and contrast enhancement (p=0.006). Within-patient paired assessments similarly revealed significant superiority with Gd-BOPTA for contrast enhancement (p=0.04).

Table 1	Gd-BOPTA (n=24)			Gd-DTPA (n=31)			Difference Gd-BOPTA – Gd-DTPA
	Pre-dose	Post-dose	Change (post – pre)	Pre-dose	Post-dose	Change (post – pre)	
Delineation of lesion borders	2.5 ± 0.7	3.3 ± 0.6 (p<0.001)	0.8 ± 0.8	2.7 ± 0.5	3.1 ± 0.7 (p=0.006)	0.4 ± 0.7	0.48; p=0.018
Visualization of internal morphology	2.5 ± 0.7	3.4 ± 0.6 (p<0.001)	0.8 ± 0.9	2.9 ± 0.3	3.4 ± 0.6 (p<0.001)	0.5 ± 0.6	0.31; p=0.126
Contrast enhancement of lesions	2.5 ± 0.6	3.4 ± 0.6 (p<0.001)	0.9 ± 0.9	2.9 ± 0.3	3.1 ± 0.7 (p<0.059)	0.3 ± 0.7	0.62; p=0.006

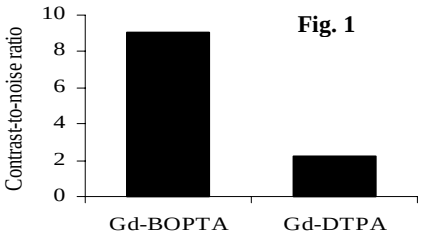

Fig. 1

Qualitative lesion-by-lesion changes during unpaired assessment revealed significant superiority for Gd-BOPTA for border delineation (p=0.01) and contrast enhancement (p=0.001), and marked superiority for visualization of internal morphology (p=0.059). Similar evaluations during paired assessment revealed superiority for Gd-BOPTA for all parameters with significant superiority indicated for contrast enhancement (p=0.001).

Mean post-dose values for L/B, CNR (Fig. 1) and %En were all superior for Gd-BOPTA (0.5±0.4 vs. 0.3±0.4; 9.1±15.4 vs. 2.2±9.9; 66.6±47.4 vs. 42.8±39.0, respectively) although wide differences between patients precluded overall demonstrations of significance.

Conclusion: As in adult patients, Gd-BOPTA demonstrates significant superiority over Gd-DTPA for enhancement of brain and spine tumors in pediatric patients. The superior contrast enhancement can be attributed to the two-fold greater T1 relaxivity in blood of Gd-BOPTA and my be clinically advantageous for the detection and diagnosis of small or poorly enhancing tumors in subjects for whom other diagnostic imaging techniques may be less desirable.

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