MRI for Evaluation of Brain Lesions: Intraindividual Comparison of Gadobenate Dimeglumine vs Conventional Gadolinium Contrast Agents

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Purpose: To present results from 2 large, multicenter, intraindividual comparisons of gadobenate dimeglumine (Gd-BOPTA, MultiHance®), one vs gadopentetate dimeglumine (Gd-DTPA, Magnevist®; study A) and the other vs gadodiamide (Gd-DTPA-BMA, Omniscan™; study B), for contrast-enhanced MRI of primary and secondary intra-axial brain lesions, and to discuss the potential implications of diagnostic accuracy on therapeutic intervention.

Materials and Methods: Comparisons of the higher-relaxivity gadolinium (Gd) contrast agent Gd-BOPTA with conventional Gd agents suggest both qualitative and quantitative advantages for depiction of central nervous system (CNS) lesions. Adults with known or suspected CNS lesions underwent 2 MRI examinations at 1.5T with a standard dose (0.1 mmol/kg) of Gd-BOPTA or the same dose of Gd-DTPA (study A) or Gd-DTPA-BMA (study B) separated by 2-14 days. Identical imaging sequences and postcontrast acquisition timing were used for the 2 examinations (T1wSE and high-resolution T1wGRE sequences at 3–7 min postdose). Three independent neuroradiologists blindly evaluated matched image pairs for qualitative diagnostic information (lesion border delineation, definition of disease extent, visualization of lesion internal morphology, lesion contrast enhancement, and global diagnostic preference) and quantitative contrast enhancement (% enhancement, lesion-to-brain ratio [LBR], and contrast-to-noise ratio [CNR]). Between-group comparisons were performed (Wilcoxon signed rank test) and inter-reader agreement (kappa [κ] statistics) was determined.

Results: A total of 93 patients with confirmed diagnoses of glioma were evaluated (47 from study A and 46 from study B) while a total of 64 patients with confirmed diagnoses of brain metastatic disease were evaluated (37 from study A and 27 from study B). For evaluation of gliomas, Gd-BOPTA was found to provide superior lesion border delineation, definition of disease extent, visualization of the internal morphology of the lesions, and lesion contrast enhancement in both study A ($p<0.0001$ for all assessments) and study B ($p<0.016$). In study A, Gd-BOPTA was preferred for evaluation of gliomas by the 3 readers in 24, 30, and 30 subjects, respectively, while Gd-DTPA was preferred in just 1 case for all 3 readers, while in study B, the 3 readers demonstrated a global diagnostic preference for Gd-BOPTA in 22, 35, and 25 patients, respectively, compared with 1 case for all 3 readers for Gd-DTPA-BMA. Quantitative enhancement of gliomas was significantly greater after Gd-BOPTA compared to Gd-DTPA (% enhancement and LBR: $p<0.0001$; CNR: $p<0.004$) and Gd-DTPA-BMA (LBR: $p\leq0.0002$ and % enhancement: $p<0.002$). In both studies, for the evaluation of gliomas, reader agreement was good, ranging from $\kappa=0.43$ to $\kappa=0.68$.

For evaluation of metastases, in study A, contrast enhancement of was preferred in 18, 21, and 25 subjects after administration of Gd-BOPTA compared with 3, 4, and 2 subjects after Gd-DTPA for readers 1, 2, 3, respectively. Similar improvements were noted for global preference (18, 20, and 26 patients after receiving Gd-BOPTA compared with 3, 5, and 2 subjects after receiving Gd-DTPA), and for all other qualitative parameters. Study A found quantitative enhancement for metastatic lesions was significantly greater after Gd-BOPTA (% enhancement: $p\leq0.013$; LBR: $p\leq0.002$; CNR: $p\leq0.04$). Reader agreement for evaluation of metastases in both studies was good for all evaluations (up to $\kappa=0.55$; 67.6%). In study B, Gd-BOPTA provided superior lesion border delineation ($p<0.0007$), definition of disease extent ($p<0.002$), visualization of lesion internal morphology ($p<0.005$), and lesion contrast enhancement ($p\leq0.0001$) compared with Gd-DTPA-BMA. The 3 readers demonstrated a global diagnostic preference for Gd-BOPTA in 20, 18, and 19 patients, respectively, compared with 2, 1, and 2 patients for Gd-DTAP-BMA ($p<0.0001$; all readers). Highly significant increases in quantitative enhancement of metastatic lesions with Gd-BOPTA relative to Gd-DTPA-BMA were noted by each reader for both % lesion enhancement ($p<0.02$) and CNR ($p<0.02$). For evaluation of metastatic lesions, reader agreement in both study A and B was good for all evaluations ($\kappa=0.55$ to $\kappa=67.6$). Combined qualitative results for Gd-BOPTA vs Gd-DTPA are shown in Table 1.

Table 1. Combined Qualitative Results for Studies A and B

	Glial tumors		Metastases	
	Preferred Agent		Preferred Agent	
	Gd-BOPTA	Other Gd	Gd-BOPTA	Other Gd
Global diagnostic preference	166	6	121	15
Lesion contrast enhancement	168	7	121	14
Lesion border delineation	112	6	100	11

Conclusions: For both gliomas and brain metastases, significantly improved lesion enhancement is obtained with a single dose of 0.1 mmol/kg bodyweight Gd-BOPTA compared to an equal dose of either Gd-DTPA or Gd-DTPA-BMA. The greater contrast enhancement seen with Gd-BOPTA may assist in presurgical patient management through improved characterization of poorly-enhancing primary brain tumors, earlier detection of tumor recurrence, or detection of additional metastatic lesions. Moreover, improved definition of radiosurgical target volumes and better selection of patients for whom surgical intervention would not prove beneficial may potentially improve prognoses and/or quality-of-life in this group of patients.

References

1. Kuhn MJ et al. *J Neurosurg*. 2007;106:557-566.
2. Rowley H et al. *AJNR*, Submitted 2007.