ORIGINAL RESEARCH

73. Using pretreatment MRI perfusion to inform subsequent MRI perfusion

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Purpose: Patients with brain metastases frequently require stereotactic radiosurgery (SRS), which offers effective local control while avoiding the neurocognitive toxicities of whole brain radiation therapy. Increasing enhancing lesions after SRS may represent recurrent metastasis or radiation necrosis. MR perfusion is commonly used to distinguish between these entities, with recent meta-analyses showing good correlations between hyperperfusion and recurrent metastasis. However, some metastases do not show hyperperfusion before SRS due to innate tumor properties rather than technical limitations. We hypothesize that pretreatment MR perfusion can improve perfusion interpretation at suspected progression, where absent hyperperfusion before treatment suggests perfusion is an unreliable marker for recurrent metastasis.

Materials and Methods : We retrospectively reviewed patients with systemic cancers and brain metastases who underwent SRS, had MR perfusion scans ≤30 days before SRS, and later developed suspected progression (>30 days post-SRS) with repeat MR perfusion ≤30 days before surgical resection. Histopathology served as the reference standard for determining recurrent metastasis versus necrosis. One metastasis was evaluated per patient. We analyzed dynamic contrast enhanced T1-weighted MR perfusion images with automated arterial input function to calculate Ktrans maps (transfer constant coefficient) and VP maps (plasma volume). The entire enhancing lesion was segmented using a semi-automated tool, propagated onto Ktrans and VP maps, and used to calculate normalized ratios (rKtrans, rVP). Absent hyperperfusion was defined as ratio <1.5. Statistical analysis used t-test where p=0.05.

Results: Initial perfusion results before SRS across the entire cohort showed median rKtrans=1.7 (range: 0.20-29.56) and median rVP=2.1 (range: 0.275-7.536). Median metastasis size was 3.0 cc (range: 0.369-10.431). We identified 22 patients with growing enhancing lesions and repeat perfusion a mean 283.7 days after SRS. Histopathology showed 14 (64%) recurrent tumors and 8 (36%) necrosis. Recurrent metastases showed median rKtrans=7.4 (range: 0.58-221.13) and median rVP=3.1 (range: 0.48-6.10), while necrosis showed lower median rKtrans=1.6 (range: 0.18-198.47) and median rVP=0.9 (range: 0-6.40), p=0.08.

Among recurrent metastases without hyperperfusion (ratio <1.5) at repeat imaging (n=6), pre-SRS perfusion showed rKtrans=10.38 (range: 0.35-15.27) and rVP=2.81 (range: 0.71-5.22). The remaining recurrent metastases (ratio ≥1.5) showed pre-SRS rKtrans=6.17 (range: 0.49-13.04) and rVP=3.94 (range: 0.20-29.56).

Conclusion: Our results confirmed MR perfusion utility in distinguishing recurrent metastasis from necrosis. Incorporating pre-SRS perfusion improved correlations and offers a novel approach for better informed management. Absent hyperperfusion in growing lesions that lacked hyperperfusion before treatment should be considered unreliable. Further patient incorporation and analysis are ongoing.

Table 1: Initial Results Suggest Utility of MR Perfusion to Distinguish Between Recurrent Metastasis and Necrosis in Treated Patients.

Pre-SRS MRI		
Ratios	**Entire Cohort**	**Non-hyperperfused (ratio <1.5)**
rKtrans	1.7	0.4
range	(0.2-29.6)	(0.4-0.5)
rVP	2.1	0.7
range	(0.4-7.5)	(0.2-1.5)

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