

Time Delayed Contrast Enhanced MRI Improves Detection of Brain Metastases and Their Apparent Treatment Volumes

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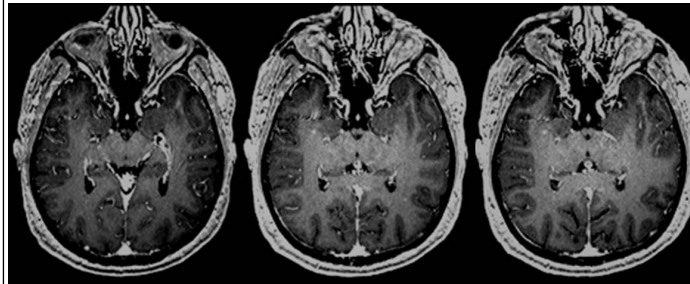
Introduction

Contrast-enhanced MRI is the preeminent diagnostic exam for brain metastases (BM). Focal treatment modalities such as stereotactic radiosurgery (SRS) have significantly improved tumor control and survival rates. Because SRS is an image-guided technique, treatment of BM with SRS requires accurate detection of lesion volume and size, which may improve with a time delay following administration of gadolinium-based contrast.

Methods

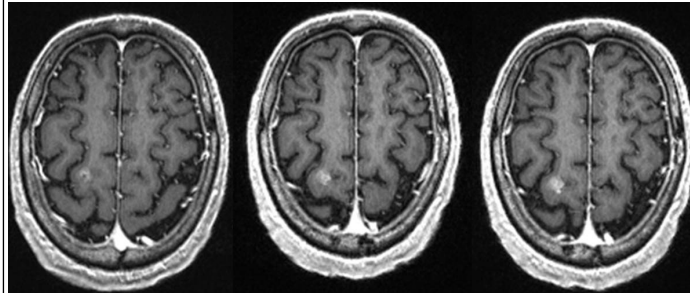
53 volumetric MRIs from 38 patients were evaluated. All studies were performed on 1.5 and 3T magnets using Gadobenate dimeglumin contrast (MultiHance®). Three axial T1 post-contrast sequences were performed; one immediately after injection, and two at delays of 10 and 15 minutes. The studies were randomized and examined separately by 3 radiologists, who were blinded to their sequence. The number of tumors in each scan was compared with a Wilcoxon signed-rank test. Tumors >2 mm in diameter (n=234) were contoured using SRS planning software and a mixed model approach examined volume changes.

Increase in Lesion Number After a Time Delay



Right parahippocampal lesion not seen immediately after contrast injection (left) becomes visible at 10 (middle) and 15 (right) minute delays

Increase in Lesion Conspicuity After a Time Delay



The right frontal lesion has some enhancement immediately after injection. However, at a time delay, there is more avid enhancement, more central solid enhancement, and tumor margins are clearer.

Brain Metastases Seen at Time Delays

	Scan 1→2	Scan 2→3	Scan 1→3
% of Studies With ≥1 New Metastasis	35.3% p=0.0367	21.6% p=0.273	43.1% p=0.0264
95% Confidence Interval	22.4%-49.9%	11.3%-35.3%	29.3%-57.8%
Range of Increase	1-10	1-9	1-14

Results

The interclass correlations (<0.72) for all three sequences demonstrated high inter-rater reliability. At least one new lesion was detected in the 2nd scan as compared to the 1st in 35.3% of subjects, (range of new lesions detected 1-10). At least 1 new lesion was detected in the 3rd scan as compared to the 2nd in 21.6% of subjects (range 1-9). Between scans 1 and 3 additional tumors were seen on 41.2% of scans (range 1-14). There was a significant increase in number of BM detected from scans 1 to 2 (P < 0.0367), and scans 1 to 3 (P < 0.0264). We found an average 25.4% increase in BM volume between scan 1 and 2 (P<0.0001), and a 9% increase between scans 2 and 3 (P<0.0001).

Conclusions

In patients who undergo SRS of BM, delayed MRI after contrast injection increases number and volume of BM to be treated. To avoid missing or undertreating tumors, we recommend MRI be acquired between 10 and 15 minutes after contrast injection.

Learning Objectives

Participants should be able to 1) describe the value of delayed MRI following administration of gadolinium-based contrast 2) consider implementing a delayed imaging protocol in clinical practice