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Noncontrast imaging for the surveillance of treated and untreated meningiomas

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Abstract

Objective: Patients with meningiomas require serial MRI for surveillance of tumor size and growth rate. The cost and resource requirements for contrast-enhanced MRI include intravenous cannulation, the contrast agent, risk of adverse reaction, and the time needed to acquire, review, and report the additional sequences. With repeated doses, gadolinium is known to accumulate in neural tissues. The authors compared the correlation and accuracy of axial T2-weighted imaging (T2WI) sequences alone for assessing tumor growth, dimensions, and dural venous sinus invasion compared with the current clinical practice of assessing both contrast-enhanced T1-weighted imaging (CE-T1WI) and T2WI sequences.

Methods: The authors retrospectively identified 136 adult patients (65 patients with treated and 71 patients with untreated meningiomas) with two MRI scans obtained at least 6 months apart. For each patient, the two CE-T1WI sequences separated by time were paired, as were the two T2WI sequences, and assessed independently. The paired scans were assessed by a neuroradiologist and advanced radiology trainee blinded to clinical data. Tumor location, dimensions, growth, and venous invasion were evaluated. Peritumoral edema was assessed on T2WI only. Agreement between assessments on both CE-T1WI and T2WI sequences compared with T2WI alone was evaluated using Cohen's kappa (κ), the intraclass correlation coefficient (ICC), and Bland-Altman plots.

Results: Growth was detected in 36 tumors on T2WI compared with 39 when both CE-T1WI and T2WI were assessed. Growth assessed on T2WI alone showed near-perfect agreement with growth assessed on CE-T1WI and T2WI together ($\kappa = 0.945$). T2WI alone had an accuracy of 97.8%, specificity of 100%, and sensitivity of 92.3%. Interrater correlation between the radiologists for tumor dimensions was good to excellent (ICC > 0.843). Intrarater agreement between T2WI and CE-T1WI measurements of anteroposterior and transverse tumor dimensions was good (ICC > 0.883 for observer 1, > 0.767 for observer 2). There was substantial agreement between venous invasion on T2WI and both CE-T1WI and T2WI ($\kappa = 0.771$). Subgroup analysis for skull base (58.1%), treated (47.8%), and large (> 20-mm diameter; 38.2%) meningiomas did not show any significant difference in agreement between T2WI only and CE-T1WI and T2WI assessments of growth, venous invasion, or tumor dimension.

Conclusions: In patients with treated and untreated meningiomas, unenhanced T2WI can assess tumor dimensions, detect growth, and detect venous invasion with comparable reliability and accuracy to the current clinical practice of using both CE-T1WI and T2WI.

Keywords: contrast; gadolinium; magnetic resonance imaging; meningioma; surveillance; tumor.