

Separation of Gliosis from Edema in Degenerating Cysticercosis using Quantitative Multiparametric Imaging

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Abstract: Magnetization transfer (MT) ratio and T2 values were computed in twenty-eight patients to predict underlying gliosis in perifocal edema around cysticercus granuloma. In nine patients gliosis appeared while in nineteen no gliosis was seen on follow-up study. In patients with gliosis, no significant difference in MT ratio and T2 values was observed between gliosis appearing region and the corresponding region of previous study. However, a significant difference was found in these values between gliosis appearing and edema disappearing region in MT ratio and T2 values on the initial study. It appears that it may be possible to predict gliosis in the initial study where it is masked by edema.

Introduction:

Neurocysticercosis (NCC) is the most common parasitic disease (60-90%) of the central nervous system in the developing countries with seizures as the most common clinical manifestation. Computed tomography (CT) and/or magnetic resonance imaging (MRI) play a critical role for lesion localization. There are two schools of thoughts regarding the treatment of single cysticercus lesion. One group feels that it should be managed with only anti-epileptic drugs (AED) alone while the other group feels that it should be treated with anti-cysticidal agents, steroids and antiepileptic agents. Recently, hyperintense signal presumably due to gliosis around the healed/ calcified cysticercus granuloma on magnetization transfer spin echo (MT SE) images has been implicated as a cause of epileptogenesis and poor long-term seizure control in these patients (1). It is not clear whether the gliosis in these healed lesions is secondary to the insult due to inflammatory reaction or a result of repeated seizures causing kindling effect and gliosis. It is likely that degeneration of the parasite results in release of the antigen and the immunogenic reaction, which may result in gliosis.

In the present study, we have computed MT ratio and T2 values with an aim to separate gliosis from edema on the initial study that may be of clinical significance in overall management of these patients.

Methods:

MR imaging was performed on 28 patients with single cysticercus cyst showing variable perifocal edema with first episode of seizure. MRI confirmed the diagnosis of cysticercus on the basis of existing criteria available in the literature. After diagnosis all patients were administered anti-cysticidal drug along with AED and were being followed up till the lesions either healed or disappeared. The presumed perilesional gliosis was considered to be present when hyperintensity was seen on MT SE image around the lesion; not/barely visible abnormality on T2 weighted images (1). The lesion was considered as healed with or without calcification when it appeared hypointense on T2 weighted images with no perifocal edema, and isointense on T1 weighted images.

MR imaging of the brain was performed on 1.5 T superconducting system using circularly polarized head coil. Conventional SE, proton density, T2 (TR/TE/1,2/n=2200 ms/12 ms, 80 ms/1) and T1 (1000 ms/14 ms/2) weighted imaging was performed in axial plane using 256x256 matrix size, 0.5 mm interslice gap and 5mm slice thickness. MT SE MR imaging was also performed with exactly the same parameters as for T1 weighted except for the off-resonance pulse. Phase corrected gradient echo (GRE) imaging (800 ms/15 ms, 35 ms/20°/1) was also performed to demonstrate the calcification in the lesion. The lesion was considered calcified when it appeared bright on phase corrected GRE image (2).

T2 values were computed using dual echo conventional SE sequence. By two-point method, pixel-to-pixel T2 maps were generated using the following equation: $T2 = (TE_2 - TE_1) / \ln(SI_1/SI_2)$, where TE_1 and TE_2 are the first and second echo times, and SI_1 , SI_2 are the signal intensities from the first and second echo images, respectively (3). MT ratios were also computed using MTR map generated by the following equation: $MTR = Mo - Mp / Mo$ (where Mo , Mp represent the signal intensity with

the saturation pulse off and on, respectively (4). Using T2 and MTR maps, T2 values and MT ratios were computed in the gliosis appearing region and results were compared with initial study of the same region in same patient and normal contralateral region. The data was analyzed by JMP IN software (version 3.2.1) independently. Depending upon the visibility on MT SE images, all patients were grouped in two categories: patients with gliosis and patients with healing/healed lesions with out gliosis.

Results:

In this study of 28 patients presented with edema on first study, there were 9 (category I) patients with gliosis and 19 (category II) patients with healing/healed lesions without gliosis on long term follow up. In category I, patients with gliosis, there was no significant difference in MT ratio and T2 values between gliosis appearing region and the corresponding region of previous study ($p > 0.05$). However, before appearance of gliosis, a significant difference ($p < 0.05$) was observed in MT ratio and T2 values between gliosis appearing and edema disappearing region on the initial study. In category II, patients without gliosis, there was also a significant difference ($p < 0.05$) in MT ratio and T2 values between edematous and normal contralateral region on initial study but when edema disappeared, there was no significant ($p > 0.05$) difference in these values in these regions.

Discussion:

The main goal of this study was to compute MT ratio and T2 values in the gliosis appearing region and compare these values with same region of initial study to predict perilesional gliosis before the disappearance of edema. Due to immunogenic insult, gliosis may appear during degeneration of colloid vesicular or granular nodular stage of NCC. In our initial study, MT ratio and T2 values were calculated in gliosis region and there was significant difference in these values when compared with normal contralateral region. In the present study, there was also significant difference in MT ratio and T2 values of edema and gliosis. This is possible because of difference in water and macromolecules concentration in edema and gliosis. In this study patients with category I, there was no statistical significant difference in MT ratio and T2 values between gliosis appearing region and same region of the previous study of the same patients. When these values were compared with normal contralateral region there was statistical significant difference in these values. However, a significant difference was found in these values between gliosis appearing and edema disappearing region in MT ratio and T2 values on the initial study. In category II, there was no statistical significant difference in T2 values and MT ratios when compared with same edematous region after disappearing edema. These values were nearly equal to normal contralateral region showing that lesions were healed/healing with out evidence of gliosis. Thus T2 relaxation time and MT ratio measurements increase the sensitivity in the assessment of apparently normal and abnormal pathology of the brain. Perilesional gliosis is known to correlate with epileptogenesis in healing/healed cysticercus granuloma and poor long-term seizure control (1).

We feel that it may be possible to predict gliosis in the initial study where it is masked by edema. This may help in instituting treatment that may help prevent gliosis and overall seizure free period for these patients in the long term.

References:

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