Comparative evaluation of magnetization transfer and fluid-attenuating inversion recovery imaging in cystic intracranial mass lesions and their correlation with biological parameters

S. Kumar[1], A. M. Mishra[1], J. Reddy[2], S. Behari[2], M. Husain[3], R. K. Gupta[1]

[1]Radiodiagnosis, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, UP, India, [2]Neurosurgery, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, UP, India, [3]Neurosurgery, King George Medical University, Lucknow, UP, India

Introduction: Differentiation in intracranial cystic lesions on MR may still be difficult despite the use of FLAIR, in vivo MR spectroscopy or DWI in the recent times. It is imperative to differentiate an abscess from other lesions such as cystic tumors or parasitic cysts since the management differs. In this study, we have compared magnetization transfer contrast (MTC) and fluid-attenuated inversion recovery (FLAIR) imaging in patients with intracranial cystic mass lesions where the diagnosis was confirmed pathologically. Further, the results of these imaging techniques have been correlated with the biological parameters such as viscosity, cell density and total proteins in the aspirated fluid from the cystic lesions to understand the possible reasons for the changes in signal intensity.

Methods: In this study 33 patients with diagnosis of pyogenic abscess (n=12), cystic tumours (n=16), arachnoid cyst (n=3), and neurocysticercus cysts (n=2) were evaluated. The ages ranged from 1.5 years to 65 years with a mean of 25 years and there were 22 males and 11 females. Final diagnosis was based on the operative findings, culture from the aspirated fluid, and histopathological results. MR imaging of these patients was performed on a 1.5T MR system using FSE-T2, FLAIR, SE-T1, MTC, DW, and contrast enhanced T1 weighted sequences in axial plane supplemented with other planes when required. The parameters used for FLAIR were TR/TE = 9000ms/89ms with inversion time=2200ms, and for MTC TR/TE=1300ms/14ms, flip angle=65 degrees, an off resonance pulse of 1200 Hz. Other parameters were field of view = 24×24 cm, nex = 1, slice thickness = 5 mm, inter-slice gap of 0.5 mm a with matrix size of 256×256 for both FLAIR and MTC sequences. Signal intensity on FLAIR and MTR values of the lesion were calculated over a number of slices using an in-house developed computer software on a stand alone PC. Fluid aspirated from the lesion at surgery was evaluated for viscosity, viable cell density, and concentration of total proteins within two hours of its removal. The viscosity was measured using Ostwald's viscometer or in case of thick pus, bench top viscometer. Cell count was done in a Hemocytometer. Non-viable cells were identified by trypan blue (0.5%) staining and percent viability was calculated**.** Total proteins in the fluid were measured by Lowery method. For evaluation and comparison purposes, the patients were divided in two groups, abscess group (n=12) and non-abscess group (n=21). Statistical analysis was performed using independent samples t-test and Pearson correlation to assess the significance of the findings using statistical software SPSS10.0; SPSS, Chicago, Ill).

Results: Signal intensity of FLAIR ranged from 91.5 to 792.11, with a mean of 318.75 $\pm$ 260.08 in the abscess group and from 8.0 to 779.35, with a mean of 257.96 $\pm$ 216.89 in the non-abscess group (Fig 1, 2). There was no significant difference statistically in the signal intensity values between the two groups ($p=0.47$). MTR values ranged from 6.06 to 17.53, with a mean of 13.02 $\pm$ 3.32 in the abscess group and from 1.13 to 7.06, with a mean of 3.49 $\pm$ 1.45 in the non-abscess group (Fig 1, 2). There was statistically significant difference in the MTR values between the abscess and non-abscess groups ($p<0.001$). In the abscess group, viable cell density was 56083.33 $\pm$ 42999.91 cells/mm^3 having more than 95% intact pus cells, viscosity of the pus was 123.62 $\pm$ 136.11 centipoise, and total protein concentration was 83.86 $\pm$ 24.95 mg/ml. In the non-abscess group, there were no visible viable cells, viscosity of the aspirated fluid was 1.69 $\pm$ 0.93 centipoise, and total protein concentration was 48.23 $\pm$ 31.60 mg/ml. Viscosity of both the groups was significantly different ($p<0.001$). When the signal intensity on FLAIR and MTR values were correlated with viscosity, cell density and total proteins, there was a statistically significant correlation between the signal intensity on FLAIR and total proteins in all the lesions ($r= 0.536$, $p<0.005$). MTR values also correlated significantly with viscosity in all the lesions ($r=0.683$, $p<0.001$).

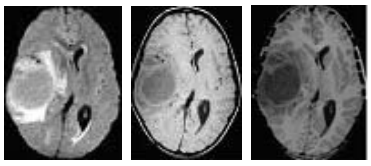

Fig 1 A B C

Fig 1 A 10 year child with pyogenic brain abscess in right fronto-parietal region. FLAIR image (A) shows a round isointense lesion with perifocal edema and mass effect. T1 (B) and MTC image (C) show the lesion as hypointense and isointense respectively with edema and mass effect.

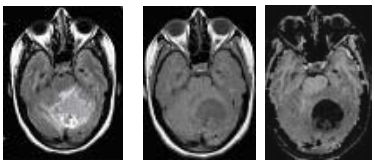

Fig 2 A B C

Fig 2. A 31 year old woman with cystic tumor (hemangioblastoma) in the left cerebellum. FLAIR image (A) shows the cystic component as slightly hyperintense with edema and mass effect. T1 (B) and MTC images (C) show the lesion as hypointense and hyperintense with edema and mass effect.

Discussion: On correlation with pathology, MTR values were found to be high in abscesses compared to other cystic lesions as has been reported earlier. Signal intensity on FLAIR did not differ statistically in the two groups. When the imaging was correlated with biological parameters, it was seen that signal intensity on FLAIR strongly correlated with the total proteins in intracranial cystic lesions in vivo confirming the published experimental results. T1 effects due to proteins predominate in the signal intensity generated by the cystic fluid on FLAIR. Correlation of MTR with viscosity in both the groups suggests that the macromolecules within cells as well as in the extracellular compartment contribute towards the viscosity of the cystic fluid. Higher viscosity in the abscess is responsible for higher MTR values. We conclude that using MTC sequence can differentiate an abscess from other cystic lesions and thus have a better utility than FLAIR imaging in these patients. In the differentiation of cystic intracranial lesions, signal intensity on FLAIR does not have a significant role.