Prospective evaluation of intracranial cystic mass lesions with in vivo proton MR spectroscopy

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Introduction: Magnetic resonance imaging (MRI) is an established technique for the evaluation of intracranial mass lesions. It is highly sensitive yet relatively non-specific. It is not always possible to characterize these lesions on MRI. In-vivo MR spectroscopy (MRS) has shown its utility in the differential diagnosis of cystic intracranial mass lesions (1-3). The results of these studies are based on the retrospective analysis. We performed prospective study to evaluate the sensitivity and specificity of the technique in differentiation of these cystic lesions.

Materials and Methods: The study included 50 patients diagnosed as having cystic intracranial mass lesions on the basis of conventional MRI findings. There were 20 patients with gliomas (12 cases of Glioblastoma multiforme and 8 cases of different grades of astrocytomas), 21 abscesses, 3 arachnoid cysts, 2 hydatid cysts and 1 case each of ependymal cyst, xanthogranuloma, infarction and acoustic neurinoma respectively. The final diagnosis in all these cases was based on the results of surgery and /or histopathology. Spectral data was also obtained from the left parietal lobe of 50 healthy volunteers.

All patients and controls underwent MRI and proton spectroscopy in one session. MRI and single voxel proton MR spectroscopy was performed on a 2 Tesla whole body system, operating at field strength of 1.5 Tesla using a circularly polarized head coil. Volume-selective spectroscopy was performed using STEAM localizing sequence with TE=20msec, SE sequence with TE=135 msec or both in all the cases. High resolution NMR spectroscopy on the aspirated fluid was performed in 25 cases. A 300 MHz NMR system (Brucker, Switzerland) with a 3 mm multinuclear probe head with z gradient was used with typical experimental parameters: flip angle 90, relaxation delay 3 sec, spectral width 3.142 KHz, transients 128 with presaturation of water. In addition, spin echo Fourier transformed spectra were also recorded with TE=80 msec with relaxation delay of 2 sec to see the phase reversal of the J coupled multiplets. Assignment of resonances was based on the existing literature. The diagnosis of different cystic lesions was based on the combination of resonances of different metabolites, described in the earlier studies.

Results: Spectral quality was interpretable in all the 50 cases. The pathology was correctly recognized in 45/50 patients; was false negative in three and false positive in 2 cases. In one patient with ependymal cyst, the resonance at 2.02 ppm was seen, not observed in earlier published studies on cystic lesions. The result in this case was considered inconclusive and interpreted only after ex vivo high-resolution study. Two cases interpreted as glioma confirmed as infarction and xanthogranuloma on histopathology respectively. In one patient who was not interpreted as glioma was actually glioblastoma multiforme. MR spectroscopy showed an overall sensitivity of 93.75%, specificity 96.15%, predictive value of positive test 95.74% and predictive value of negative test 94.34%.

Discussion: The present study shows excellent sensitivity and specificity in differentiation of different types of cystic intracranial mass lesions. However, there were two cases with non–neoplastic cystic lesions interpreted as glioma on the basis of presence of choline, lipid/lactate. Presence of high choline in solid intracranial mass lesions has also been seen in other non-neoplastic lesions like infarction, pseudotumors and demyelination (4). This has been suggested to be due to the high cellularity of the benign lesions or due to breakdown of myelin. However, in the cystic lesions presence of choline is probably due to incluson of the wall of the lesion in the voxel, that was highly cellular on histopathology in xanthogranuloma and showed cellular infiltrates and demyelination in the infarcted tissue. Presence of resonance at 2.02 ppm in an extraventricular intraparenchymal ependymal cyst is surprising and has not been described previously. The NAA is a neuronal marker and is not reported to be present in the ependymal lining. This resonance was confirmed on ex vivo study as NAA. Another case was interpreted as a cyst with lipid/lactate as inconclusive and was confirmed as glioblastoma multiforme on histopathology. Ex vivo study also did not show any choline in the cystic fluid. Such spectral pattern has been previously reported in cystic glioblastoma multiforme (1).

Conclusion: The study shows that 1H-MRS metabolic patterns of various intra cranial cystic lesions show very high specificity in prospective. This may compliment imaging in the preoperative diagnosis and influence the overall management of such patients.

References:

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