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Original Research Paper

Magnetic Resonance Spectroscopy in Differentiation of Intracranial Tuberculoma and Neurocysticercosis.

Microbiology

KEYWORDS: Magnetic resonance spectroscopy, Neurocysticercosis, Tuberculoma

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ABSTRACT

Objective: This study was conducted to investigate role of MRS in differentiation of intracranial tuberculomas and neurocysticercosis based on metabolite peaks and ratios.

Methods: 23 patients (12 cases of tuberculoma and 11 cases of neurocysticercosis) were studied using Single voxel spectroscopy (PRESS technique) with identification of various metabolite peaks and calculation of NAA/Cho, Cho/Cr and NAA/Cr ratios. MRS findings were analyzed independently and subsequently correlated with clinical findings, conventional MRI findings and patient follow up.

Results: Elevated choline noted in 75% (9/12) of tuberculomas and 64% (7/11) of neurocysticercosis respectively (P value 0.67). Lipid peak seen in 67% (8/12) tuberculomas with the sensitivity, specificity, PPV and NPV for tuberculomas of 67%, 91%, 89% and 71% respectively. The lactate peak noted in 45% (5/11) of NCC with the sensitivity, specificity, PPV and NPV of 45%, 100%, 100% and 67% respectively. Elevated Cho/Cr ratio(>1) was noted in 83%(10/12) cases of tuberculomas and 54% (6/11) cases of neurocysticercosis (P value 0.19). Sensitivity for tuberculoma 83%, specificity 45% with PPV 63% and NPV 71%.

Conclusions: Presence of lipid peak is more specific for diagnosis of tuberculoma while lactate peak may be helpful for characterisation of neurocysticercosis. Elevated Ch/Cr ratio >1 has high sensitivity for tuberculoma but poor specificity in differentiating from neurocysticercosis.

Introduction

Neurocysticercosis (NCC) and tuberculomas, are the two most common etiologies of inflammatory granulomas encountered in clinical practice especially in Indian subcontinent and the differentiation between the two is difficult many times on basis of clinical and conventional radiological criteria.[1,2] Although stereotactic brain biopsy can reveal the nature of these pathologies, it is generally not favouredas it is an invasive procedure.[3]Hence a noninvasive investigative tool is preferable that would facilitate the diagnosis of these lesions. MR spectroscopy (MRS) is one such modality which has been explored for the differentiation of tuberculoma and neurocysticercosis in limited number of studies.[3-5]We wish to share our experience on use of MRS in differentiation of solitary intracranial tuberculoma from neurocysticercosis detected on routine MR imaging. This study was conducted to describe the most common metabolic patterns of tuberculomas and neurocysticercosis on MRS with emphasis on potential markers for differentiation.

Methods

Twenty three patients with a single intracranial granulomatous lesion caused by tuberculosis (n=12) and neurocysticercosis (n=11) were examined by proton magnetic resonance spectroscopy. The spectroscopic findings were analysed independent of clinical findings and conventional MRI findings. The diagnosis was confirmed by clinico-pathological workup including CSF examination and response to treatment initiated based on radiological diagnosis within a time span of six months. Patients with more than one granulomatous lesion, those lost to follow up and without clinico-pathological correlation were not included in the study.

This study was done on 1.5T GE SignaHDe (GE, Milwaukee, WI, U.S.A.) whole body scanner using phased array 8 channel head coil. Initially, each patient was subjected to routine spin echo (SE) T2W sequence. The volume of interest (VOI) from the lesion was selected on SE-T2-weighted images for single voxelspectroscopy(SVS).SVS studies were performed with Point Resolved Spectroscopy (PRESS) sequence {TR/TE/Ac (repetition time/time to echo/acquisitions) (1500/144/128)}.The MRS findings were tabulated and correlated with the final diagnosis based on clinical, pathological, radiological and follow up findings. Metabolite ratios (Cho/Cr,NAA/Cho& NAA/Cr) were calculated and diagnostic accuracy of the metabolite ratios was compared.The level of significance MRS findings was determined using the Fisher test and probability value (P)<0.05 was regarded as significant.

Results

Spectroscopic peaks representing elevated choline were well defined in 75% (9/12) of tuberculomasand 64% (7/11) of neurocysticercosis respectively (statistically not significant, P value 0.67). Lipid peak was present in 67% (8/12) tuberculomas& only in 9% (1/11) in neurocysticercosis (statistically significant with Pvalue 0.027). The sensitivity, specificity, PPV and NPV of above finding for tuberculomas was 67%, 91%, 89% and 71% respectively.

The lactate peak was present in 45%(5/11) of NCC and in none of the tuberculomas. (statistically significant, P value 0.014).The sensitivity, specificity, PPV and NPV of above finding for neurocysticercosis was 45%, 100%, 100% and 67% respectively.

Elevated succinate/pyruvate /alanine/acetate peaks were noted in 36% (4) cases of neurocysticercosis and none of the tuberculomas (statistically significant with P value 0.03). The sensitivity, specificity, PPV & NPV of this finding for neurocysticercosis was 36%,100%,100% and 63% respectively.

Elevated Cho/Cr ratio(>1) was noted in 83%(10/12) cases of tuberculomas and in 54% (6/11) cases of neurocysticercosis (P value 0.19). Sensitivity for tuberculomawas 83%, specificity 45% with PPV 63% and NPV 71%. While decreased NAA/ choline ratio (<1.2) was noted in 67% (8/12) tuberculomas and 45%(5/11) neurocysticercosis (P value 0.4) with sensitivity, specificity, PPV and NPV of 67%,54%, 62% and 60% respectively for tuberculoma.

Decreased NAA/Cr ratio (<1.6) was noted in 7 cases, while it was normal in 3 cases and not measurable in 2 cases of tuberculoma. Decreased NAA/Cr ratio was noticed in 8 cases of neurocysticercosis with rest 3 cases showing normal value.The differences were not statically significant (P value 1).

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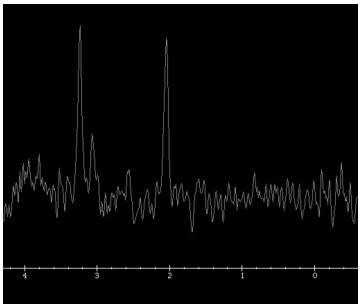

Figure 1. NCC: Single voxel MR spectroscopy showing elevated Choline (3.2ppm), diminished creatine (3 ppm) peaks (Cho/Cr >1) and small inverted lactate peaks (1.2-1.4ppm)

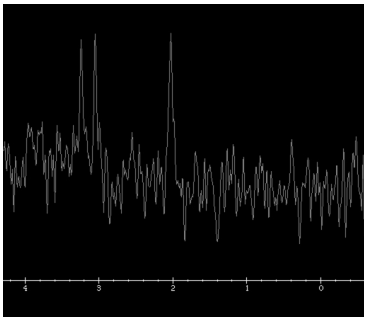

Figure 2. NCC: Single voxel spectroscopy shows inverted lactate peak (1.3ppm) with elevted succinate/pyruvate peak (2.5ppm) with preserved NAA, creatine and choline peaks.

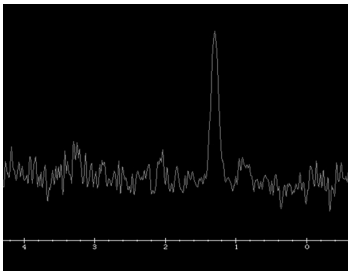

Figure 3.Tuberculoma: Single voxel MR spectroscopy trace showing marked lipid peak (1.2ppm) with diminished other metabolite peaks

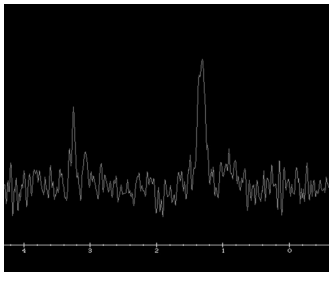

Figure 4. Tuberculoma: Single voxel spectroscopy shows elevated choline (3.1ppm) and diminished creatine (3.0ppm) peaks (Cho/Cr > 1) with prominent lipid peak (1.2ppm)

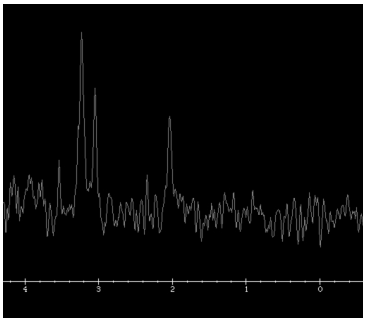

Figure 5. Tuberculoma: Single voxel spectroscopy reveals elevated Cho/cr ratio (>1) with diminished NAA peak with no significant lipid peak.

Discussion

MRS complements the MRI as a non-invasive means for the characterization of the tissue. While the MRI uses signals from hydrogen protons to form anatomic images, the proton MRS uses this information to determine the concentration of brain metabolites such as N-acetyl aspartate (NAA), choline (Cho), creatine (Cr), and lactate in the tissue examined.[6] Single voxel spectroscopy with PRESS technique has advantage of higher signal to noise ratio and scan timecompared to other techniques and there is inversion of lactate and alanine peaks at echo time of 144ms due to J- coupling allowing differentiation to be made from lipid peaks resonating at similar frequencies.[7]

Various authors have reported, that all the tuberculomas had lipid peaks,increased choline and decreased N-acetyl aspartate (NAA) and creatine(Cr) peaks, and Cho/Cr ratio >1, which was not noted with neurocysticercosis.[1,8-10]. However in our study lipid peak was noted in 67% cases of tuberculomas, with no statistically significant difference noted with respect to the increased choline and decreased N- acetyl aspartate and creatine metabolite peaks. Further Cho/Cr ratio >1 was noted in both the tuberculomas and neurocysticercosis with no statistically significant difference. Few authors have also stated that lipid peaks may not be seen in all cases of tuberculomas and may be observed in few cases of neurocysticercosis as well and no significant difference may be noted in values of Cho/Cr ratio between the two conditions.[3,11,12]

Whereas as per various studies, MRS findings of neurocysticercosis include a combination of elevated levels of lactate, alanine, succinate and choline and reduced levels of NAA and creatine.[13,14,15]Jayasunder et al [3] have concluded that extremely low levels of MRS-detectable metabolites together with a poor S/N ratio could itself act as a marker for nerocysticercosis. In our study measurable metabolite peaks were noted in all the case of neurocysticercosis with statistically significant detection of lactate peak in 45% cases and amino acid peaks in 36% cases.

Conclusions

Presence of lipid peak is more specific for diagnosis of tuberculoma while lactate peak may be helpful for characterisation of neurocysticercosis. No statistically significant difference in various metabolite ratios was noted in between neurocysticercosis and tuberculoma. Elevated Ch/Cr ratio >1 has high sensitivity for tuberculoma but poor specificity in differentiating from neurocysticercosis. This study has obvious limitations of small sample size with inherent bias and lack of histopathological correlation. But most of the cases in these two conditions in Indian setup are managed conservatively and response to specific therapy on follow up are mainstay of confirmation of diagnosis.

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