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EVALUATION OF DIFFUSION WEIGHTED MAGNETIC RESONANCE IMAGING AGAINST CONTRAST ENHANCED MAGNETIC RESONANCE IMAGING IN DIAGNOSIS OF SPINAL TUBERCULOSIS.

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ABSTRACT

Background: Tuberculosis is a very important health issue in the developing countries. The spinal tuberculosis is characterised by intervertebral disc involvement, pre/paravertebral and epidural abscess formation, skip lesions with destruction and collapse of the vertebral bodies leading to spinal deformity.

RI is the investigation of choice for the diagnosis of spinal tuberculosis because it provides excellent soft tissue contrast with multiplanar imaging capability leading to better evaluation of bone marrow and neural structures. Presently contrast enhanced MRI is the gold standard modality for clinching the diagnosis of Pott's spine which shows the vertebral bodies and intervertebral disc enhancement in the affected area with associated pre and Para-vertebral soft tissue component or abscess. Diffusion weighted imaging (DWI) has emerged as a promising tool in evaluation of spinal TB.

Methods: MRI scans of 50 suspected cases of spinal tuberculosis visiting the place of study were studied prospectively.

Results: The 94 % cases showed contrast enhancement. Restriction of diffusion with correspondingly low ADC values were seen in 30% cases.

Conclusion: The CE MRI continues to be the gold standard imaging modality for Pott's spine. However, DWI may emerge as a useful adjunct to confirm the diagnosis in equivocal cases after further research on its utility.

KEY WORDS : Pott's spine, DWI, CE MRI. tuberculosis

Introduction:

In most of the vertebrae, the cancellous bone of the vertebral body located anteriorly under the periosteum is the starting point of tuberculosis infection, and subsequently spreads to the intervertebral disc and to other parts of vertebrae [1]. The collapse of vertebral body along with wedging is seen due to bony destruction. The infective process forms the granulation tissue and necrotic material within the lytic areas of the bone and in the surrounding soft tissues plane including psoas muscles.

RI is the investigation of choice for the diagnosis of spinal tuberculosis because it provides excellent soft tissue contrast with multiplanar imaging capability leading to better evaluation of bone marrow and neural structures in comparison to the other modalities. Presently contrast enhanced MRI is the gold standard modality for clinching the diagnosis of Pott's spine which shows the vertebral bodies and intervertebral disc enhancement in the affected area with associated pre and Para-vertebral soft tissue component or abscess. Diffusion weighted imaging (DWI) is based on the measurement of the random Brownian motion of water molecules within a voxel of tissues.[2]. Usually the dense cellular tissues or those with cellular swelling show lower diffusion coefficient and are seen as bright signal on higher b values and corresponding low signal on ADC map. DWI has been used in brain for tumour characterization, cerebral ischemia and brain abscess. In spine its role for evaluation of metastasis has been studied [3] but its role in spine for evaluation of Pott's spine has not been extensively studied so far.

Therefore, aim of this study is to compare the sensitivity and specificity of DWI with contrast enhanced MRI in diagnosis of Pott's spine. If this sequence has comparable sensitivity and specificity to that of contrast enhanced MR, this will help in diagnosing cases of Pott's spine with conviction in cases of deranged renal function where contrast administration is contraindicated. It will also reduce the time taken for the investigation besides reducing the cost [4].

Materials and methods:

The study was carried out in the Radiology Department of a tertiary care teaching hospital in Maharashtra. MRI scans of all the clinically diagnosed cases of spinal tuberculosis were performed between September 2016 to August 2018. The patients of all age groups and both sexes were included in the study. The 1.5T Siemens Somatom Symphony, Germany MRI machine was used for the scan. Our institutional MR Protocol for spine which was followed for this study is given below: - MRI was performed with sagittal T1W, T2W, STIR, T1FS and DW Imaging, Axial T1W, T2W and DW Imaging, Coronal STIR Images were obtained which was followed by axial, coronal and sagittal post contrast fat sat images.

The single shot echo planar sequence was used for DW-MRI. Sagittal DWI was performed at TR – 2400 ms, TE – 88 ms, slice thickness – 4 mm, FOV – 35 × 35 cm, number of excitations – 1, and matrix – 128 × 128. Sagittal and axial DW-MRI was performed at b values of 0, 500, and 700. Corresponding ADC maps were generated and evaluated. The study was completed by administration of MR contrast agent (Gadolinium) IV in the dose of 0.02 mmol/kg body.

The sensitivity and specificity of DWI was compared with that of CE MR to evaluate the utility of this sequence in the spinal tuberculosis diagnosis.

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Results:

A total of 50 clinically diagnosed/suspected cases of Potts spine were included in present study. They were subjected to contrast-enhanced MRI of spine after taking informed consent from patients/parents.

All 50 patients were divided into four age groups: ≤ 20 completed years, 21– 40 completed years, 41- 60 completed years and > 60 completed years. The maximum numbers of cases were seen in age group of 21 – 40 years and these cases amounted to total of 21 (42%). The minimum number of patients was seen in >60 years age group and amounted to total of 03 cases (6%). In this study the youngest patient was of age 2 years and the oldest patient was of age 62 years. Out of total 50 patients, 39 (78%) were males and 11 (22%) were females.

Based on history and clinical details, we divided the patients into five groups like low grade fever, back pain, weight loss, lower limb weakness and deformity. The number of patients who had low grade fever, back pain, weight loss, lower limb weakness, and deformityconstituted44(88%),44(88%),42(84%),30(60%)and11(22%) respectively. Out of total 50 patients; 42 (84 %) patients had raised ESR and 08 (16 %) patients had normal ESR.

All patients underwent multiplanar T1WI, T2WI / STIR, DWI (Diffusion weighed imaging) with ADC map and contrast enhanced MRI of spine. T1 hypointensity and T2/STIR hyper intensity of affected discs and vertebral bodies was seen in 47 (94%) patients. There was restriction of diffusion with corresponding low ADC values in 15 (30%) patients. Contrast enhancement was seen in 47 (94%) patients.

Discussion:

In the present study, 50 patients were divided into four age groups with the largest number of patients belonging to the age group 21-40 years. J C Ghosh et al (5) reported the highest number of patients in the age group < 20 years. However; the present study also revealed that very few (6%), patients belonged to the age group of > 60 Years, echoing a similar trend as reported by JC Ghosh et al.

The present study had 39 (78 %) males and 11 (22 %) female patients. JC Ghosh et al reported that out of 107 patients of Pott's spine included in their study, 46 (43%) were males and 61 (57 %) were females. This difference may be due to the referral pattern prevalent in the respective study centres.

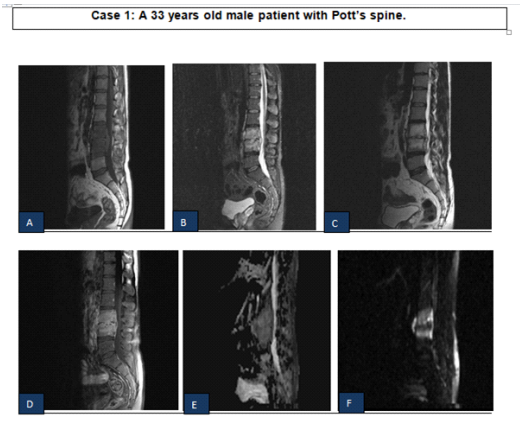

Fig:1- (A to F) shows features suggestive of Pott's spine involving the L3-4 vertebrae in the form of hypointense on T1WI and hyperintense on T2/STIR images, showing post contrast enhancement, restriction of diffusion and correspondingly low ADC values.

Our diagnostic evaluation study included 50 patients referred from various departments of our institute presenting with a broad spectrum of clinical symptoms. In present study back pain was seen in 44 (88%) cases. Ansari et al (6) has described that out of total 30 patients in his study 19 (63.3%) had back pain. Alothman et al (7) reported that 84% of patients had low backache in their study. Thus, low backache remains the most common symptom in patients of Pott's spine.

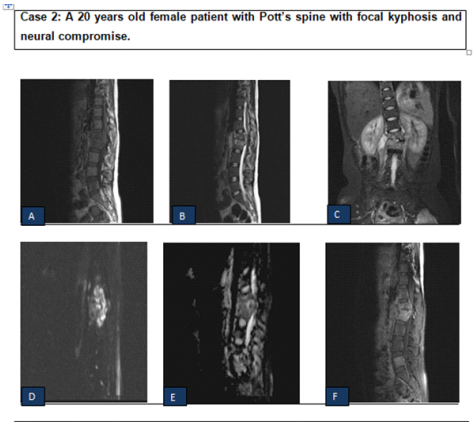

Fig:2- (A to F) shows features suggestive of Pott's spine involving the L3-4 vertebrae in the form of hypointense on T1WI and hyperintense on T2/STIR images, showing post contrast enhancement, restriction of diffusion and correspondingly low ADC values.

In present study, low grade fever was seen in 44 (88%) cases. Ansari et al (6) has described that out of total 30 patients in his study 19 (63.3%) had back pain. Leibert et al (8) reported 57.7% patients in their study to have fever. Thus, our study group had a higher percentage of patients presenting with fever. The possible explanations for this could be an advanced stage of presentation in our study population.

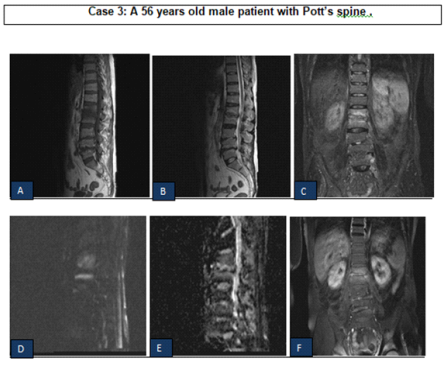

Fig:3- (A to F) shows features suggestive of Pott's spine involving the L3-4 vertebrae in the form of hypointense on T1WI and hyperintense on T2/STIR images, showing post contrast enhancement, restriction of diffusion and correspondingly low ADC values.

In present study weight loss was seen in 30 (60%) cases. Alothman et al (7) has described weight loss in 27.5% of study population. Leibert et al (8) reported weight loss in 57.7% patients. These differences can be due to subjective nature of weight loss in different patient populations.

In present study paraparesis was seen in 19 (38%) cases. Ansari et al (7) has described lower limb weakness in 40% of his patients as a symptom. Alothman et al (8) and Leibert et al reported neurological symptoms in 28% and 26.7% of their study populations respectively. So, across various trials around one third of patients have been shown to present with neurological symptoms which is consistent with our findings.

In present study spinal deformity was seen in 11 (22%) cases which is

much less compared to the findings of Ansari et al (7) who have described deformities in 56.7% of their study population. Turgut et al (9) reported the deformities in 46% of their patients. In view of low incidence of deformities in our study, a focused evaluation would be warranted in further studies to look for subtle deformities.

In our study ESR was raised in 39 (78%) patients (cut off values were > 22mm/hr for males and > 29 mm/hr for females). Patients with spinal TB routinely show raised ESR with mean value of 49 mm (range, 22–68 mm) (10) and 84.5 mm (range, 1–143 mm) (11). According to study by Hongwei Wang et al. (12) the ESR varied from 1 to 145 mm/h, with the mean value of 41.2 mm/h. 73.2% of patients had a raised ESR of more than 20 mm/h and 4.9% had an ESR of more than 100 mm/h. Our study showed a similar pattern of raised ESR in approximately three-fourth of the study population.

In our study, 94% (47 out of 50) of the study population showed post contrast enhancement of the involved vertebrae and IV disc. Nam-Hyun Kim (13) reported contrast enhancement in all 22 patients in their case series study on Gadolinium administration. Rivas-Garcia et al (14) reported contrast enhancement in 16 out of 20 (80%) of their patients.

In our study, 30% (15 out of 50) of the study population showed restriction of diffusion in the involved vertebrae and IV disc with corresponding low ADC values on ADC map. There have been a few studies investigating the role of DWI in Pott's spine (99, 100). Palle et al (15) calculated ADC values of 128 vertebrae in 56 patients of Pott's spine. They reported low ADC values (restricted diffusion) in 46 out of 128 vertebrae (35.9%). They did not comment on contrast enhancement of the vertebral bodies.

Other studies (16) have attempted to calculate mean ADC values for tubercular vertebrae in known cases of Pott's sine. Despite extensive literature search we could not find direct comparison of DWI with CE MRI in cases of Pott's spine. Thus, present study fills a void in this area and investigates the diagnostic accuracy of DWI in this pathology.

On statistical analysis, we found the sensitivity, specificity, positive predictive value and negative predictive value of DWI in Pott's spine to be 30%, 100%, 100% and 8.57% respectively. If we consider CE MRI as gold standard, the rates of true positive cases of Pott's spine were 30% whereas false positive cases were zero.

With such high positive predictive value DWI appears to be a very specific diagnostic test for Pott's spine. However, it suffers from low sensitivity and a high rate of false negative cases (64%). With high specificity proven by present study, DWI could serve as a confirmatory test for Pott's spine in equivocal cases. Further studies are warranted in this field to establish the exact place of this sequence in diagnostic algorithm of Pott's spine. Until then CE MRI remains the cornerstone of diagnostic work-up in Pott's spine.

Conclusion:

The present study was an attempt to establish the role of DWI in Pott's spine and compare it with contrast enhanced imaging. CE MRI already has an established role in diagnostic work-up of Pott's spine. However, it suffers from certain disadvantages in form of longer imaging times and risk of complications in patients suffering from renal diseases. DWI is a relatively newer modality of MRI with ever-increasing applications in different parts of body. Despite extensive literature search we could not find a previous study comparing these two sequences in Pott's spine.

Our study showed similar age distribution when compared to previous studies with variation in gender distribution. Clinical presentation was similar to previous studies except increased weight loss in our population. ESR values were also matching the previous studies. Our MRI findings were similar to previous studies with a high incidence of T1 hypointensity, T2/ STIR hyperintensity and contrast enhancement in involved vertebral bodies or discs. We acknowledge the drawbacks in our study which include lack of histopathological analysis, examination by single observer and lack of blinding. On statistical analysis we found a statistically significant correlation between patients presenting with low back ache and positive MRI findings. Similar correlation was also present between raised ESR and positive MRI findings. No correlation was found between age/ gender/ other clinical symptoms and MRI findings.

On comparing DW MRI with CE MRI we found it to be highly specific for Pott's spine but suffering from poor sensitivity. Further studies are required to assess the role of DWI in Pott's spine.

Thus, the CE MRI continues to be the gold standard for imaging diagnosis of Pott's spine. However, DWI may emerge as a useful adjunct to confirm the diagnosis in equivocal cases after further research on its utility.

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