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Ankylosing Spondylitis and Axial Spa : Xray Grading vs MR assessment

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ABSTRACT:

Ankylosing spondylitis and other seronegative arthropathies are conventionally diagnosed using clinical criteria and xrays of SI joints and spine. The introduction of MRI particularly the STIR sequence has revolutionised the diagnosis and assessment of activity of the diseease. But as inferred from this study MRI is not infallible and xrays maybe superior to MRI to identify the structural changes and low dose CT maybe a good alternative to even MRI to establish the Diagnosis.

INTRODUCTION

Seronegative spondyloarthropathy is a general term for a group of joint conditions that are not associated with rheumatoid factors or rheumatic nodules. Five subgroups of spondyloarthropathy are distinguished: 1) ankylosing spondylitis ,2)reactive arthropathy (eg, Reiter syndrome), 3)psoriatic arthropathy,4)arthropathy associated with inflammatory bowel disease(eg, Crohn disease or ulcerative colitis),and5) undifferentiated spondyloarthropathy. These conditions may have overlapping symptoms. The subtypes of spondyloarthropathy are usually distinguished on the basis of the patient's history and clinical findings (eg, history of urogenital tract infection in reactive arthropathy, psoriatic skin lesions in psoriatic arthropathy). Extraaxial involvement suchas uveitis, calcaneal enthesitis, or peripheral arthropathy occurs in all five subtypes but with different frequencies.

Imaging does not play a major role in differentiating between the subtypes of spondyloarthropathy because their imaging features are comparable, especially in early disease. One exception is undifferentiated spondyloarthropathy, which is diagnosed in cases with no definite radiologic signs of sacroiliitis. Another exception is psoriatic arthropathy, which is known to produce parasyndesmophytes,a form of bony outgrowth distinct from syndesmophytes. Also, spondylitis with bone marrow edema of the entire vertebra occurs more frequently in psoriatic arthropathy. All forms of spondyloarthropathy may ultimately develop into ankylosis in patients with longstanding disease.

MATERIALS AND METHODS

This was a cross sectional prospective observational study carried out in the Department of Radiodiagnosis and Imaging, And Department of Rheumatology of Skims. The Patients with clinical suspicion of having Axial spondyloarthropathy were included in the study (fufilling the clinical arm of Modified New York criteria) i.e Any inflammatory back pain,that does not resolve,within 3 months,with age of onset less than 45 yrs and after ruling out other common causes.Patients in whom MRI is contraindicated, deranged renal function and already on treatment with TNF alpha inhibitors were excluded.

Methodology:

Detailed History was taken from all patient.Detailed clinical examination was conducted by An experienced Rheumatologist.All Base line investigations (Complete Blood Count, Kidney Function Test, Electrolytes, Random Blood Sugar Levels, Coagulogram, Routine Urine Examination, Ultrasonography of Abdomen, Chest Radiography, Electrocardiography) were done.A proper consent was taken from all Patients.First the patients underwent X-ray of B/L SI joints and spine, and sacroilitis and any other features when found were documented and graded. Irrespective of xray findings Patients underwent MRI spine and SI joints on 1.5 Tesla MRI (Magnetom Vision Siemens, Erlangen, Germany).

MR-IMAGING PROTOCOL

MR imaging protocol for evaluating the spinal column comprised a sagittal T1-weighted turbo spin-echo sequence and a sagittal short inversion time inversion-recovery (STIR) sequence with an image matrix of 512 pixels acquired at 1.5 T. Administration of a paramagnetic contrast medium such as gadopentetate dimeglumine was required in spinal MR imaging only in specific cases. Enthesitis was better visualized on contrast material–enhanced MR images. If a patient's history suggested septic spondylodiskitis or abscess formation, contrast medium administration was done to distinguish between florid infection and necrotic tissue,to assess the extent of the soft-tissue mass, and to show disk enhancement. When a contrast medium was given, images were acquired with a fat-suppressed, T1-weighted turbo spin-echo sequence. Depending on the findings and their location, a supplementary transverse STIR sequence was used, particularly to visualize the costovertebral junctions.

Analysis: Analysis of all MR images was performed with a picture archiving and communications system (PACS) workstation monitor by an experienced radiologist

Statistical analysis- was performed with SPSS v21

Results

he study entitled "ANKYLOSING SPONDYLITIS CONVENTIONAL RADIOGRAPHYvs$_{T}$MRI" was carried out in department of Radiodiagnosis & Imaging SKIMS Srinagar from September 2019 for period of 2years .During this period 52 cases were enrolled with clinical suspicion of axial spa referred from Dept. of Rheumatology.

Table 1: Shows distribution of patients with respect to age.

Age Group		No of patients
VALID	<25	6
	25-35	18
	35-45	28
TOTAL		52

Table 2: Shows distribution of patients with respect to Gender.

GENDER		
VALID	MALES	37
	FEMALE	15
	TOTAL	52

Table 3: Xray SI Joint Findings using Basri

BasriGrade	No of patients
0	9
1	6
2	15
3	12
4	10

Total 52

Table 4: Xray SI Joint findings compared with final diagnosis:

Note: Final diagnosis based on clinical assesment by an experienced rheumatologist+HLA B27 positivity / f/u.Basri greater or equal to 2 taken as positive

Basri	True positive	True Negative	False Positive	False Negative
Basri >/= 2	31	5	6	10

Table 5: Xray findings in Spine

Findings	No. of Patients
Romanus Lesion	9
Anderson Lesion	4
Syndesmophytes	7
Enthesitis	0

Table 6: Comparison of Xray spine findings with final diagnosis:

	Findings
TP	22
TN	8
FP	3
FN	9

Table 7 : Comparison of MRI spine findings with final diagnosis:

Findings	No of patients
Romanus Lesion	11
Anderson Lesion	5
Syndesmophytes	4
Enthesitis	4

Table 8: Comparison of MRI Spine changes with final diagnosis:

	Findings
TP	27
TN	9
FP	2
FN	14

Table 9: Comparison of STIR Hypersensitivity with Final Diagnosis:
Bone Marrow Edema appaears as STIR Hyperintensity in subchondral bone in SI joints

TP	37
TN	7
FP	4
FN	4
Total:	52

Table 10:MRI T1 changes of patients in SI joints:

T1 changes	No of patients
Sclerosis	31
Erosions	27
Bony Ankylosis	8
Fat Deposition	13

Total patients that showed T1 changes: 34

Table 11:Comparison of T1 Changes with Final diagnosis:

TP	32
TN	8
FP	3
FN	9

Table 12: Comparison of Xray SI joints with MRI STIR Hyperintensity:

	Xray	MRI-STIR
Sensitivity	75.61	90.24%
Specificity	45.45%	63.63%
PPV	83.78%	90%
NPV	33.33%	64%%

Table 13: Comparison of Xray SI joint with MRI T1 changes:

	Xray	MRI T1 changes
Sensitivity	75.61	78.05%
Specificity	45.45%	72.73%
PPV	83.78%	91.43%
NPV	33.33%	47.06%

Table 14 : Comparison of Xray spine findings with MRI Spine findings:

	Xray	MRI
Sensitivity	53.6%	65.8%
Specificity	50%	81.82%
PPV	88%	93.1%
NPV	13.6%	40%

Table 15:Overall comparison of Xray vs MRI

Modality	Xray	Mri
TP	31	38
TN	5	7
FP	6	4
FN	10	3

Modality	Xray	MRI
Sensitivity	75.61	92.68
Specificity	45.45%	63.64%
PPV	83.78%	90.48%
NPV	33.33%	70%

Additional TABLE 16: LDCT findings in few patients:

Though originally not part of the study Low dose CT scanning was done in a few patients on the recommendations of the experienced reading radiologist to achieve final diagnosis. Proper informed consent regarding radiation effects and safety was taken from the patient. LDCT was only done in patients who had a Basri score of less than 2. Results were as follows.

9 of the patients with a basri score of < 2 underwent LDCT whose results are as follows:

TABLE 16: LDCT findings in few patients:

LDCT grade	No of patients
0	3
1	2
2	4
3	0
4	0

IMAGES:

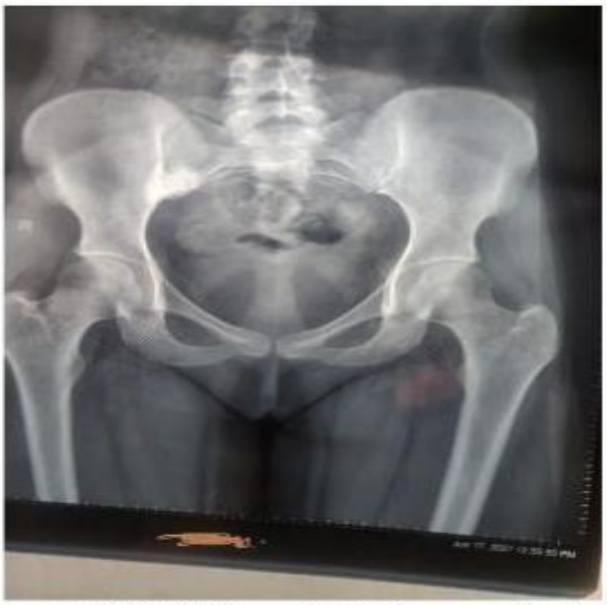
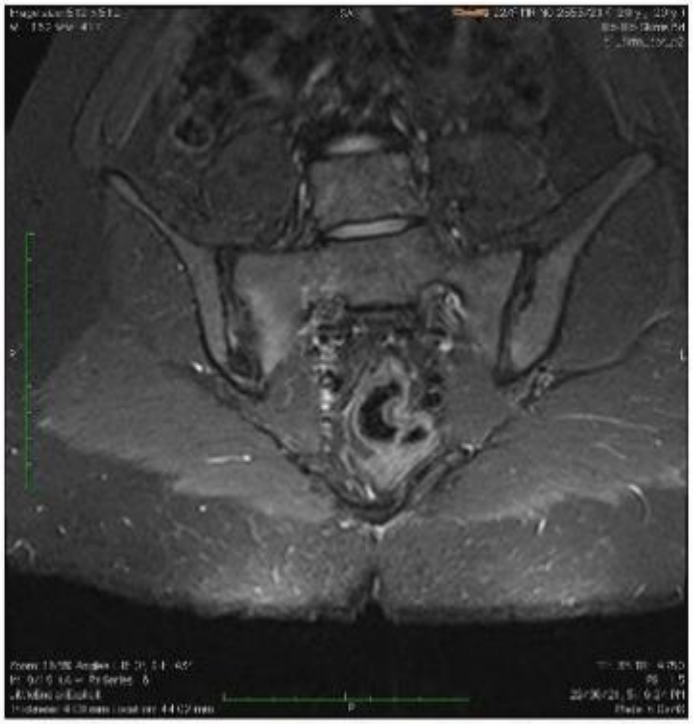
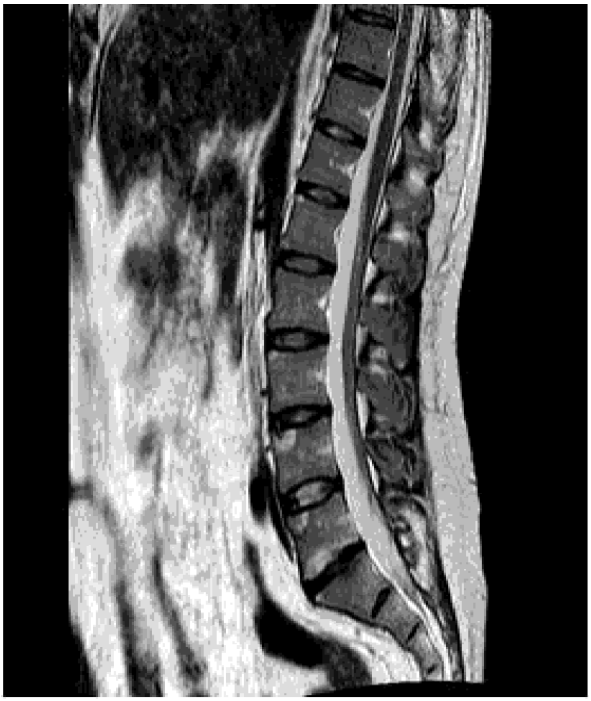


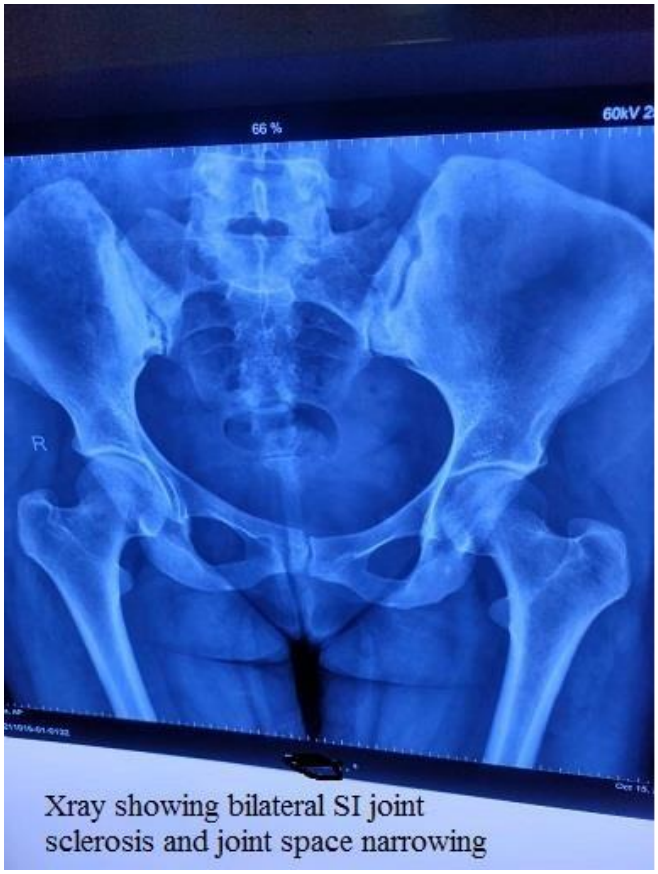
Image 1: BASRI grade 3 changes in rt si joint and grade 2 changes in left SI joint



STIR Image revealing hyperintensity in Rt SI joint s/o Bone Marrow Edema



IDU T2 weighted image res ealing anterior spondylitis or romanus lesion



DISCUSSION:

The use of Xray SI joint alone revealed a sensitivity of 83 % in the diagnosis of Axial Spa, with a specificity of 65%. MRI SI joint particularly the STIR sequence revealed a sensitivity approaching that of 100% in the diagnosis of Axial Spa($p<0.05$). This reveals that MRI SI joint particularly the STIR sequence is extremely sensitive in detection of Bone marrow edema/inflammation at SI joints. However,such findings must be taken with a grain of salt as comparison of specificities reveals that with the use of STIR MRI sequence the specificity falls to 45 %. This is likely because bone marrow edema/ inflammation of SI joints may be causedby a variety of causes leading to higher rates of false positives.

Similar results were obtained by Torsten Diekoff, and Iris Ished et al in 2021 who reported that XRay showed lower sensitivity (66.3%) than MRI(82.0%).Rudwaleit M, van der Heijde D in 2009 reported sensitivity and specificity of Xray close to 82.9 and 84.4% while Bone oedema was found in up to 90% of patients with SpA by Chiowchanwisawakit P, Lambert RG et al.Close agreement with our study was found by Chary-Valckenaere et al. in 2011 who reported that MRI sacroiliitis combined with at least one clinical criterion is 97.2% sensitive for diagnosis of Axial Spa.
The low specificity of STIR MRI was also confirmed by Weber U, Lambert et al who found that Healthy controls can have isolated foci of hyperintensity on STIR (bone pseudo-oedema) with a frequency close to 30%.Varkas G, de Hooge Malso concluded that bone marrow oedema findings could be seen in in SIJoints of Belgian military recruits, in 23% and 36% before and 6 weeks after intensive physical training, respectively, confirming the low specificity of this finding in Axial Spa. Also in 2009, Marzo-Ortega et al reported a high prevalence of bone marrow oedema in up to 6/22 (27%) in a control sample of healthy volunteers and patients with mechanical back pain.

Our study is complimented by Lusi Ye et al concluded that MRI-BMO had the highest sensitivity for nr-axSpA (88%), but had lower specificity (67%)
On comparison of xray SI joint with T1 sequences, T1 sequences showed a sensitivity of 75 % which waslower than that of plain xray(83%)($p<0.05$). This is attributed to poor visualisation of cortical bone by MRI and subsequent failure of MRI in detecting the very early structural lesions and changes. However ankylosis and fatty change was easily appreciable on MRI T1 weighted images. The result of this comparison shows that Xray may have equal sensitivity and in some cases may even be better in depicting the structural changes of SI joints in axial SpA.
To our knowledge this is the first study that compares conventional radiography directly with T1 sequences and not MRI as a whole. Thus the results of this data may need to be validated with further studies having larger sample size.
Imaging of spine revealed that MRI was much better in depicting the lesions of spine including romanus lesions, andersons lesions, and squaring of vertebrae with MRI having a sensitivity of 66 % and specificity of 82% as compared to that of plain xray which showed a sensitivity of 53% and a specificity of only 50 %.(p value <0.05). Of particular note was enthesitis, the inflammation of the insertion of tendons and ligaments which in our study was detected by MRI in 4 patients and was not detected by xray in any case.

However lesions such as syndesmophytes were better picked up by xray, and MRI was not sensitive enough to detect cases of new bone formation which can be attributed to the inability of MRI to visualise bone properly due to a lack of mobile protons.J Braun, X Baraliakos concluded that the x ray showed that 16/35 (44.3%), 17/35 (47.1%), and 15/28 (41.6%) patients had definite involvement of the cervical spine (CS), thoracic spine (TS), and lumbar spine (LS), respectively whereas The MRI showed that 19/36 (52.8%), 26/36 (68.3%), and 19/35 (54.7%) patients had definite involvement of the CS, TS, and LS, respectively. These results are very similar to our results. A. N. Bennett et al observed that Romanus lesions were the most frequently observed lesion(n= 297) and were found with a sensitivity of 67 % on MRI and that their was high diagnostic utility of MRI in axial SpA, with severe or multiple RLs evident on MRI being characteristic in younger patients. A study performed by Torsten Diekhoff et al who showed that CT had higher sensitivity and specificity than xray(sensitivity 76% vs 66%, specificity 97% vs 67%) They even showed a higher specificity of CT than MRI (97% vs 66%).

Conclusion

MRI particularly the STIR sequence is very sensitive in detecting the early changes of Bone Marrow Edema/Inflammation in cases of axial spa, however interpretation of such a finding must be made cautiously as False positive cases are not rare. X-ray is sufficient and some times superior to MRI in depicting the structural changes of SI joints in axial Spa.MRI is generally better in depicting the spine changes in Axial Spa, except for syndesmophytes which are better appreciated on Xray.Thus MRI and xray are together helpful in making the right diagnosis and one cannot exclude the other. LDCT may be better in detecting the changes associated with Axial Spa in SI joints, however more extensive study in this regard is needed to validate this.

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