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Original Article

Internal Medicine Section

Correlation between Ankylosing Spondylitis Disease Activity Score and MRI Scoring in Patients with Ankylosing Spondylitis: A Cross-sectional Study

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ABSTRACT

Introduction: Ankylosing Spondylitis (AS) is an inflammatory disorder of unknown cause that primarily affects the axial skeleton, peripheral joints, and extra-articular structures. Typically, the condition starts in the second or third decade. Lower back pain lasting longer than three months, morning stiffness lasting more than 30 minutes, relieved by daily activities, are signs of disease onset.

Aim: To establish a correlation between disease severity score Ankylosing Spondylitis Disease Activity Score (ASDAS) and Magnetic Resonance Imaging (MRI) scoring in patients with AS.

Materials and Methods: This cross-sectional study was conducted on 66 patients attending the Medicine Emergency/Outpatient Department (OPD)/ward of ESIPGIMSR and ESI Hospital, Basaidarapur, New Delhi, India, who were diagonsed with AS based on the modified New York Criteria. Clinical assessments included ASDAS based on Erythrocyte Sedimentation Rate (ESR) and C-reactive Protein (CRP), while MRI disease activity scores were determined using the Spondyloarthritis Research Consortium of Canada (SPARCC) MRI scoring. The sample size was calculated with a coefficient limit of 10% and a confidence level of 95%. Data analysis was performed using Statistical Packages for Social Sciences (SPSS) version 21.0, a widely used statistical computing and graphics tool. Pearson's correlation coefficients were computed to explore relationships between variables, including age, disease duration, ASDAS-ESR, and MRI changes.

Results: In present study, a total of 66 patients were included, out of which 51 (77.3%) were males and 15 (22.7%) were females. The age group of patients included in present study was 33 years to 44 years with a mean of 37.96 years. In present study, the disease duration ranged from a minimum of two years to a maximum of 10 years with a mean of 5.4 years. The mean ASDAS CRP was 3.687 (minimum-2.80, maximum-4.60), and the disease activity as assessed by MRI score (SPARCC) had a minimum value of 8.85 and a maximum value of 26.2 with a mean of 16.359. In present study, the X-ray grading of sacroiliitis revealed that 19.7% of the subjects were classified as Grade-2, 60.6% as Grade-3, and 19.7% as Grade-4.

Conclusion: The clinical disease activity index may not always reflect active inflammation, which is detectable by MRI. Incorporating MRI into diagnostic and treatment strategies for AS is crucial for the accurate assessment of disease severity and better patient outcomes.

Keywords: Inflammation, Magnetic resonance imaging, Sacroiliitis, Spondyloarthritis

INTRODUCTION

Ankylosing Spondylitis (AS) is an inflammatory disorder that primarily affects the axial skeleton, peripheral joints, and extra-articular structures. It typically starts in the second or third decade [1] and is characterised by lower back pain lasting longer than three months, morning stiffness lasting more than 30 minutes, and relief after daily activities [2]. Spondylarthritis (SpA) is strongly correlated genetically and mainly affects the spine and Sacroiliac Joints (SIJ). Joint rigidity and fusion occur as the condition progresses. About 70-90% of AS patients have positive Human Leucocyte Antigen B-27 (HLA B-27) results, and environmental factors like *Salmonella*, *E. coli,* and *Klebsiella* may contribute to the disease development [3,4].

The incidence and prevalence of AS vary. It ranges from 0.1% to 1.4%, respectively [5]. Men are three times more likely to be affected than women. Early warning signs include SIJ discomfort and inflammation. Symptoms typically appear in people under the age of 45 [6] and include lower back pain lasting longer than 90 days, morning stiffness lasting longer than 30 minutes, and definite SIJ involvement confirmed by radiographic examination [7]. While AS has immune-mediated pathogenesis, there is little direct evidence of antigen-specific autoimmunity. Therapeutic suppression of tumour necrosis factor-alpha or interleukin-17A significantly affects the disease, highlighting the importance of these cytokines in the immunopathogenesis of AS [8,9]. Extra-articular symptoms of AS include acute anterior uveitis, which affects upto 40% of patients, and intestinal inflammation [10], which may occur in up to 60% of individuals. Lung involvement can lead to upper lobe fibrosis, and there is a higher risk of skin and cardiac diseases in a smaller percentage of patients [11].

Both Computed Tomography (CT) and MRI can be used for AS assessment, but MRI is more sensitive in detecting early inflammatory changes in the spine and SIJs. The ASAS (Assessment of Spondyloarthritis International Society Classification Criteria) has modified its diagnostic criteria to include active inflammation on MRI in addition to clinical spondyloarthropathy characteristics and blood tests [12].

The primary objective of present study is to investigate the relationship between clinical scores and MRI disease activity scores, particularly concerning the spine and SIJs. There is a lack of data regarding the importance of ASDAS scoring in clinical diagnosis correlating with MRI scoring in Indian literature. After an extensive search in the National Medical Library and internet sources like PubMed and Google Scholar, present study was planned to assess the correlation between disease severity score ASDAS and MRI scoring in patients with AS. The present study aimed to explore the correlation between ankylosing spondylitis clinical disease activity score and magnetic resonance findings in AS patients.

MATERIALS AND METHODS

The present study was a cross-sectional design done from December 2020 to April 2022 with patients attending the medicine emergency, medicine ward and out patient department of ESIPGIMSR and ESI Hospital, Basaidarapur, New Delhi, India, who were diagnosed with AS. These patients were included in the study after taking due clearance from the Institutional Ethics Committee and scientific committee, and informed consent was taken from the patients for inclusion in the study. Ethical approval was obtained from the Institutional Ethical Committee, ESI--postgraduate Institute of Medical Sciences and Research (DM(A)H-19/14/17/IEC/2021-PGIMSR to safeguard participant rights and welfare.

Sample size calculation: A sample size of 66 patients was calculated with a coefficient limit of 10% and confidence level of 95%.

Inclusion criteria: Patients in the age group 15-45 years were included in the study after due consent, who presented with a history of lower back pain lasting more than 3 months, morning stiffness lasting more than 30 minutes, and definite radiographic sacroiliitis changes for AS.

Exclusion criteria: Patients with systemic lupus erythematosus, rheumatoid arthritis, metallic implants, MR-incompatible prosthetic heart valves, orthopaedic surgery, and other implants were excluded from the study.

Study Procedure

A detailed history was taken, including the history of the presenting illness, past history, history of chronic illness, personal history, family history, and previous surgical morbidities. A thorough clinical examination was carried out, including general physical examination and systemic examination.

Disease severity scoring was carried out by using the standard scoring system ASDAS and MRI of the SIJ and spine at the time of diagnosis, and the correlation between the two was established.

Participants were diagnosed using the disease activity, and severity was assessed using the Ankylosing Spondylitis Disease Activity Score (ASDAS) scoring system. The grading is as follows: Grade-0: normal, Grade-1: suspicious changes, Grade-2: minimal definite changes (circumscribed areas with erosions or sclerosis with no changes of the sacroiliac joint space), Grade-3: distinctive changes (sclerosis, changes of joint space-decreased or widened, partial ankylosis), Grade-4: ankylosis.

Additionally, MRI scoring based on the Modified New York criteria for the diagnosis of AS was performed. The ASDAS scores and MRI scores were compared to evaluate the correlation and agreement between the two scoring systems [13].

The formula used to calculate ASDAS-CRP is: ASDAS-CRP = 0.12×back pain+0.06×duration of morning stiffness+0.11×patient global+0.07×peripheral pain/swelling+0.58×Ln(CRP+1). The formula used to calculate ASDAS-ESR is: ASDAS-ESR = 0.08×back pain+0.07×duration of morning stiffness+0.11×patient global+0.09×peripheral pain/swelling+0.29×√(ESR).

Grading is done on a numerical basis from 0 to 10 for parameters assessed: back pain, patient global assessment, duration of morning stiffness, and peripheral pain/swelling. If, the grading is <1.3, it is considered to be between "inactive disease" and "moderate disease activity"; <2.1 between "moderate disease activity" and "high disease activity"; and >3.5 between "high disease activity" and "very high disease activity.

The cut-offs for improvement scores were: a change ≥1.1 units for "clinically important improvement" and a change ≥2.0 units for "major improvement.

Grading of the severity of changes in the SIJ using X-rays was utilised during the study: Grade 0-normal, Grade 1-suspicious changes, Grade 2-minimal definite changes with circumscribed areas showing erosions or sclerosis but no changes in the SIJ space, Grade 3-distinctive changes including sclerosis, changes in joint space (either decreased or widened), and partial ankylosis, Grade 4-ankylosis [14].

For MRI disease activity scoring, the Spondyloarthritis Research Consortium of Canada's MRI index (SPARCC MRI scoring) [15] was used to assess inflammation in the SIJ. Thorough evaluation was performed based on predefined inclusion and exclusion criteria [16]. In present study, each SI joint was divided into four quadrants: upper iliac, lower iliac, upper sacrum, and lower sacrum. The presence of increased signal in each quadrant was recorded, with a maximum score of eight for two SI joints in each coronal slice. The maximum score for six coronal slices is 48. A score of one is assigned if "intense" signal is seen in any quadrant of an SI joint on a single slice. Therefore, the maximum score per slice is two, and for six slices, it is 12. Pre- and post-treatment MR images were scored together with the observer blinded to the time sequence, resulting in a total sequence score of 72 (bone marrow oedema-48, intense oedema-12, deep oedema-12).

STATISTICAL ANALYSIS

Results were expressed as mean±Standard Deviation (SD) or number and percentage, as appropriate, for qualitative and quantitative variables. Data analysis was performed using SPSS version 21.0, a widely used statistical computing and graphics tool. Pearson correlation coefficients were computed to explore relationships between variables, including age, disease duration, ASDAS-ESR, and MRI.

RESULTS

A total of 66 subjects were analysed, out of which 15 (22.7%) were females and 51 (77.3%) were males. Young individuals were most commonly affected by AS, as the mean age of the patients in the study was 37.969±3.309 years. The mean duration of the disease was 5.469 ± 2.367 years, with a minimum duration of two years and a maximum duration of 10 years for AS. The mean ASDAS CRP value was 3.687 (with a minimum of 2.80 and a maximum of 4.60). The mean ASDAS ESR value was 4.089 (with a minimum of 3.30 and a maximum of 4.95), and mean value of SPARCC MRI value was 16.353 (with a minimum of 8.85 and a maximum of 26.2) as depicted in [Table/Fig-1].

Parameters	Range	Mean±SD
Age (years)	33-44	37.96±3.309
Disease duration (years)	2-10	5.469±2.367
ASDAS-CRP	2.80-4.60	3.687±0.528
ASDAS-ESR	3.30-4.95	4.089±0.478
SPARCC MRI scoring	8.85-26.2	16.359±5.5785

[Table/Fig-1]: Composite table depicting all parameters.

The age of all patients was correlated with the MRI score using Pearson correlation. Age was not found to be statistically significantly associated with MRI severity. A weak correlation was found between MRI severity and the age of patients in the study. The disease duration of all patients was correlated with the MRI score using Pearson correlation. Duration was found to be weakly correlated with MRI severity. There was a weak positive correlation between ASDAS-ESR and MRI score (SPARCC), suggesting a statistically significant association. In contrast, ASDAS-CRP also showed a weak positive correlation with the MRI score (SPARCC), which was not statistically significant according to [Table/Fig-2].

The X-ray grading of sacroiliitis revealed that 19.7% of the subjects were classified as Grade-2, 60.6% as Grade-3, and 19.7% as Grade-4 according to [Table/Fig-3].

Parameters	MRI score	
	r-value	p-value
Age	-0.011	0.930
Disease duration	0.011	0.932
ASDAS-ESR	0.260	0.035
ASDAS-CRP	0.192	0.122

[Table/Fig-2]: Correlation of age, disease duration, ASDAS-ESR, ASDAS-CRP with MRI score (SPARCC).

X-ray grading of sacroiliitis in Ankylosing Spondylitis (AS)	Number of study subjects n (%)
Grade-2	13 (19.7%)
Grade-3	40 (60.6%)
Grade-4	13 (19.7%)

[Table/Fig-3]: Distribution of study subjects as per X-ray grading of sacro-ilitis in Ankylosing Spondylitis (AS).

DISCUSSION

The axial spondyloarthritis (AS) is a chronic inflammatory condition that primarily affects the spine and SIJs. It is most commonly observed in young individuals, typically starting in late adolescence or early adulthood. To diagnose and monitor present condition, various imaging methods such as radiography, CT, and MRI are employed [17]. Among these, MRI stands out as the most sensitive imaging modality for detecting early inflammatory changes in SIJs and the spine. This makes it an essential tool for the early diagnosis, disease activity monitoring, and treatment of patients with AS [18]. The present study aimed to explore the correlation between the clinical Ankylosing Spondylitis Disease Activity Score (ASDAS) and the MRI scores in patients with AS, with the main goal of understanding how the clinical assessment relates to the MRI findings [19-21].

The current study included 66 subjects with an average age of 37.969±3.309 years. Out of the 66 patients, the majority (77.3%) were male and 22.7% were female, diagnosed with AS. The analysis revealed a weak negative correlation (r=-0.011) between the MRI score and age, but this association was not statistically significant (p=0.930). These findings suggest that age does not significantly affect MRI results in patients with AS. Comparing the present study's results with similar research, Lau HW et al., reported a mean age of 37±12 years, (47 males and 10 females), which were comparable to the study conducted at ESIC where there were 22.7% females and 77.3% male subjects [22]. Another study by Proft F et al., also observed a similar average age of 38.4 years among their study respondents (63.3% males), which was comparable to the study conducted at ESIC. It is worth noting that AS typically manifests in individuals during the second or third decades of life [23].

In the current study, the X-ray grading of sacroiliitis revealed that 19.7% of the subjects were classified as Grade-2, 60.6% as Grade-3, and 19.7% as Grade-4. This pattern of higher grades suggests that the disease may have progressed over a few years before the patients presented for evaluation, as AS is known for its slow progression. Therefore, by the time patients seek medical care, the disease may have reached a more advanced state, and this trend is similar to the study done by Cunha RN et al., [24,25].

The current study investigated the relationship between the MRI SPARCC score (a measure of inflammation on MRI) and disease duration. The analysis revealed a weak positive correlation (r=0.011) between these two factors; however, this correlation was not statistically significant (p=0.932). Similarly, Proft F et al., found that the mean disease duration was approximately 6.2 years [23]. Taken together, these findings suggest that disease duration may play a role in the severity of AS observed on X-ray grading, but it may not have a significant impact on the MRI SPARCC score.

In present study, the mean ASDAS-CRP score was calculated to be 3.687 ± 0.528. However, there was a weak positive correlation between the ASDAS-CRP and MRI SPARCC scores, which was not statistically significant. A study conducted by Lau HW et al., reported a similar mean ASDAS-CRP score of 3.7 [22], whereas another study by Proft F et al., found a lower mean ASDAS-CRP score of 2.1 [23]. It is worth noting that some studies have observed a positive correlation between ASDAS and MRI SPARCC scores, but this association may be limited by various factors [22]. One possible explanation for the limited association between clinical scoring systems such as ASDAS and MRI findings is that clinical scores are subjective evaluations based on patient experiences, and these experiences can vary based on factors such as pain perception, sensitivity, and tolerance, which may differ depending on demographics, age, and socioeconomic level [26]. Additionally, the MRI scores used in the study may not fully capture pain caused by inflammation in structures other than the SIJs and disco vertebral units, such as capsulitis or facet joint arthritis. This type of pain is more difficult to measure and merits additional investigation. Although the sample sizes of these studies were comparable to those of the present study, the variations in the results might be due to varying patient baseline characteristics. According to MacKay JW et al., there was no statistically significant relationship between MRI and clinical scores, such as ASDAS-ESR and ASDAS-CRP, in the context of AS [13]. MRI is considered advantageous for early diagnosis and monitoring of therapy because it provides more objective insights into current inflammation than clinical scores [27]. The use of MRI scoring systems offers several benefits, including quantitative evaluation of disease activity, repeatability, and reliability. Prior research has demonstrated that MRI disease activity scores can predict how AS responds to biological therapy in affected individuals.

In present study, despite a weak correlation between the MRI scores of the SIJs and those of the spine, additional MRI of the spine proved valuable in enhancing useful information for diagnosis, disease activity monitoring, and treatment guidance. While the MRI scores might represent short-term active inflammation, this information can be crucial for timely and appropriate treatment to prevent irreversible damage.

Limitation(s)

A key limitation of the study is the limited generalisability of the study findings, as the study was conducted in a tertiary care referral hospital and may represent serious cases in the spectrum of the disease.

CONCLUSION(S)

In patients with AS, the clinical disease activity index may not indicate active inflammation. MRI can detect these changes at an early stage, hence incorporating MRI in patients with AS helps in accurately assessing disease activity and severity. This is necessary for stratifying patients into different subgroups and developing targeted treatment plans for better patient outcomes. Further, research is needed to fully understand the relationship between clinical scores and MRI findings in AS.

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