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ORIGINAL RESEARCH

Evaluating the Role of Musculoskeletal Ultrasound in the Diagnosis and Management of Psoriatic Arthritis

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ABSTRACT

Aim: To evaluate the role of musculoskeletal ultrasound (MSUS) in the diagnosis and management of psoriatic arthritis (PsA), focusing on its utility in detecting inflammation, monitoring disease activity, and influencing therapeutic decisions.**Material and Methods:** A prospective, observational study was conducted involving 120 PsA patients diagnosed using the CASPAR criteria. All participants underwent a comprehensive clinical evaluation, including DAS28-CRP, Leeds Enthesitis Index (LEI), Psoriasis Area and Severity Index (PASI), and patient-reported outcomes such as VAS Pain and Global Health. High-resolution MSUS assessed 40 joints and entheses for synovial hypertrophy, effusion, power Doppler signals, enthesitis, enthesophytes, and calcifications. Findings were correlated with clinical and laboratory measures, and their impact on therapeutic decisions was analyzed.**Results:** The mean age of participants was 45.6 years, with 60% males. MSUS detected synovial hypertrophy in 81.67%, joint effusion in 74.17%, and power Doppler positivity in 53.33% of patients. Enthesitis was identified in 56.67%, with structural damage observed as enthesophytes (45.83%) and calcifications (28.33%). Subclinical inflammation was noted in 20% of cases for synovial involvement and 15.83% for enthesitis. MSUS findings led to medication adjustments in 35% of cases, initiation of biologics in 15%, and DMARD changes in 20%. Significant correlations were observed between MSUS findings and DAS28-CRP ($r = 0.62$) and LEI ($r = 0.58$).**Conclusion:** MSUS is a valuable tool for diagnosing and managing PsA, offering superior sensitivity in detecting subclinical inflammation and structural damage. Its integration into routine practice enhances diagnostic accuracy, facilitates early interventions, and supports personalized treatment strategies, improving patient outcomes.

Keywords: Psoriatic arthritis, musculoskeletal ultrasound, diagnosis, subclinical inflammation, disease management

INTRODUCTION

Psoriatic arthritis (PsA) is a chronic inflammatory disease characterized by joint inflammation, enthesitis, dactylitis, and axial involvement, commonly occurring in individuals with psoriasis. It is a heterogeneous disease with varying clinical manifestations, ranging from mild synovitis to severe joint deformities. PsA not only causes significant functional disability and impaired quality of life but is also associated with systemic inflammation and comorbidities such as cardiovascular diseases, metabolic syndrome, and mental health disorders. Early diagnosis and precise assessment of disease activity are critical to optimizing treatment and preventing irreversible joint damage.[1]Traditional methods for diagnosing and monitoring PsA, including clinical examination and laboratory testing, often lack the sensitivity to detect subclinical inflammation and structural changes in their early stages. Conventional radiography, while effective in identifying chronic joint damage, is limited in its ability to detect soft tissue abnormalities or early inflammatory changes. Consequently, the need for more sensitive imaging modalities has gained attention in the management of PsA.[2]Musculoskeletal ultrasound (MSUS) has emerged as a valuable imaging tool for the assessment of PsA. It is a non-invasive, cost-effective, and widely accessible modality that provides real-time visualization of joints, tendons, and entheses. MSUS allows for the

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detailed assessment of soft tissue abnormalities, including synovial hypertrophy, joint effusion, enthesitis, and tendon pathologies. Additionally, the use of power Doppler technology enables the detection of active inflammation by visualizing increased blood flow in inflamed tissues, which may be missed by clinical examination alone. This ability to detect subclinical inflammation has positioned MSUS as a critical tool in the early diagnosis and management of PsA.[3]The versatility of MSUS extends beyond its diagnostic capabilities. In clinical practice, it has become an essential tool for monitoring disease activity and guiding treatment decisions. MSUS findings often correlate with clinical measures of disease activity, providing an objective and quantitative assessment of inflammation. This correlation is particularly valuable in cases where clinical assessments may be inconclusive or where patients present with non-specific symptoms. Furthermore, MSUS has demonstrated utility in evaluating enthesitis, a hallmark feature of PsA that is often under-recognized using traditional diagnostic methods.[4]One of the key advantages of MSUS is its ability to detect subclinical disease activity. Studies have shown that MSUS can identify inflammation in asymptomatic joints and entheses, which may not be evident on clinical examination. This is particularly relevant in PsA, where subclinical inflammation can precede clinical manifestations and contribute to progressive joint damage. By identifying these early changes, MSUS enables timely intervention, potentially altering the course of the disease and improving long-term outcomes.Another important application of MSUS in PsA is its role in differentiating PsA from other inflammatory and degenerative joint conditions, such as rheumatoid arthritis and osteoarthritis. The ability to visualize specific patterns of inflammation and structural changes unique to PsA enhances diagnostic accuracy, especially in patients with overlapping symptoms or atypical presentations. Additionally, MSUS can be used to assess the efficacy of therapeutic interventions, providing valuable insights into treatment response and guiding adjustments to therapy as needed.[5]Despite its numerous advantages, the use of MSUS in PsA is not without challenges. Variability in operator expertise and interpretation of findings remains a limitation, underscoring the need for standardized training and scoring systems. Advances in technology, including the development of high-frequency probes and automated image analysis, may address some of these limitations and further enhance the utility of MSUS in clinical practice.[6]The integration of MSUS into routine care for PsA has the potential to revolutionize the management of the disease. By providing a more comprehensive assessment of disease activity and structural changes, MSUS facilitates personalized treatment approaches tailored to the specific needs of each patient. Moreover, its ability to detect subclinical inflammation and monitor therapeutic response aligns with the goals of treat-to-target strategies, which emphasize achieving and maintaining minimal disease activity or remission.[7,8]MSUS is an indispensable tool in the management of PsA, offering unparalleled insights into the inflammatory and structural aspects of the disease. Its utility extends from early diagnosis to treatment monitoring and optimization, making it a cornerstone of modern rheumatology practice. As the field continues to evolve, ongoing advancements in technology and standardization will further solidify the role of MSUS in improving outcomes for patients with PsA.

MATERIAL AND METHODS

This study was a prospective, observational study conducted to evaluate the utility of musculoskeletal ultrasound (MSUS) in the assessment and management of patients with psoriatic arthritis (PsA). Ethical approval was obtained from the Institutional Review Board, and all participants provided written informed consent prior to inclusion in the study.A total of 120 patients diagnosed with PsA according to the Classification Criteria for Psoriatic Arthritis (CASPAR) were included. Participants were recruited from the outpatient rheumatology clinic. The study population consisted of adult patients aged 18–75 years with varying disease durations and activity levels. Patients with other autoimmune conditions, active infections, or contraindications to MSUS were excluded.

Clinical Assessment

All participants underwent a comprehensive clinical evaluation to assess their demographic and disease-specific characteristics. Demographic data, including age, gender, body mass index (BMI), and disease duration, were recorded for each patient. Disease activity was measured using standardized tools such as the 28-joint Disease Activity Score with C-reactive protein (DAS28-CRP) to evaluate joint inflammation, the Leeds Enthesitis Index (LEI) to assess enthesitis, and the Psoriasis Area and Severity Index (PASI) for grading skin involvement. Additionally, a Visual Analog Scale (VAS) was used to capture patient-reported outcomes, including pain severity and overall health status. Laboratory investigations were conducted, with blood samples collected to measure inflammatory markers, including C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR), to provide further insights into systemic inflammation. This comprehensive evaluation provided a detailed profile of each participant's disease activity and overall health.

Ultrasound Examination

Musculoskeletal ultrasound was performed using a high-resolution ultrasound system equipped with linear probes (6–18 MHz) to ensure detailed imaging of joints and entheses. The assessments were

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conducted by two experienced sonographers who were blinded to the clinical data to maintain objectivity and ensure inter-observer reliability. A standardized protocol was followed during the evaluation. The ultrasound examination included a bilateral assessment of 40 joints, covering small joints of the hands and feet as well as major joints such as the knees, elbows, shoulders, and ankles. Enthesitis evaluation focused on common sites, including the Achilles tendon, plantar fascia, and the patellar and quadriceps tendon insertions.Joint effusion, synovial hypertrophy, and power Doppler signals were graded according to the OMERACT (Outcome Measures in Rheumatology) scoring system. Enthesitis was assessed based on specific ultrasound findings such as thickening, hypoechogenicity, enthesophytes, calcifications, and the presence of power Doppler activity. Static and dynamic images were meticulously documented for each evaluated site, providing a comprehensive record of findings. These ultrasound results were subsequently correlated with the clinical symptoms to enhance diagnostic accuracy and understanding of disease activity.The primary outcome measure was the agreement between MSUS findings and clinical assessment of joint inflammation and enthesitis. Secondary outcomes included the utility of MSUS in detecting subclinical disease activity and its impact on therapeutic decision-making.

Statistical Analysis

Clinical, laboratory, and ultrasound findings were recorded for all participants. Data were analyzed using SPSS software 25.0. Descriptive statistics were used to summarize the baseline characteristics of the cohort. The correlation between clinical disease activity indices and MSUS findings was assessed using Spearman's correlation coefficient. Inter-observer reliability was evaluated using Cohen's kappa coefficient for categorical variables and intraclass correlation coefficients (ICC) for continuous variables. A p-value <0.05 was considered statistically significant.

RESULTS

Baseline Characteristics of the Study Population (Table 1)

The study included 120 participants diagnosed with Psoriatic Arthritis (PsA) based on the CASPAR criteria. The mean age of participants was 45.6 ± 12.3 years, with a slight male predominance (72 males, 60.00%; 48 females, 40.00%). The average BMI was 27.8 ± 4.6 kg/m², suggesting a generally overweight population, consistent with PsA-associated metabolic comorbidities. The mean disease duration was 6.2 ± 3.8 years. Elevated markers of inflammation were evident, with mean C-reactive protein (CRP) levels at 8.4 ± 5.1 mg/L and erythrocyte sedimentation rate (ESR) at 22.7 ± 10.5 mm/hr, reflecting active disease in most participants.

Clinical Disease Activity Scores (Table 2)

The clinical evaluation of disease activity highlighted moderate to high levels of disease burden among participants. The mean DAS28-CRP score was 4.2 ± 1.3, with a range from 1.8 to 6.8, indicating active joint inflammation in the majority of patients. The Leeds Enthesitis Index (LEI) had a mean score of 2.1 ± 1.5 (range: 0–6), reflecting varying degrees of entheseal involvement. Skin involvement was moderate, with a mean Psoriasis Area and Severity Index (PASI) score of 7.4 ± 4.8 (range: 1.0–19.2). Patient-reported outcomes showed high levels of discomfort, with an average Visual Analog Scale (VAS) Pain score of 64.3 ± 15.7 and VAS Global Health score of 57.2 ± 18.6, indicating significant disease impact on quality of life.

Ultrasound Findings: Joints and Entheses (Table 3)

Musculoskeletal ultrasound (MSUS) findings revealed substantial subclinical and clinical inflammatory changes. Synovial hypertrophy was the most common finding, present in 98 cases (81.67%), followed by joint effusion in 89 cases (74.17%). Positive power Doppler signals, indicative of active inflammation, were observed in 64 cases (53.33%). Enthesitis was identified in 68 cases (56.67%), while structural damage such as enthesophytes and calcifications was seen in 55 cases (45.83%) and 34 cases (28.33%), respectively. These findings highlight the utility of ultrasound in identifying both active inflammation and structural changes in PsA.

Correlation Between Clinical and Ultrasound Findings (Table 4)

Significant correlations were observed between clinical measures and ultrasound findings. DAS28-CRP showed a strong positive correlation with power Doppler activity ($r = 0.62$, $p < 0.001$), indicating that ultrasound findings align well with systemic measures of joint inflammation. LEI was moderately correlated with ultrasound-detected enthesitis ($r = 0.58$, $p < 0.001$), reflecting concordance between clinical and imaging assessments of entheseal involvement. VAS Pain demonstrated a weaker but significant correlation with synovial hypertrophy on ultrasound ($r = 0.47$, $p = 0.002$), suggesting that pain perception partially reflects imaging findings.

Subclinical Findings Detected by Ultrasound (Table 5)

Ultrasound was particularly valuable in detecting subclinical inflammation. Synovial inflammation was identified in 24 cases (20.00%) that were clinically silent, while enthesitis was found in 19 cases (15.83%) without corresponding clinical signs. Positive power Doppler signals were observed in 12 cases (10.00%) of clinically asymptomatic joints. These findings underscore the sensitivity of MSUS in

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identifying subclinical disease activity, which may influence treatment decisions.

Impact of Ultrasound on Therapeutic Decisions (Table 6)

The integration of MSUS findings into clinical evaluation significantly influenced therapeutic decisions. Medication adjustments were made in 42 cases (35.00%) based on ultrasound findings. Biologics were initiated in 18 cases (15.00%) due to evidence of active disease detected by ultrasound. Disease-modifying antirheumatic drugs (DMARDs) were adjusted in 24 cases (20.00%), reflecting the role of MSUS in refining treatment strategies. These results highlight the impact of MSUS in optimizing disease management by providing detailed insights into inflammatory and structural changes.

Results

Table 1. Baseline Characteristics of the Study Population

Variable	Mean ± SD / n (%)
Age (years)	45.6 ± 12.3
Gender (Total)	
Male	72 (60.00%)
Female	48 (40.00%)
BMI (kg/m²)	27.8 ± 4.6
Disease duration (years)	6.2 ± 3.8
CRP (mg/L)	8.4 ± 5.1
ESR (mm/hr)	22.7 ± 10.5

Table 2. Clinical Disease Activity Scores

Assessment Tool	Mean ± SD	Range
DAS28-CRP	4.2 ± 1.3	1.8–6.8
Leeds Enthesitis Index (LEI)	2.1 ± 1.5	0–6
PASI Score	7.4 ± 4.8	1.0–19.2
VAS Pain (0–100)	64.3 ± 15.7	30–90
VAS Global Health (0–100)	57.2 ± 18.6	20–85

Table 3. Ultrasound Findings: Joints and Entheses

Ultrasound Finding	Positive Cases (n)	Percentage (%)
Synovial hypertrophy	98	81.67
Joint effusion	89	74.17
Positive power Doppler signal	64	53.33
Enthesitis	68	56.67
Enthesophytes	55	45.83
Calcifications	34	28.33

Table 4. Correlation Between Clinical and Ultrasound Findings

Clinical Measure	Ultrasound Correlation (r)	p-value
DAS28-CRP and power Doppler	0.62	<0.001
LEI and enthesitis on ultrasound	0.58	<0.001
VAS Pain and synovial hypertrophy	0.47	0.002

Table 5. Subclinical Findings Detected by Ultrasound

Parameter	Clinically Silent Cases (n)	Percentage (%)
Synovial inflammation (joints)	24	20.00
Enthesitis	19	15.83
Positive Doppler signal	12	10.00

Table 6. Impact of Ultrasound on Therapeutic Decisions

Therapeutic Adjustment	Number of Cases (n)	Percentage (%)
Change in medication	42	35.00
Initiation of biologics	18	15.00
Adjustment of DMARDs	24	20.00

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DISCUSSION

This study demonstrates the utility of musculoskeletal ultrasound (MSUS) in assessing and managing. The demographic profile of our cohort, with a mean age of 45.6 years and male predominance (60%), aligns with studies such as Anandarajah et al. (2017), which reported a similar mean age (46 years) and male proportion (58%) in a PsA cohort.[9]The BMI in our study (27.8 kg/m²) reflects the established association between PsA and obesity, as highlighted by Love et al. (2016), where PsA patients had a mean BMI of 28.2 kg/m².[10] Elevated inflammatory markers (CRP 8.4 mg/L, ESR 22.7 mm/hr) are consistent with studies reporting systemic inflammation in PsA patients, such as Eder et al. (2016), who reported mean CRP levels of 7.8 mg/L.[11]The mean DAS28-CRP score of 4.2 indicates moderate to high disease activity. Similar values have been reported in studies like Michelsen et al. (2016), where the mean DAS28-CRP score was 4.3.[12] Our findings for the Leeds Enthesitis Index (2.1) are comparable to Gisondi et al. (2019), who reported a mean LEI score of 2.3, reflecting moderate entheseal involvement.[13] PASI scores (mean 7.4) are consistent with PsA cohorts in studies by Mease et al. (2020), with similar ranges for skin involvement.[14] The high VAS Pain (64.3) and Global Health scores (57.2) confirm significant disease burden, paralleling findings by Eder et al. (2020).[11]

MSUS findings in our study revealed synovial hypertrophy in 81.67% of cases, joint effusion in 74.17%, and power Doppler positivity in 53.33%. These findings are higher compared to studies such as Naredo et al. (2018), where synovial hypertrophy and Doppler signals were detected in 70% and 45% of PsA patients, respectively.[15]The high prevalence in our study could reflect differences in disease activity or the use of high-resolution ultrasound technology. Structural changes, including enthesophytes (45.83%) and calcifications (28.33%), align with Schett et al. (2017), who reported similar rates of chronic damage in PsA patients.[16]

The correlation between DAS28-CRP and power Doppler activity ($r = 0.62$, $p < 0.001$) is consistent with Naredo et al. (2019), who reported a correlation coefficient of 0.58.[15] The moderate correlation between LEI and enthesitis ($r = 0.58$) supports findings by Gisondi et al. (2018), who also noted a moderate association ($r = 0.55$).[13] The weaker correlation between VAS Pain and synovial hypertrophy ($r = 0.47$) is in line with Mease et al. (2020), emphasizing that subjective pain does not always correlate with objective inflammation.[14]

Our study highlights the sensitivity of MSUS in detecting subclinical inflammation, identifying silent synovial inflammation in 20% of cases, enthesitis in 15.83%, and Doppler signals in 10%. These results align with Peluso et al. (2017), who reported subclinical joint and entheseal involvement in 18% and 14% of PsA patients, respectively. This underscores the added diagnostic value of MSUS, particularly in asymptomatic cases.[17]

MSUS findings influenced treatment changes in 35% of patients, with biologics initiated in 15% and DMARD adjustments in 20%. These results are comparable to studies like Mandl et al. (2019), where MSUS altered treatment plans in 30–40% of cases.[18] The ability of MSUS to guide therapeutic escalation is particularly valuable in cases with subclinical inflammation, as highlighted by Coates et al. (2021).[19]

CONCLUSION

This study highlights the utility of musculoskeletal ultrasound (MSUS) as a sensitive and reliable tool in the assessment and management of psoriatic arthritis (PsA). MSUS demonstrated significant correlations with clinical measures, identified subclinical inflammation in a substantial proportion of patients, and influenced therapeutic decisions in many cases. Its ability to detect both active inflammation and structural damage underscores its role in early diagnosis, disease monitoring, and personalized treatment strategies. Incorporating MSUS into routine clinical practice enhances diagnostic accuracy, optimizes therapeutic outcomes, and supports the treat-to-target approach in PsA management.

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