AJPMHS GLOBAL RESEARCH NETWORK

AMERICAN Journal of Pediatric Medicine and Health Sciences
Volume 3, Issue 1, 2025 ISSN (E): 2993-2149

Ultrasound Examination of Joints in Rheumatoid Arthritis

Salohiy Iqbolbegim Otabek qizi, Xamidov Obid Abduraxmanovich, Ametova Aliye Servetovna
Samarkand state medical university

Abstract: Rheumatoid Arthritis (RA) is an autoimmune rheumatic disease characterized by chronic erosive arthritis and systemic inflammatory changes in internal organs, leading to early disability and a reduced quality of life for patients. Modern imaging techniques have marked a new milestone not only in the diagnosis of diseases but also in the evaluation of their progression and outcome prediction. Joint ultrasound examination in RA is currently regarded as one of the most accessible and widely used instrumental diagnostic methods.

This review of international literature provides a detailed analysis of publications dedicated to ultrasound examination of joints in RA. The findings are contradictory and often question the informativeness of this method. The abundance of original publications reflects the significant interest of rheumatologists in this technique. The current perspectives on the pathogenetic rationale, diagnostic value, and prognostic potential of ultrasound use in RA patients are presented. Issues of diagnostic procedure methodology, the necessity of using power Doppler imaging, and modern semi-quantitative scales for assessing the severity of inflammation are discussed. Existing international guidelines for the use of ultrasound in RA are outlined, emphasizing the importance of this imaging modality.

Keywords: rheumatoid arthritis; power Doppler; grayscale; radiographic progression.

In the past decade, there has been significant progress in the development of ultrasound (US) diagnostic methods. New technologies used in modern medical devices allow for the assessment not only of structural features but also of dynamic imaging of objects, enabling the acquisition of additional information that can be crucial for detecting diseases at early and preclinical stages. The primary aim of this study is to summarize the results of numerous studies on ultrasound diagnostics in rheumatoid arthritis (RA) and to define the role of this instrumental method in disease monitoring.

Any medium, including body tissues, resists the propagation of ultrasound waves, i.e., it has varying acoustic impedance, which depends on its density and the velocity of sound waves passing through it. The higher these parameters, the greater the acoustic impedance. The ultrasound method allows for the measurement of the distance to the boundary between two materials with different densities based on the time it takes for the wave to reflect back from the interface. Modern medical ultrasound equipment is designed with capabilities that enable visualization of organs and tissues at a microscopic level. This has become possible through the use of high-frequency ultrasound probes, which provide higher image quality but reduce the depth of penetration. These probes are optimal for examining small joints of the hands and feet.

The two-dimensional grayscale mode (GS) provides information on the anatomy and morphological changes in the examined area. The power Doppler method (PD), on the other hand, visualizes blood flow within the studied structures. Unlike color Doppler imaging (CDI),

which conveys blood flow velocity and direction using a color spectrum, PD uses the amplitude of the Doppler signal to detect moving substances, such as red blood cells, which allows for the detection of minimal flow rates in the microvasculature of the synovium.

In 2005, OMERACT and the European League Against Rheumatism (EULAR) working group published consensus-based definitions of ultrasound features of various inflammatory processes in joints and periarticular tissues. Several approaches exist to assess the activity of inflammatory changes in joints, which are generally divided into B-mode sonography (or GS) and PD. GS reflects synovial proliferation—hypoechoic thickening of intra-articular tissues that are non-compressible by the probe. PD, conversely, directly visualizes blood flow in the inflamed synovial membrane, the thickening of which is identified through GS findings.

The pathogenesis of rheumatoid arthritis (RA) is based on a complex combination of genetically determined and acquired defects in immunoregulatory mechanisms that limit the pathological activation of the immune system in response to potentially pathogenic environmental factors. Of particular interest are pro-inflammatory cytokines, such as tumor necrosis factor-alpha (TNF-α) and interleukin-6 (IL-6), as well as IL-1, IL-12, IL-17, IL-23, and others, which are involved in the development of chronic inflammation leading to joint destruction. Angiogenesis factors also play an important role in this process.

Pro-inflammatory cytokines secreted by macrophages (TNF-α, IL-1, IL-6, IL-8, IL-18, and the macrophage migration inhibitory factor) play a central role in angiogenesis in RA, both through their direct effects on endothelial cells and indirectly by stimulating the production of pro-angiogenic factors by various cell types in the synovial membrane.

The development of RA is accompanied by hypertrophy of the synovial membrane with active vascularization. The increased blood flow in the synovial membrane, characteristic of chronic inflammation, is driven by vasodilation and angiogenesis.

For example, S. Alivernini et al. demonstrated differences in the levels of pro-inflammatory factors and angiogenesis factors in the synovial membrane of RA patients in remission, as well as in those with low and high disease activity. Similar findings were reported by J. Ramirez et al, who examined patients with RA in remission and in the active phase, using both morphological and ultrasound (US) evaluations. They observed an increase in lymphoid infiltration, mast cell count, fibroblasts, and pro-angiogenic factors, which was more pronounced in active RA and less so in patients with remission who exhibited inflammatory signs on ultrasound (US).

The processes of neoangiogenesis are closely linked to inflammation in RA, and this connection has been proven in many studies. Considering the pivotal role of these pathogenic mechanisms, studies have investigated the relationship between pro-inflammatory cytokines and angiogenesis markers, as well as US findings characterizing the state of the synovial membrane in RA .

A. Baillet et al. studied the relationship between IL-6 concentration prior to therapy, synovial membrane inflammation as determined by ultrasound, and joint destruction progression based on radiographic findings over a three-year observation period in RA patients. A positive correlation was found between baseline IL-6 levels, the number of swollen joints (SJCs), and ultrasound indicators of joint inflammation, including synovitis detected via power Doppler (PD) and grayscale (GS) ultrasound, and the presence of erosions. Interestingly, the concentration of C-reactive protein (CRP) correlated only with SJCs. These findings suggest that baseline IL-6 levels are a more sensitive biomarker of synovitis detected by ultrasound than CRP.

In the study by A. Fazaa et al., it was shown that the concentration of another pro-inflammatory cytokine, IL-17, which is involved in the development of inflammation and bone tissue destruction, in plasma can serve as a quantitative indicator of RA activity. In patients with varying disease duration and activity levels, a correlation was found between CRP levels and plasma IL-17 concentrations ($r=0.374$; $p=0.025$). The cumulative grayscale (GS) score and, to a

greater extent, the power Doppler (PD) score also correlated with the concentration of soluble IL-17 receptors with a high degree of reliability.

A connection was identified between ultrasound (US) indicators of inflammation and another promising biomarker for RA—chemokine CXCL13, whose concentration correlates with baseline clinical RA activity and the persistence of inflammation during therapy, regardless of baseline synovitis activity on ultrasound, changes in clinical activity, acute phase protein levels, or autoantibodies. Interestingly, PD and GS data also strongly correlate with the expression of messenger RNA (mRNA) genes of a wide range of pro-inflammatory and angiogenic mediators, including TNF-α, IL-1β, vascular endothelial growth factor (VEGF), IL-6, and angiopoietins 1 and 2 (ANG-1 and ANG-2), in the synovial tissue of RA patients, obtained via biopsy.

At the same time, S. Hernandez Diaz et al. did not find any correlation between the levels of biomarkers, including IL-1β, IL-10, IL-6, IL-5, IL-2, IL-4, IL-8, TNF-α, and IFN-γ, with US indicators of synovitis in 21 patients with RA in clinical remission.

In the study by J. Ramires et al., involving 55 patients with long-standing RA in clinical remission, a correlation was observed between the activity of subclinical synovitis detected via PD, DAS28-CRP, DAS28-ESR, SDAI, and levels of pro-angiogenic biomarkers such as MMP-2, TGF-β1, and ANG. However, no correlation was found between US indicators of synovitis and the concentrations of pro-inflammatory cytokines (TNF-α, IL-6, IL-8, IL-17A, IL-17F, IL-18, IL-20, IL-23, and IL-33).

The inconsistency of results can be attributed to the fact that most cytokines may exert either stimulatory or inhibitory effects on the production of other cytokines at different times. Depending on the predominance of certain functional groups of cytokines at a given moment, the activity of inflammation and the severity of clinical manifestations may vary. This suggests that evaluating the overall cytokine profile might provide more informative insights compared to assessing specific biomarkers alone.

Conflicting data have also been obtained regarding the relationship between ultrasound (US) findings and more accessible markers of inflammatory activity, such as erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP), as well as with composite indices of clinical activity.

Ultrasound is used as a tool to monitor disease activity in RA. Synovial hypertrophy with a grayscale (GS) score ≥2 and vascularization with a power Doppler (PD) score ≥1 can indicate inflammatory activity. Recent studies have detected vascularization corresponding to a PD score of 1 in normal joints, which suggests that a PD score ≥2 might be considered indicative of inflammation, though there is still no consensus on this issue.

Before 2005, comparisons of clinical and ultrasound markers of inflammation were conducted on mixed patient groups and were limited to a single large joint (often the knee) or several joints. The Doppler method for assessing blood flow, including spectral Doppler, was initially studied in small patient groups. Among the earliest and most significant large-scale studies are those by A. Scheel et al. , E. Naredo et al., and E. Filippucci et al., which initiated an ongoing discussion on the relationship between clinical and ultrasound indices.

The primary goal of A. Scheel et al.'s study was to compare quantitative and semi-quantitative ultrasound methods for assessing inflammation using GS mode, incorporating varying numbers of assessed regions into the indices. Among 46 RA patients with varying disease activity and duration, the authors found discrepancies between clinical and ultrasound joint assessments. The researchers highlighted the hand joints, particularly the proximal interphalangeal joints, where discrepancies reached 56.1%. They also noted a lack of correlation between the GS indices and ESR or CRP levels.

The study by E. Filippucci et al. was one of the first to use PD to evaluate the efficacy of biologic disease-modifying antirheumatic drugs (bDMARDs). The authors found only a trend

towards a correlation between PD results and DAS28 at the second week of follow-up, with no significant correlations at other time points.

E. Naredo et al. identified the strongest correlation between US and clinical findings. In 94 patients with long-standing active RA, they observed a correlation between the swollen joint count (SJC) and US indices of effusion, synovitis (GS), and PD. However, no correlation was found between US results and tender joint count (TJC). The most pronounced correlation was between the total swelling index of the examined joints and US indices ($r=0.65$; $p<0.01$), while moderate correlations were found between ESR, CRP, and US indices. The authors noted that this strong correlation was due to the large number of joints (60) included in the study, while discussing the feasibility of using an index with 28 joints for routine practice, where the correlation between clinical and US findings was the most significant.

The number of joints assessed remains one of the most debated parameters in evaluating RA patients, as it is limited by the time required for examination. A wide variety of indices exist, ranging from assessments of 5 to 78 joints, using both GS and PD.

V. Vlad et al. identified a strong correlation between ultrasound (US) indicators of inflammatory activity (PD) and clinical disease activity indices (CDAI and SDAI) in active, long-term RA patients, with the strongest correlation observed for CDAI. Y. Geng et al. also reported an association between PD data and swollen joint count (SJC), tender joint count (TJC), ESR, CRP, and disease activity indices, but only in patients in the active phase of the disease.

In another study, E. Naredo et al. examined 67 RA patients in clinical remission or with low disease activity and found correlations between PD and GS scores with DAS28 and SDAI (correlation coefficients ranging from 0.46 to 1.0). It was concluded that the more joints included in the index, the stronger the association with composite indices (DAS28 and SDAI). Their correlation with US-detected inflammation was weaker for large joints than for small ones. The strongest correlations for DAS28 and SDAI were with US indices involving metacarpophalangeal joints, wrist joints, ankle joints, and metatarsophalangeal joints. This index also demonstrated the highest sensitivity for detecting subclinical synovitis in both GS and PD modes in patients in remission by DAS28 and SDAI.

K. Ikeda et al. did not find a dependency between clinical and US parameters on RA activity: the correlation between PD and GS scores with DAS28-CRP and CDAI persisted throughout the treatment period with methotrexate (MTX) and biologic agents (adalimumab and tocilizumab).

Moderate correlations between DAS28-CRP and DAS28-ESR with GS and PD indices were reported by P. Zufferey et al. in a study of 563 RA patients. No significant changes in correlation coefficients were noted during therapy or with decreasing disease activity.

Original data from C. Dejaco et al. revealed a relationship between patient age and US and clinical parameters. The DAS28 index correlated with GS and PD findings; however, correlation coefficients were lower in patients with a later disease onset (0.39) than in those with an earlier onset (0.65).

The inconsistency in research findings may be due to differences between US and clinical assessments of joints, which are particularly evident at disease onset or in cases of low activity. As previously mentioned, inflammation of the synovial membrane in clinically intact joints, including in patients in remission by RA activity indices, can be detected using PD. This has increased interest in identifying US markers of inflammation in the absence

In recent algorithms and recommendations, ultrasound (US) methods are proposed for identifying "subclinical" synovitis, not only as a diagnostic marker but also as an argument for escalating therapy.

Detecting US markers of inflammation at the early stages of the disease allows for diagnosing polyarthritis at a "preclinical" stage and identifying predictors of potential relapse during initial

therapy. One of the key topics of discussion is the prognostic role of the initial severity of inflammation. E. Naredo et al. demonstrated that PD findings could predict clinical disease activity observed during subsequent follow-up visits. This relationship was confirmed by J. Freeston et al., who observed RA patients where the presence of "active" inflammation on PD served as a predictor of increased clinical disease activity during further follow-up. Similarly, V. Foltz et al. found that in RA patients in clinical remission or with low disease activity, the baseline severity of inflammation identified using PD had a prognostic role. Patients with more pronounced initial synovitis on PD experienced more frequent disease exacerbations. B. Saleem et al. categorized patients based on the presence of active inflammation identified by PD at week 48 of follow-up. However, their study did not confirm the prognostic value of disease activity indices over the entire observation period.

Structural joint damage is another potential factor for relapse. A recent study by S. Kawashiri et al. showed that 47.5% of patients experienced a relapse within 12 months after discontinuing therapy. It was found that bone erosions identified via US at the time of therapy discontinuation were the only predictor of disease relapse. Among RA patients with and without relapse, clinical characteristics, serological biomarkers, and US findings of synovitis did not differ significantly.

Table 4 summarizes the most significant studies on the frequency of disease relapse in patients who achieved clinical remission through biologic disease-modifying antirheumatic drugs (bDMARDs). The results of these studies are highly inconsistent.

In the study by D. Marks et al. remission by DAS28 and PD was maintained in 96% of patients at 3 months, 63% at 6 months, 37% at 9 months, and 34% at 18 months. In 88% of patients, DAS28 remained <3.2, and PD was ≤1 after 6 months. Signs of synovitis on PD were identified in 8 patients (25% of those with a relapse) who were in remission by DAS28. Factors contributing to sustained remission included RF negativity and a lower DAS28 value at the start of bDMARD therapy. Disease worsening was associated with persistent inflammation detected by US. V. Foltz et al. found that in RA patients in remission or with low disease activity, those with more pronounced active synovitis on PD experienced more frequent relapses.

Number of Patients	Observation Duration	Results
42	6 months	SS+/ED-: At 3 months, dose reduction led to flare-ups in 13 patients (30.9%). At 6 months after discontinuation of biological therapy: flare-ups in 3 patients (10.3%).
85	12 months	ED+ and radiological progression: OR=1.4 (95% CI 1.1–1.9). Low activity ED+ progression: OR=6.3 (95% CI 2.0–20.3). Flare-ups after 12 months in 26 patients (32.1%), 11 in remission, 15 with low activity.
42	6 months	SS+/ED+: AUC 0.76–0.73; p<0.001. Flare-ups in 16 patients after 6 months.
48	12 months	Group ED+/SS+: Relapse in 47.1%. Groups ED-/SS- and ED-/SS+: Relapse in 20%.
106	24 months	ED+ clinical remission cases increased: OR=12.8 (95% CI 1.6–103.5).
259	12 months	No predictors identified. Ultrasound results had no impact.
40	12 months	Erosions on US data increased flare risk: OR=8.35 (95% CI...).

Persistent subclinical inflammation leads not only to RA exacerbation but also to the progression of joint destruction.

One of the earliest studies on the use of US to predict radiographic progression was conducted by P.C. Taylor et al. In patients receiving conventional disease-modifying antirheumatic drugs

(cDMARDs) or cDMARDs combined with bDMARDs, a weak inverse correlation was observed between GS/PD findings and the Sharp score. In the placebo group, a significant direct relationship was found between baseline synovial thickness and hypervascularization on the one hand, and the overall radiographic progression score after 54 weeks on the other.

Several studies have demonstrated the progression of radiographic changes in joints during clinical remission, with ultrasound (US) indicators of inflammation (particularly power Doppler [PD] findings) serving as predictors of these changes. According to N. Tokai et al., in a study of 44 RA patients in clinical remission, persistent synovitis was observed in 59% of cases during US examinations, which was accompanied by worsening radiographic findings.

The progression of radiographic changes in patients with persistent synovitis detected via PD after 4 months of biologic therapy (bDMARDs) was demonstrated in a study by M. Dougados et al., involving 59 RA patients. Similarly, M. Hama et al. found a significant correlation between PD scores and changes in the Sharp index in RA patients treated with tocilizumab (a monoclonal antibody targeting the IL-6 receptor). This issue has also been analyzed in several studies by E. Naredo et al., which identified a relationship between radiographic progression and US inflammation parameters. One of these publications described strong correlations between PD findings and radiographic progression in patients with early RA receiving conventional disease-modifying antirheumatic drugs (cDMARDs) and bDMARDs. Another study demonstrated the potential use of PD to predict radiographic progression following the discontinuation of bDMARDs.

Number of Patients	Observation Duration	Results
24	12 months	SS score and Sharp score: r=0.69; p=0.02 (relationship identified). ED score and Sharp score: r=0.78; p=0.005 (relationship identified).
42	12 months	ED score and Sharp score: r=0.59–0.66; p<0.001 (relationship identified).
90	12 months	ED score and Sharp score: r=0.032; p<0.001 (relationship identified, OR=12.21; p<0.001).
31	50 weeks	ED score and Sharp score dynamics: no relationship identified. Persistence of synovitis by ED data and Sharp score dynamics: no relationship identified.
85	1 year	ED score and Sharp score: identified as a predictor of radiological progression (OR=1.4; p<0.001).
69	24 weeks	ED score and Sharp score: r=0.357; p=0.006 (relationship identified in the general cohort). Under MT treatment: r=0.7; p=0.004 (relationship identified).
59	2 years	ED score and SS score after 4 months of therapy identified as predictors of radiological progression over 2 years (OR=2.79; 95% CI 1.19–6.56; p=0.019).
127	2 years	ED score and Sharp erosion sum: predictive significance over 1 year (OR=1.51; 95% CI 1.01–2.28), over 2 years (OR=1.22; 95% CI 1.04–1.42). Sensitivity: 80%, specificity: 60%.
68	1 year	Sharp score and ED at 12 months: r=0.354; p=0.003 (relationship identified).
111	18 months	SS score and Sharp score: no relationship identified. ED score and Sharp score: no relationship identified.

According to K. Ikeda et al., radiographic progression was observed in 21 out of 57 patients (36.8%) over a 24-week follow-up period. A significant correlation was noted between changes

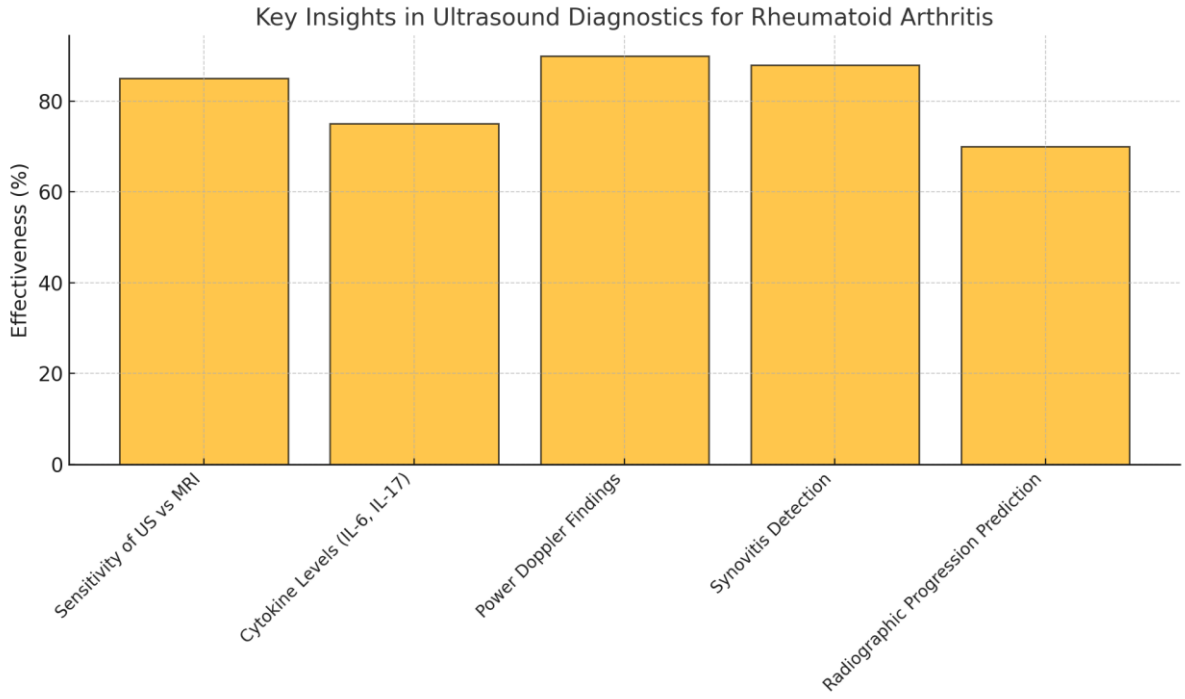
in the Sharp index and both DAS28-CRP and PD scores. Among patients receiving cDMARDs, PD scores correlated with changes in the Sharp index but not with CRP or DAS28. In contrast, during bDMARD therapy, no correlations between PD and activity indices were observed.

Other authors have also reported inconsistent findings regarding the relationship between synovitis severity on PD and RA outcomes. For instance, J. Fukae et al. investigated the association between active synovitis in hand joints and radiographic progression in patients with low clinical activity during bDMARD therapy. No significant correlation between US findings and the Sharp score was identified. However, a significant increase in destructive changes on radiography was observed with longer persistence of synovitis.

Other studies have confirmed the association between persistent US-detected synovitis activity and the progression of destructive joint changes. For example, H. Harman et al. identified a correlation between the Sharp score and PD findings after 12 months of follow-up in 68 patients.

As previously mentioned, the persistence of US-detected active synovitis leading to radiographic progression may be associated with elevated baseline levels of IL-6 and CRP, as observed in the study by A. Baillet.

It is hypothesized that longer observation periods may help establish a link between baseline indicators and subsequent progression. One such study was conducted by T. Funck-Brentano et al., who examined 127 patients with early arthritis. Over a two-year follow-up, PD was shown to predict radiographic progression. Moreover, the presence of erosions detected via US prior to treatment was identified as a predictor of worsening destructive changes one year after the start of therapy.



One of the reasons for inconsistent evaluations and discrepancies is considered to be the limited capabilities of each individual method (GS or PD). Currently, there are several scales or indices for assessing ultrasound (US)-detected joint changes, most of which use separate semi-quantitative evaluations of synovitis based on GS and PD findings. Recently, some authors have adopted the combined GLOESS (Global OMERACT-EULAR Synovitis Score), which also uses semi-quantitative evaluations of synovitis in both GS and PD modes.

The primary evaluation criterion is the degree of synovial vascularization as measured by PD. However, despite this apparent objectivity, studies using the GLOESS scale still produce inconsistent results. In the multicenter APPRAISE study, no association was found between US-

detected changes and disease activity indices, although a low correlation was observed with swollen joint count (SJC) and tender joint count (TJC).

Another reason for skepticism regarding US-detected changes, particularly those interpreted as subclinical synovitis, is the presence of similar findings in healthy volunteers. I. Padovano et al. examined 6,621 joints in 182 individuals and identified US-detected inflammation on GS in 406 joints (2.8%) and on PD in only 42 joints (0.7%). The majority of "false-positive" results were based on borderline (1-point) values in the semi-quantitative assessment of inflammation. Similar findings have been reported by other authors.

Another limiting factor is the lack of a universal evaluation scale, as the indices currently in use are not always comparable or equivalent. A further independent limiting factor is the resolution capacity of ultrasound probes, along with settings for signal processing and transformation, which is especially relevant when using PD. Despite these contradictions and the absence of large-scale multicenter studies, recommendations for US diagnostics in rheumatology were developed and proposed in 2013 based on numerous published works discussed in this review. However, these recommendations require further clarification in today's context.

At present, despite divergent opinions regarding the role of joint ultrasound in RA, ranging from support to outright dismissal, this method is actively used for diagnosis, dynamic disease monitoring, evaluation of treatment effectiveness, and outcome prediction. Further research in this area, especially large-scale multicenter studies involving extensive patient cohorts and the development of standardized examination protocols and equipment, could help identify new factors and more accurately define the role of ultrasound in the daily practice of rheumatologists.

Literature

1. Умаркулов, З. З. (2023). Визуализация Множественной Миеломы. Central Asian Journal of Medical and Natural Science, 4(3), 906-916.
2. Умаркулов, З. З. (2024). ПРЕИМУЩЕСТВА УЛЬТРАЗВУКОВОЙ ЭЛАСТОГРАФИИ ПРИ РАКЕ МОЛОЧНОЙ ЖЕЛЕЗЫ. THEORY AND ANALYTICAL ASPECTS OF RECENT RESEARCH, 3(26), 1-4.
3. Умаркулов, З. З., & Сувонов, З. К. (2023). СОВРЕМЕННЫЕ РАЗВИТИЯ ЛУЧЕВОЙ ДИАГНОСТИКИ. Journal the Coryphaeus of Science, 5(5), 237-251.
4. Умаркулов, З. З., & Хакимов, М. Б. (2023). Совместный Выпот Коленного Сустава: Возможности И Ограничения Узи. Diversity Research: Journal of Analysis and Trends, 1(3), 244-253.
5. Умаркулов, З. З., Хамидов, О. А., & Давлатов, С. С. (2023). Диапевтические методы в хирургическом лечении кистозных образований печени. Журнал гуманитарных и естественных наук, (6), 108-112.
6. Умаркулов, З. З., Хамидов, О. А., & Давлатов, С. С. (2023). Результаты анализа хирургического лечения больных кистозными образованиями печени. Журнал гуманитарных и естественных наук, (6), 133-137.
7. Умаркулов, З. З., Хамидов, О. А., Давлатов, С. С., & Усмонов, А. У. (2023). Роль диапевтических методов в диагностики и результатов хирургического лечения больных паразитарными и непаразитарными кистами печени. Журнал гепато-гастроэнтерологических исследований, 4(3)
8. Умаркулов, З. З., Хамидов, О. А., Давлатов, С. С., & Усмонов, А. У. (2023). Роль диапевтических методов в хирургическом лечении кистозных образований печени. Журнал гепато-гастроэнтерологических исследований, 4(3).
9. Умаркулов, З., Усмонов, А., Арзиев, А., & Атоева, М. (2023). МЕСТО ДИАПЕВТИЧЕСКИХ МЕТОДОВ В ХИРУРГИЧЕСКОМ ЛЕЧЕНИИ КИСТОЗНЫХ

ОБРАЗОВАНИЙ ПЕЧЕНИ. Development of pedagogical technologies in modern sciences, 2(12), 120-128.

10. Alivernini S, Tolusso B, Petricca L, et al. Synovial features of patients with rheumatoid arthritis and psoriatic arthritis in clinical and ultrasound remission differ under anti-TNF therapy: a clue to interpret different chances of relapse after clinical remission? Ann Rheum Dis. 2017;76:1228-36. doi: 10.1136/annrheumdis-2016-210424
11. Babcock DS, Patriquin H, LaFortune M, Dauzat M. Power Doppler sonography: basic principles and clinical applications in children. Pediatr Radiol. 1996;26(2):109-15. doi: 10.1007/BF01372087
12. Baillet A, Gossec L, Paternotte S, et al. Evaluation of serum IL-6 level as a surrogate marker of synovial inflammation and as a factor of structural progression in early rheumatoid arthritis: results from a French National Multicenter Cohort. Arthritis Res Ther. 2015;67:905-12. doi: 10.1002/acr.22513
13. Bugatti S, Msanzo A, Benaglio F, et al. Serum levels of CXCL13 are associated with ultrasonographic synovitis and predict power Doppler persistence in early rheumatoid arthritis treated with non-biological disease-modifying anti-rheumatic drugs. Arthritis Res Ther. 2012;14:R43. doi: 10.1186/ar3742
14. Dayer J-M, Choy E. Therapeutic targets in rheumatoid arthritis: the interleukin-6 receptor. Rheumatology. 2010;49:15-24. doi: 10.1093/rheumatology/kep329
15. Fazaa A, Ben Abdelghani K, Abdeladhim M, et al. The level of interleukin-17 in serum is linked to synovial hypervascularisation in rheumatoid arthritis. Joint Bone Spine. 2014;81(6):550-1. doi: 10.1016/j.jbspin.2014.05.008
16. Folkman J, Shing Y. Angiogenesis. J Biol Chem. 1992;267(16):1093-4.
17. Folkman J. Angiogenesis and angiogenesis inhibition: an overview. EXS. 1997;79:1-8. doi: 10.1007/978-3-0348-9006-9_1
18. Hernandez Diaz C, Robles-San Roman M, Vargas A, et al. SAT0180 Subclinical Inflammation in Rheumatoid Arthritis (RA) in Clinical Remission, Lack of Association between Cytokines Level and Ultrasound-Defined Synovitis. Ann Rheum Dis. 2014;73:655. doi: 10.1136/annrheumdis-2014-eular.4855
19. Jacobson JA. Fundamentals of Musculoskeletal ultrasound. In: Fundamentals of Radiology Series. Elsevier Health Sciences; 2007. ISBN 1416035931, 9781416035930-345.
20. Koch AE. Review: angiogenesis: implications for rheumatoid arthritis. Arthritis Rheum. 1998;41:951-62. doi: 10.1002/1529-0131(199806)41:6<951::AID-ART2>3.0.CO;2-D
21. Matlabbek, Akobirov, and Nurmurzaev Zafar. "CHECKING THE CONDITION OF THE CORONARY ARTERIES OF THE HEART BY THE METHOD OF MULTISPIRAL COMPUTED TOMOGRAPHY." AMALIY VA FUNDAMENTAL TADQIQOTLAR JURNALI| JOURNAL OF APPLIED AND FUNDAMENTAL RESEARCH 2.5 (2023): 26-29.
22. McInnes IB, Schett G. Cytokines in the pathogenesis of rheumatoid arthritis. Nat Rev Immunol. 2007;7:429-42. doi: 10.1038/nri2094
23. Nurmurzaev Zafar Narbay Ugli, Usarov Mukhriddin Shukhratovich, and Akobirov Matlabbek Talat Ugli. "SOME FEATURES OF TREATMENT OF DIAPHRAGM HERNIAS WITH THE USE OF LAPAROSCOPIC ANTI-REFLUX METHODS." Research Focus 3.4 (2024): 106-110.

24. Nurmurzaev Zafar Narbay Ugli, and Dusmuradova Dildora Khushmuradovna. "DIAPEUTIC METHOD OF TREATMENT OF VARICOCELE." JOURNAL OF APPLIED MEDICAL SCIENCES 6.5 (2023): 80-85.
25. Nurmurzaev Zafar Narbay Ugli, and Dusmuradova Dildora Khushmuradovna. "DIAPEUTIC METHOD OF TREATMENT OF VARICOCELE." JOURNAL OF APPLIED MEDICAL SCIENCES 6.5 (2023): 80-85.
26. Nurmurzaev Zafar Narbay Ugli, and Shodikulova Parvina Shukhratovna. "BILIARY PERITONITIS AS A COMPLICATION OF CHRONIC CALCULAR CHOLECYSTITIS." Research Focus 3.4 (2024): 111-116.
27. Nurmurzaev Zafar Narbay Ugli, et al. "DIAGNOSIS AND SURGICAL TREATMENT OF ECHINOCOCCAL CYST OF THE LIVER." Research Focus 3.4 (2024): 76-81.
28. Nurmurzaev Zafar Narbay Ugli, et al. "EARLY DIAGNOSTICS OF INFECTED PANCREONEKROSIS." Research Focus 3.4 (2024): 71-75.
29. Nurmurzaev Zafar Narbay Ugli, Gaibullaev Sherzod Obid Ugli, and Mukhiddinov Adham Ahmadjon Ugli. "INTRAOPERATIVE ENDOSCOPIC CORRECTION OF CHOLEDOCHOLITHIASIS." Research Focus 3.4 (2024): 89-93.
30. Nurmurzaev Zafar Narbay Ugli, Khamidov Obid Abdurakhmonovich, and Utaeva Ugilbibi Akbaralievna. "ROLE OF ENDOSCOPIC, DIAPEUTIC METHODS AND X-RAY SURGERY IN THE TREATMENT OF COMPLICATED FORMS OF CHOLELITHIASIS." JOURNAL OF APPLIED MEDICAL SCIENCES 6.5 (2023): 30-35.
31. Nurmurzaev Zafar Narbay Ugli, Nodirov Kosimjon Komilzhonovich, and Abduraxmanov Diyor Shukurullaevich. "TENSIONED HERNIOPLASTY AND ABDOMINOPLASTY IN PATIENTS WITH MORBIDE OBESITY." Research Focus 3.4 (2024): 94-105.
32. Ramirez J, Celis R, Usategui A, et al. Immunopathologic characterization of ultrasound-defined synovitis in rheumatoid arthritis patients in clinical remission. Arthritis Res Ther. 2016;18:74. doi: 10.1186/s13075-016-0970-9
33. Ramirez J, Ruiz-Esquide V, Pomes I, et al. Patients with rheumatoid arthritis in clinical remission and ultrasound-defined active synovitis exhibit higher disease activity and increased serum levels of angiogenic biomarkers. Arthritis Res Ther. 2014;16:R5. doi: 10.1186/ar4431
34. Shu Q, Amin MA, Ruth JH, et al. Suppression of endothelial cell activity by inhibition of TNFalpha. Arthritis Res Ther. 2012;14(2):R88. doi: 10.1186/ar3812
35. Strunk J, Bundke E, Lange U. Anti-TNF-alpha antibody Infliximab and glucocorticoids reduce serum vascular endothelial growth factor levels in patients with rheumatoid arthritis: a pilot study. Rheumatol Int. 2006;26(3):252-6. doi: 10.1007/s00296-005-0619-5
36. Sudol-Szopinska I, Jans L, Teh J. Rheumatoid arthritis: what do MRI and ultrasound show. J Ultrasonogr. 2017;17(68):5-16. doi: 10.15557/JoU.2017.0001
37. Taylor PC. VEGF and imaging of vessels in rheumatoid arthritis. Arthritis Res. 2002;4(Suppl 3):S99-S107. doi: 10.1186/ar582
38. Wain DL. Sensitivity, specificity and responsiveness of magnetic resonance imaging and ultrasound in rheumatoid arthritis diagnosis, Bioscience Horizons. Int J Stud Res. 2014 Jan;7. doi: 10.1093/biohorizons/hzu005
39. Wakefield RJ, Balint PV, Szkudlarek M, et al. Musculoskeletal ultrasound including definitions for ultrasonographic pathology. J Rheumatol. 2005;32(12):2485-7.