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MODERN DIAGNOSTICS OF JUVENILE RHEUMATOID ARTHRITIS IN CHILDREN

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Abstract

Juvenile Rheumatoid Arthritis (JRA), currently referred to as Juvenile Idiopathic Arthritis (JIA), represents a heterogeneous group of chronic inflammatory joint diseases occurring in children under the age of 16. Early diagnosis remains a clinical challenge due to the variability of symptoms and lack of a single definitive diagnostic test. Modern diagnostic approaches combine clinical evaluation, laboratory markers, imaging modalities, and emerging biomarkers. This article reviews current advances in the diagnosis of JIA and highlights the importance of early detection for improving long-term outcomes.

Introduction. Juvenile Idiopathic Arthritis is the most common chronic rheumatic disease in childhood, with an estimated incidence of 1–22 per 100,000 children annually. The etiology remains unclear, but it is believed to involve genetic predisposition, immune dysregulation, and environmental triggers.

According to the International League of Associations for Rheumatology (ILAR), JIA is classified into several subtypes, including oligoarticular, polyarticular (RF-positive and RF-negative), systemic, enthesitis-related, psoriatic, and undifferentiated arthritis. Accurate diagnosis is essential for selecting appropriate treatment strategies and preventing irreversible joint damage.

Clinical Assessment. Clinical evaluation is the cornerstone of diagnosis. Key diagnostic criteria include:

- Arthritis in one or more joints lasting at least six weeks
- Onset before the age of 16 years
- Exclusion of other known conditions

Symptoms

- Persistent joint swelling
- Morning stiffness
- Pain and limitation of movement
- Limping in younger children

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• Systemic manifestations (fever, rash, hepatosplenomegaly)

Systemic JIA may present with quotidian fever and evanescent rash, making diagnosis more complex.

Laboratory Diagnostics. Laboratory investigations support diagnosis and help classify disease subtypes.

Inflammatory Markers

• **ESR (Erythrocyte Sedimentation Rate)**

• **CRP (C-reactive Protein)**

These markers indicate active inflammation but are nonspecific.

Autoantibodies

• **Rheumatoid Factor (RF)**

Found in a minority of children but associated with severe disease.

• **Anti-Nuclear Antibodies (ANA)**

Common in oligoarticular JIA and linked to uveitis risk.

• **Anti-Cyclic Citrullinated Peptide (Anti-CCP)**

Highly specific for erosive arthritis and predictive of disease severity.

Other Laboratory Tests

• Complete blood count (CBC)

• Liver and renal function tests

• Ferritin (elevated in systemic JIA)

• HLA-B27 typing (important in enthesitis-related arthritis)

Imaging Modalities

Ultrasound (US). Ultrasound has become a first-line imaging tool due to its accessibility and sensitivity. It can detect:

• Synovitis

• Joint effusion

• Tenosynovitis

• Early erosions

Doppler ultrasound allows visualization of active inflammation through increased blood flow.

Magnetic Resonance Imaging (MRI). MRI is the most sensitive imaging modality for early detection. It provides detailed visualization of:

• Synovial hypertrophy

• Bone marrow edema

• Cartilage damage

• Early erosions

MRI is particularly useful in assessing temporomandibular and hip joints.

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Radiography (X-ray). Although less sensitive in early disease, X-rays are useful for:

- Detecting joint space narrowing
- Bone erosions
- Growth abnormalities

They are mainly used for monitoring disease progression.

Advanced Diagnostic Approaches

Biomarkers

Recent research focuses on identifying biomarkers for early diagnosis and prognosis:

- Cytokines (IL-6, TNF-α, IL-1)
- S100 proteins (S100A8/A9, S100A12)
- Matrix metalloproteinases (MMPs)

These biomarkers may help predict disease activity and response to therapy.

Genetic and Molecular Techniques

- HLA gene associations
- Genome-wide association studies (GWAS)
- Epigenetic modifications

These approaches provide insight into disease mechanisms and personalized medicine.

Synovial Fluid Analysis

Synovial fluid examination may reveal:

- Elevated leukocyte count
- Increased protein levels
- Presence of inflammatory mediators

This helps differentiate JIA from septic arthritis.

Differential Diagnosis

Accurate diagnosis requires exclusion of other conditions:

- Septic arthritis
- Reactive arthritis
- Systemic lupus erythematosus
- Malignancies (e.g., leukemia)
- Lyme disease

Modern diagnostic tools significantly reduce misdiagnosis.

Role of Early Diagnosis

Early diagnosis is crucial for:

- Preventing joint destruction
- Reducing disability

• Improving growth and development
• Enhancing quality of life

The use of advanced imaging and biomarkers enables earlier intervention with disease-modifying therapies.

Conclusion. Modern diagnostics of Juvenile Idiopathic Arthritis involve a comprehensive and multidisciplinary approach. Integration of clinical findings, laboratory tests, imaging techniques, and novel biomarkers has significantly improved early detection and disease management. Continued research in molecular diagnostics and personalized medicine holds promise for further advancements in this field.

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