Role of ultrasound in the assessment of juvenile idiopathic arthritis

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Abstract

US has demonstrated higher sensitivity in detecting synovitis, tenosynovitis and enthesitis than clinical examination in JIA. US has also allowed earlier assessment of cartilage and bone abnormalities than conventional radiology. Although it seems that US detects a high frequency of subclinical synovitis in JIA patients with clinically inactive disease, further studies are needed to clarify those findings. In addition, assessment of structural damage changes in growing children should be taken with caution until more information about normal US articular anatomy in healthy children is available.

Key words: juvenile idiopathic arthritis, ultrasound, Doppler, synovitis, enthesitis, structural damage.

Introduction

The term JIA encompasses a group of clinically heterogeneous arthritides characterized by a chronic inflammatory process of the synovium and periarticular tissue that can lead to structural damage that is responsible for most disabilities in JIA [1]. The primary goal of managing JIA is early detection of inflammatory activity in order to avoid disability. Traditionally, the gold standard for detecting joint inflammation has been the clinical assessment of swollen joints. However, imaging in JIA is crucial for diagnosing the disease, assessing inflammation activity and monitoring therapeutic response. Furthermore, the availability of new effective therapies for JIA has increased the interest of physicians in looking for valid and feasible imaging tools for monitoring activity changes. US and MRI can detect inflammatory and destructive changes in JIA [2]. MRI can clearly differentiate the proliferative synovial tissue (i.e. pannus) from effusion and from the individual components of the joint (articular and growth cartilage, fibrocartilage, subchondral bone and bone marrow, tendon and ligaments) [3, 4]. US is a quick, inexpensive and bedside method for evaluating children with no need for anaesthesiological support. US has proven earlier assessment of synovial, cartilage and bone abnormalities than conventional radiology. US has demonstrated higher sensitivity for detecting synovitis compared with clinical examination [5]. Repeatability and the possibility of examining several joint regions at one session are of paramount importance for monitoring joint damage in JIA. The presence of joint involvement in JIA may be expressed by ultrasonographic findings such as synovial proliferation, effusion, cartilage thinning and bone erosions. US can also be used to assess tenosynovitis and to guide joint aspiration or injection. In addition, the use of Doppler techniques facilitates detection of synovial vascularization in identifying active disease.

Synovial proliferation and effusion

US is well suited for the diagnosis and assessment of synovitis. The severity of joint disease can be estimated by using grey-scale US to assess the size of joint effusion and synovial proliferation (Fig. 1). However, these abnormalities can be residual findings and may not necessarily reflect ongoing active disease [6]. Power Doppler (PD) or colour Doppler US techniques are considered superior to grey-scale US to identify active disease. Doppler US, with or without contrast enhancement, can assess synovial hyperaemia and distinguish between active and inactive joint disease [7, 8].

As US may be more accurate in detecting synovitis than physical examination, some authors have found a high prevalence of subclinical synovitis [5]. Identification of subclinical disease is relevant for patient classification in the different JIA categories and taking decisions in patient

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Enthesitis

Enthesitis inflammation is a distinctive feature of enthesitis-related arthritis, which represents nearly 20% of JIA categories [1]. Enthesitis is also much more common in the juvenile form of SpA than the adult form. The entheses commonly involved in children are the plantar aponeurosis, calcaneal entheses, and distal and proximal insertions of the patellar tendon. So far, only clinical examination has been able to detect entheses involvement by touching the painful entheseal sites.

Grey-scale US coupled with PD has proved its sensitivity in detecting enthesitis in adults with SpA [11]. In childhood arthritis is surprising [5, 10]. US may detect bursae inflammation and synovial cysts, in addition to effusion and synovial thickening in joint recess and tendon sheath. Tenosynovitis is not uncommon in some JIA categories though there are few studies documenting such US findings. Tenosynovitis is often difficult to diagnose by clinical examination, but US lets physicians distinguish between joint synovitis and tenosynovitis, particularly in joints difficult to evaluate clinically, such as the ankle.

Cartilage thinning and erosions

Few data are available about the US evaluation of structural damage in children affected by JIA. Unlike adult RA, the quantitative radiographic scoring systems may not be feasible in patients with JIA due to the peculiarities of the growing skeleton. On the contrary, US assessment could be an interesting alternative. The cartilage of unossified epiphyses can be readily evaluated by US. Spannow et al. [14] were the first authors to delineate the normal ranges of cartilage thickness in the small and large joints by US in healthy children. They demonstrated significantly thicker cartilage measurements in boys compared with girls and a progressive reduction in cartilage thickness with age in both sexes [14]. The same authors previously reported a good intra- and inter-observer agreement in the evaluation of cartilage thickness in several joints, using US standard scans according to European League Against Rheumatism guidelines [15].

US may be a good tool to capture bone erosions due to its capacity to evaluate the joints in several planes. However, assessment of bone changes in the growing skeleton is challenging. Physiological irregularities visualized by US in some ossification centres may be misinterpreted as cortical erosions (Fig. 2). Recently, Malattia et al. [16] conducted a study comparing MRI, US and conventional radiography in the detection and grading of bone erosions in JIA patients with wrist disease. They found that >90% of evaluated children showed one or more erosions as detected by MRI, whereas conventional radiography and US revealed erosions in 50%. MRI also demonstrated a significantly higher ability to detect erosive changes with respect to conventional radiography and US, according to studies conducted in the adult population. However, this difference was significant in the patient subgroup with shorter disease duration.
Fig. 2 Longitudinal scan of distal femur shows bone erosion at the level of femoral bone surface (asterisk).

Interestingly, authors also reported that US was superior to conventional radiography in the detection of bone lesions in some carpal bones that are more accessible for US evaluation.

Monitoring joint damage

US assessment has been proved to support clinical evaluation in monitoring response to treatment in JIA patients [6, 8, 10, 17]. US assessment in JIA patients after 4 weeks following IA steroid injection showed a reduction in effusion, synovial thickness and synovial hyperaemia on the joints evaluated in each study [6, 17]. Systemic treatment with naproxen in JIA patients showed similar results with grey-scale US [10] and PD US [8]. In addition, PD US seems to be more sensitive in the assessment of therapeutic response compared with grey-scale US evaluation [8]. Nevertheless, there is still a paucity of data on PD US findings detected during therapy follow-up.

Rheumatology key messages

- US has proved superior to physical examination in detecting synovitis, tenosynovitis and enthesitis in children.
- US may be appropriate for the evaluation of integrity of cartilage in children.

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References