CONCISE REPORT

Arthrosonography of hip and knee joints in the follow up of juvenile rheumatoid arthritis

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Objective: To evaluate sensitivity of arthrosonography of hip and knee joints for monitoring disease activity in juvenile rheumatoid arthritis (JRA).

Methods: Twenty eight patients with JRA with active disease at entry in 15 hips and 38 knee joints were followed up three times in intervals of 4–6 weeks. Sonographic, clinical, and laboratory findings were documented at the same time in clinically active and inactive disease. As controls of the sonographic variables 10 children without a history of arthritis were examined by ultrasound.

Results: In active arthritis of the hip joint 19/31 (61%) examinations showed a pathological widening of the synovial joint space. There was no significant correlation between sonographic and clinical measures of disease activity in coxitis. Marked effusion within the suprapatellar pouch was seen in 87% and thickening of the synovial membrane in 92% of cases of active gonarthritis in patients with JRA. There was a significant difference in the number of patients with joint effusion and in the mean joint effusion between patients with clinically active gonarthritis at entry and inactive arthritis at follow up ($p<0.001$). In contrast, synovial thickening persisted in about 80% after induction of clinical remission.

Conclusion: The data confirm the high sensitivity of arthrosonography in imaging changes in hip and knee joints of patients with JRA. Sonographic effusion of the knee provided the highest correlation with measures of clinical disease activity. Further prospective studies should evaluate whether persistent thickening of the synovial membrane detected by ultrasound in clinically inactive arthritis indicates residual inflammatory activity and an increased risk of relapse.

So far, only a few studies have compared the sensitivity of ultrasound investigation with clinical examination in juvenile rheumatoid arthritis (JRA).^{1–5} Ultrasound assessment allows sensitive detection of effusions and synovial thickening in knees^{1–3} and hips^{1,4} in JRA.

Definition of disease activity in JRA—that is, active arthritis, improvement, and remission of disease, is exclusively based on clinical or laboratory criteria.^{6–9} On the other hand, there is a high rate of relapses in JRA after reduction of immunosuppressive therapy during clinical remission.^{10,11} Thus, it would be helpful to define more sensitive markers for determining the risk of remitting arthritis in JRA. Imaging methods may be useful in the future, but no prospective data exist which correlate sonographic features with clinical and laboratory measurements in the follow up of JRA in a sufficient number of patients. Potential differences between sonographic examinations of different joints are almost completely neglected.

In this study we compared clinical, sonographic, and laboratory parameters of 28 patients with JRA in a prospective follow up study to evaluate the sensitivity of arthrosonography for monitoring disease activity. To differentiate the importance of arthrosonography of a deep and a superficial joint we examined exclusively patients with either hip or knee joint involvement.

PATIENTS AND METHODS

Patients

We performed a prospective study including 28 children who fulfilled the criteria for JRA with a pauciarticular or polyarticular course of the disease.¹² At study entry 15 hip joints in eight patients and 38 knee joints in 25 patients showed clinical symptoms of active arthritis as defined previously.⁷

All patients with active joints were followed up three times within three months, in intervals of 4–6 weeks.

Documentation of clinical and laboratory data

We recorded the following measurements: joint swelling, score 0–3 (0=none; 1=mild, definitive swelling without blurring of skeletal outlines; 2=moderate, definitive obscuring of skeletal landmarks; 3=severe, discernible skeletal landmarks); joint pain on movement, score 0–3 (0=none; 1=mild, patient complains on movement; 2=moderate, patient withdraws or changes facial expression on movement; 3=severe, patient responds severely to movement); and limitation of motion, score 0–3 (0=normal joint mobility; 1=<10 degrees; 2=10–30 degrees; 3=>30 degrees' reduction from normal joint mobility).

Erythrocyte sedimentation rate (Westergren method) and C reactive protein (nephelometry) were analysed at each point of this study.

Standardised sonographic analysis of knee and hip joints

Ultrasound images were obtained with an Acuson model 128 equipped with a 7.5 MHz transducer. A standardised procedure similar to that used by other investigators was followed^{1–4,13,14}; a ventral, longitudinal approach was chosen for the hip.^{1,4} Arthritic changes of the hip joint were measured in the space between the femoral neck and the joint capsule, the so-called synovial joint space (SJS) (fig 1A). Knee ultrasound was obtained by sagittal images of the suprapatellar pouch, with the knee in 30 degrees of flexion. The maximum thickness of the synovial membrane of the anterior wall and the largest anteroposterior diameter of the suprapatellar pouch (mm) was measured on the longitudinal scan (fig 1B). For controls 10 children without a history of arthritis were examined.

Abbreviations: JRA, juvenile rheumatoid arthritis; SJS, synovial joint space

Figure 1 Arthrosonography of the hip and knee joint. (A) Ultrasound of the hip joint in a ventral sagittal approach with the hip in extension, r = right and l = left side of the patient with active hip involvement in JRA. The scan shows the femoral head (H), the femoral neck (N), and the joint capsule (C). The distance between the femoral neck and the capsule is measured as the so-called synovial joint space (SJS). (B) Ultrasound of the knee joint in a ventral longitudinal scan of the suprapatellar pouch. Femur (F), patella (P), and the ligament (L) of the quadriceps are bordering the suprapatellar pouch. The joint effusion is measured in the largest anteroposterior diameter of the suprapatellar effusion (asterisks). In addition the maximum thickness of the synovial membrane (S) of the anterior wall is determined.

Statistical analysis

A Kruskal-Wallis test was performed to correlate clinical, laboratory, and sonographic parameters, Fisher's exact test for the differences of sonographic parameters, and a Whitney-Wilcoxon test for the mean values between active and inactive arthritis.

RESULTS

Arthrosonography of the hip

Controls showed an SJS of the hip of 3–6 mm (mean (SD) 4.3 (0.9) mm). An SJS of more than 6 mm was recorded as indicative of arthritis. No synovial thickening of the hip joint could be detected in the control group.

Thirty one of 45 examinations in eight patients with hip involvement in JRA showed clinical signs of active arthritis. In this group sonographic parameters of coxitis were found in 22/31 (71%) examinations (table 1). Most of them (61%) presented with a pathological widening of the SJS (7.5 (3.6) mm), only a few joints (10%) showed hyperplasia of the synovial membrane. In the follow up 50% of examinations showed sonographic arthritic changes in the absence of clinically active coxitis. There were no significant differences for SJS or synovial thickness between those with active or inactive arthritis in the follow up of patients with JRA with hip involvement.

We found no significant correlation between the SJS of the hip and any clinical or laboratory measure. Thickening of the synovial membrane of the hip joint correlated with the reduction of joint mobility ($p < 0.05$) and the concentration of C reactive protein ($p < 0.05$).

Arthrosonography of the knee

None of the controls showed joint effusion, and the synovial thickness in these controls was 0–2 mm (0.75 (0.76) mm).

Eighty seven of 114 examinations in 25 patients with knee involvement in JRA showed clinical signs of active gonarthrosis. In this group 76 (87%) examinations showed a marked effusion within the suprapatellar pouch of between 3 and 16 mm (6.6 (3.7) mm) (table 1). Thickening of the synovial membrane in a range from 3 to 11 mm (5.8 (1.9) mm) was seen in 80 (92%) of these investigations. In contrast with the data found for active coxitis, there was a significant difference in the number of patients with joint effusion as well as in the mean joint effusion between patients with clinically active and inactive gonarthrosis at follow up examinations ($p < 0.001$). Persistent thickening of the synovial membrane (5.2 (2.6) mm), however, was found in about 81% of sonographic follow up investigations even in the absence of clinically active arthritis. Accordingly, there was no significant difference in the number of patients with synovial thickening and in the mean synovial thickness between clinically active and inactive arthritis.

In contrast with the observations for the hip joints, we found strong correlations between sonographic parameters, especially for joint effusion, and clinical findings of knee joint examinations ($p < 0.01$). As with the results found for hip joint arthrosonography no correlations were seen between sonographic and laboratory parameters in knee examinations.

Table 1 Arthrosonographic follow up results in clinical active and inactive JRA

	Active arthritis	Inactive	p Value
Knee joints			
Examinations (No)	87	27	
Joints (No)	38	19	
Joint effusion >2 mm (No (%))	76 (87%)	8 (30%)	<0.001
Synovial thickness >2 mm (No (%))	80 (92%)	22 (81%)	NS
Mean (SD) joint effusion (mm)	6.6 (3.7)	1.2 (2.1)	<0.001
Mean (SD) synovial thickness (mm)	5.8 (1.9)	5.2 (2.1)	NS
Hip joints			
Examinations (No)	31	14	
Joints (No)	15	9	
SJS >6 mm (No (%))	19 (61%)	6 (43%)	NS
Synovial thickness (No (%))	3 (10%)	1 (7%)	NS
Mean (SD) SJS (mm)	7.5 (3.6)	5.3 (2.6)	NS

SJS, synovial joint space of the hip; NS, not significant.

DISCUSSION

In JRA, sonography has been shown to be more sensitive than physical investigation for detection of minimal amounts of effusion.^{2,3} Cellierini *et al* used sonography to show an increase of intra-articular fluid and synovial thickening in active arthritis of the knee, which was significantly less in a group of patients during remission.³ In a small number of 10 patients and a maximal follow up of one month Eich *et al* confirmed that ultrasonography is sensitive to changes in effusion and synovial hyperplasia and may be useful for monitoring response to intra-articular treatment.¹

So far, no study has compared the sonographic findings with the clinical course of disease activity in a sufficient number of patients with JRA in a prospective follow up. A higher sensitivity of arthrosonography than of clinical parameters for detection of inflammatory changes during follow up would be a prerequisite for its use in monitoring disease activity—for example, improvement or remission of JRA.

Our data confirm the high sensitivity of arthrosonography in imaging arthritic changes in hip and knee joints of patients with JRA as described earlier,^{1-5,15} but show significant differences between sonographic results of knee and hip joints during follow up. Parameters reflecting an increase of intra-articular fluid—that is, effusions of knees and SJS of hips, were found in a large number of active joints. During prospective follow up joint effusions showed a high correlation with clinical parameters for knee joints, whereas no association was found for hips. This may be due to the fact that the increase of SJS in hips seen during inflammation is relatively low compared with the baseline level in normal controls, whereas any effusion in knee joints is a pathological finding. Anatomical differences between these two joints may also be responsible for the different sensitivity of arthrosonographic detection of intra-articular fluid. In previous reports the difficulties found in differentiating between pannus and joint effusion in hip joints of patients with JRA were mentioned.^{1,4} Ultrasound measurement of the SJS might give a combined measure of effusion and synovial thickening in the hip.

More interesting is the fact that synovial thickening of affected knee joints persists in about 80% and an SJS >6 mm is found in more than 40% of the hip joints after induction of clinical remission. This important finding suggests two possible interpretations: (a) persistent synovial thickening (or widening SJS in the hip) might be an epiphenomenon without clinical relevance during clinical remission; (b) persistent sonographic abnormalities might reflect residual inflammatory activity in the joint which is not detected by common clinical or laboratory examinations and increases the risk of remitting disease.

Our data underline the necessity of further prospective studies in JRA which have to examine the question as to whether patients with persistent arthritic changes in arthrosonography despite clinical remission have an increased risk of relapse.

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