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Clinical and ultrasonographic findings related to knee pain in osteoarthritis

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Summary

Objectives: To determine clinical and sonographic factors associated with painful episodes in patients with knee osteoarthritis (OA).

Methods: In this cross-sectional controlled study, patients with primary knee OA (ACR criteria) were prospectively placed into two groups. Group A: 81 patients with knee pain during physical activity ≥30 mm in visual analogue scale (VAS) for pain for at least 48 h prior to inclusion; Group B: 20 patients without knee pain from at least 1 month prior to inclusion. Clinical parameters, knee radiographic and ultrasonographic findings were collected. The sonographic study assessed joint effusion in the suprapatellar pouch, infrapatellar superficial and deep bursitis, meniscal lesions, anserine tendinobursitis, and Baker's cyst.

Results: Group A patients tended to be older and heavier women than group B ($P < 0.05$). The most frequent radiographic stage was III (57%) in group A, and I (35%) and II (35%) in group B, showing differences in the distribution of each radiographic stage ($P < 0.005$). The most frequent ultrasonographic finding in group A was suprapatellar effusion (79%), and in group B it was meniscal lesions (40%). Ultrasonographic findings showed in group A a significant increase of suprapatellar effusion ($P < 0.001$) and a tendency towards an increase of Baker's cyst ($P = 0.06$). Suprapatellar effusion, Baker's cyst, and body mass index (BMI) were the factors associated with the appearance of pain after the logistic regression analysis.

Conclusions: Suprapatellar effusion, Baker's cyst, and higher BMI are more frequent and seem to be risk factors of painful flare in OA of the knee.

Key words: Osteoarthritis, Knee, Ultrasonography, Pain.

Introduction

Osteoarthritis (OA) is the most common joint disorder and the knee is one of the most frequent joints involved. The Framingham study showed a prevalence of knee OA in adult women and men of 2% and 6% that increases up to 34% and 31% in over 60 years, respectively[1]. In Spain, the EPISER study showed an estimated prevalence of 10.2% of symptomatic knee OA in adults over 60 years[2]. Knee OA causes an important disability especially during painful episodes[3–10]. Pain is the main reason for consultation. Both pain and disability significantly decrease the quality of life and increase health resources.

The cause for pain is not fully understood so far. Community based studies have shown that severe radiographic knee OA is associated with greater pain[11–15]. However, many patients with radiographic OA do not have pain. This discrepancy between pain and radiographic structural lesions is probably due to the fact that the origin of pain is multifactorial[15–17]. Demographic, mechanic, structural and psycho-sociologic factors play an important role in both the genesis and the severity of pain.

Structural or morphological causes of pain can be assessed by non-invasive imaging techniques such as magnetic resonance imaging (MRI) and ultrasonography (US). However, to date few studies have used MRI and US to establish the causes of pain in patients with painful and non-painful knee OA[10,18–21]. US is safe, quick, increasingly accessible in the clinical practice, and has demonstrated to be more sensitive than clinical diagnosis in detecting intra-articular and periarticular lesions[22–27].

Recently, our group was involved in a European study under the umbrella of EULAR-ESCISIT. The primary endpoint of that study was to assess the prevalence of inflammation in subjects with chronic painful knee OA. An ultrasound examination was realized in the suprapatellar pouch. Significant correlations between knee synovitis, effusion and clinical parameters suggestive of an inflammatory flare were shown[28].

In order to evaluate other possible factors involved in pain, each patient in Spain had an extended US examination, which included joint effusion in the suprapatellar pouch, infrapatellar superficial and deep bursitis, meniscal lesions, anserine tendinobursitis, and Baker's cyst. Furthermore, we also included patients with a diagnosis of knee OA, who were free of pain at least for 1 month.

The aim of this study was to determine clinical and sonographic factors associated with pain in OA of the knee. In

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patients either with painful or painless knee OA we compared the prevalence of different radiographic stages (Kellgren/Lawrence (K/L)) [29], and ultrasonographic intraarticular and periarticular lesions. In addition, we searched for factors associated with the severity of pain.

Patients and methods

PATIENTS

This was a cross-sectional controlled study realized over a 4 month period. Patients over 40 years, already seen at the Department of Rheumatology of the University Hospital, La Paz, with primary knee OA according to the clinical and radiological ACR criteria[30], were prospectively included into two groups. Group A comprised patients with unilateral or bilateral knee pain $\geq$30 mm during physical activity for at least 48 h prior to inclusion, measured by the visual analogue scale (VAS) from 0 to 100 mm. These patients were the same recruited in Spain for the "EULAR decision rules for the use of US in painful knee osteoarthritis" study[28]. If both knees were painful, the most symptomatic one was included. Group B comprised patients with knee OA without knee pain at least 1 month prior to inclusion (VAS 0 mm); these patients were seen in the out-patient clinics for problems other than knee pain, but previously they had had an X-ray performed and were found to have knee OA with pain. In both groups, Steinbrocker functional score was from I to III. No drug changes were allowed during the study.

Patients were excluded if any of the following situations was found: (1) severe knee OA with Steinbrocker's grade IV; (2) secondary knee OA following GREES (Group for the Respect of Ethics and Excellence in Science)[31]: septic arthritis, inflammatory joint disease, microcrystalline joint disease, Paget's disease, joint fracture, ochronosis, acromegaly, hemochromatosis, Wilson's disease, primary osteochondromatosis; (3) knee trauma 6 months prior study; (4) partial or complete knee replacement, osteotomy or arthroscopy 1 year prior study; and (5) intraarticular steroid injection 4 weeks prior study and/or hyaluronic acid injection or synoviorthesis 3 months before the study started. Written informed consent to participate in the study was obtained from each patient. The hospital's committee of clinical research and ethics approved the study.

CLINICAL EVALUATION

Patients from groups A and B underwent a clinical evaluation and the following parameters recorded − sex, weight, height, and VAS pain during physical activity within the last 48 h (0 to 100 mm). All patients were examined by the same rheumatologist.

RADIOGRAPHIC EVALUATION

All patients had standing weight-bearing posterior−anterior and lateral knee radiographies within the last year. The Kellgren/Lawrence grading system was used (I−IV)[29]. Films were read by the same rheumatologist who performed the clinical evaluation.

SONOGRAPHIC EVALUATION

A systematic knee sonographic examination (7−11 MHz linear array transducer, Logic 400, General Electric Medical Systems) was performed in all patients no more than 2 h after clinical evaluation. The investigator who performed the US examination was unaware of the clinical results before performing the examination. All patients in group A were examined by one rheumatologist. Group B was examined, in an almost similar number, by two rheumatologists highly experienced in ultrasound, with common criteria and good agreement in previous inter-observer reliability[32]. The presence or absence of the following findings was recorded in all patients using Van Holsbeeck technique[33]:

Effusion in the suprapatellar pouch: Hypoechoic or anechoic anteroposterior distention of the bursa larger than 2 mm at midline on longitudinal and transverse scan with knee flexed 30°[33].
Infrapatellar superficial and deep bursitis: Enlarged bursa larger than 2 mm on longitudinal and transversal scan, in the infrapatellar anterior knee.
Meniscal lesions: Heterogeneous echogenicity and/or extrusion of the anterior and posterior meniscal horns larger than 3 mm from the joint line. Medial meniscus was examined with the patient supine, external rotation of the leg, the knee flexed 10° and mild valgus stress. Lateral meniscus were performed in the lateral aspect of the knee, with the patient supine, internal rotation of the leg, knee flexed 10° and mild varus stress.
Anserine tendinobursitis: Hypoechogenic increase of the pes anserinus insertion compared with the asymptomatic side and/or distention of bursa larger than 2 mm on longitudinal and transverse scans.
Baker's cyst: Hypoechogenic collection of fluid in medial posterior side that communicates with joint larger than 4 mm on long and short axes.

STATISTICAL STUDY

Data analyses were performed using SPSS PC package. Qualitative data were described as absolute frequencies and percentages. Quantitative data were described as mean, median and typical deviation (minimum and maximum). The following variables were compared in group A and B: sex age, BMI, radiographic stage and the prevalence of the sonographic findings. Chi-squared and Fisher's test were used for qualitative data and Student's t and Mann−Whitney U test for comparing means. A logistic regression model was used to determine which variables were independently associated with pain. To study which variables were associated with the severity of pain, the Pearson's correlation, Student's t test or Kruskal−Wallis test was used. All statistical analyses were performed at $P \leq 0.05$.

Results

A total of 81 symptomatic knees were included in group A (93.3% women) and 20 asymptomatic knees in group B (70% women). The demographic and anthropometric characteristics are described in Table I. Women were more often symptomatic than men ($P < 0.002$). Moreover, patients in group A tended to have a higher age and BMI than those in the other group ($P < 0.05$).

Table II shows the radiographic stages and the sonographic findings in both groups. Radiographic stages III (56.79%) and II (34.2%) were most frequently found in group A, whereas I (35%), II (35%) and III (25%) were found in group B. When comparing the radiographic stages in both groups, group A had greater radiographic stages than group B ($P < 0.005$). The most encountered

Table I
Demographic and anthropometric characteristics

	Group A ($n=81$)	Group B ($n=20$)	*P*
Female	78 (96.3%)	14 (70%)	0.002
Age	66.75 ± 8.67	62.1 ± 9	0.046
BMI*	31.3 ± 4.8	28.4 ± 4.1	0.036

*BMI = body mass index.

sonographic findings in group A were suprapatellar effusion (79%) (Fig. 1), meniscal lesion (45.7%), and Baker's cyst (37%) (Fig. 2). In group B the sonographic findings were meniscal lesions (40%), suprapatellar effusion (35%), and Baker's cyst (15%). No anserine tendinobursitis or infrapatellar bursitis was found in group B. Sonographic lesions were more frequently found in group A than in B. Suprapatellar effusion was significant ($P < 0.001$) and Baker's cyst tended to be statistically significant ($P = 0.06$).

In the multivariant analyses we found that the presence of suprapatellar effusion increases 6.5 times the risk of suffering pain (95% CI 1.87−22.37); this risk is also higher for each unit of increase in BMI (1.18 OR, 95% CI 1.03−1.367) and for the presence of Baker's cyst (5.5 OR, 95% CI 1−31.05).

When studying the association between severity of pain and the different variables, we found that patients with anserine tendinobursitis and infrapatellar bursitis had higher VAS scores than patients without these lesions (66 vs 59.46 and 61.29 vs 59.77, respectively). However, these findings were non-significant.

Discussion

Our study shows that age, female sex and BMI are all associated with pain in primary knee OA. BMI is the anthropometric variable that clearly increases the risk of suffering pain. As well, painful OA knees have higher radiographic scores than painless OA knees. In addition, US has proved that suprapatellar effusion and Baker's cyst increase the risk for pain.

Epidemiologic studies have demonstrated that age, sex, and BMI are knee OA risk factors[2], but these variables

Table II
Prevalence of the radiographic stages and ultrasonographic findings

	Group A ($n=81$)	Group B ($n=20$)	*P*
RX K/L* scores, *n* (%)			0.005†
I	5 (6.17%)	7 (35%)	
II	28 (34.56%)	7 (35%)	
III	46 (56.79%)	5 (25%)	
IV	2 (2.46%)	1 (5%)	
US findings, *n* (%)			
Suprapatellar effusion	64 (79%)	7 (35%)	<0.001
Meniscal lesion	37 (45.7%)	8 (40%)	0.803
Baker's cyst	30 (37%)	3 (15%)	0.06
Infrapatellar bursitis	7 (8.6%)	0	0.340
Anserine tendinobursitis	5 (6.2%)	0	0.580

*K/L = Kellgren/Lawrence.

†Statistical significance in the distribution of each radiographic stage.

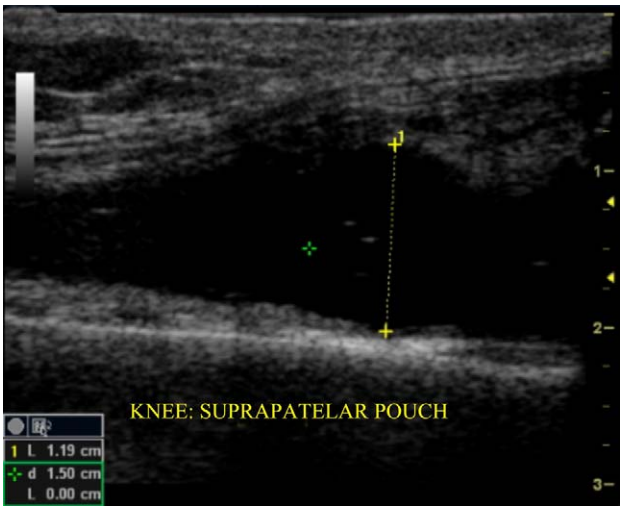

Fig. 1. Synovial fluid in the suprapatellar pouch of the knee. Longitudinal sonogram.

have not been identified as pain risk factors in studies that compare patients either with or without pain in knee OA[9,15,34]. In this study the calculated risk for suffering pain increases 1.18 times for each unit of increase in BMI (95% CI 1.03−1.367). That means that obesity is not only a risk factor for OA but also of having pain, and this has been described by Hill *et al.*[18,19] as well.

Radiographic findings are not always related with pain[35,36]. Sometimes, patients with OA have no pain while in other cases the severity of pain does not correlate with the radiographic signs of OA. We found an association between the stages and pain of Kellgren and Lawrence, as previously described by other authors[9,10,12,14,15,18,19].

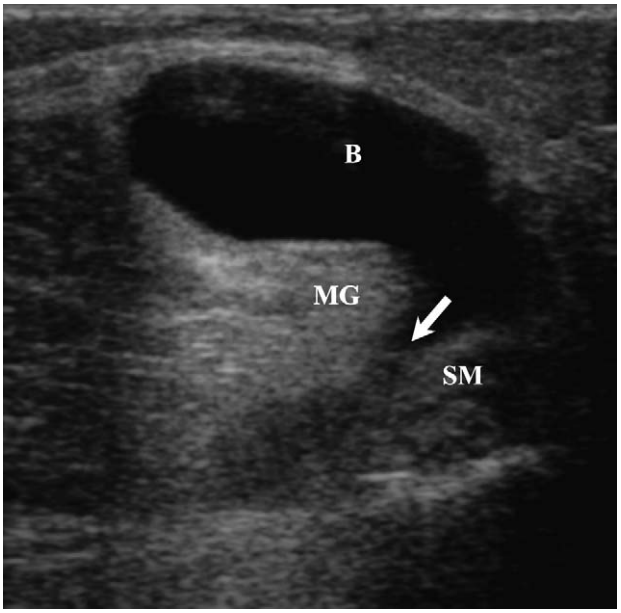

Fig. 2. Baker's cyst: transverse sonogram with anechoic fluid. Baker's cyst (B), medial head of gastrocnemius muscle (MG), joint communication of the Baker's cyst (arrow), semimembranous tendon (SM).

The reason for pain in the symptomatic OA of knee has been studied by means of studies of images in different populations, which necessarily can offer different results. Our study approaches the problem of symptomatic OA patients with OA patients without knee pain for 1 month before the study entry, but who were previously symptomatic.

MRI has been used for studying structural lesions responsible for pain in patients with knee OA. Hill *et al.* compared symptomatic knee OA, asymptomatic knee OA and normal subjects, and found an association between pain and joint effusion detected by MRI; however, they did not find an association with Baker's cyst[19]. Two ultrasonographic knee OA studies have been recently presented, one in abstract form[37] and the other one as a paper[20]. Both intended to demonstrate the ultrasonographic differences in patients with painful knee OA when compared with asymptomatic knee OA or healthy people. One study reported in 126 patients with unilateral symptomatic knee OA pain and ultrasound examination in both knees, and in a group of 102 healthy subjects with joint effusion, Baker's cyst, internal meniscus cyst, and reduction in thickness of medial femoral condyle which are the most frequently encountered lesions in patients with painful OA when compared with controls and healthy subjects ($P < 0.05$)[37]. The second one studied the ultrasonographic finding in 74 symptomatic knee OA and in 10 asymptomatic knee OA (42 patients)[20]. They found that only the painful knees had joint effusion, anterior meniscus horn protrusion and/or bulging of the collateral medial ligament ($P < 0.05$). We demonstrated increased frequency of suprapatellar effusion in painful knee OA ($P < 0.001$), and that the risk for developing pain increases 6.4 times when effusion is present.

The prevalence of joint effusion showed an increase when compared to data found in the EULAR study[28] (79% vs 43.6%). This difference might appear since in this study we considered that patients had suprapatellar effusion when distension of the bursa was larger than 2 mm[33]. Furthermore, each patient was examined with the knee flexed 30°, which, from our experience has shown to be an accurate position to detect small effusions[38].

Also, our findings show that there is a 5.5 times higher risk to develop pain in knee OA with Baker's cyst, and this association has never been published. These findings are very important because both effusion and Baker's cysts are signs of inflammation that can be easily diagnosed and treated with the help of ultrasound in the rheumatologist's office. This diagnostic approach will probably allow a prompt design of more specific treatments to increase the patient's quality of life.

Periarticular complications are rare in knee OA. We found anserine tendinobursitis in 6.2% and infrapatellar bursitis in 8.6% of the symptomatic knees. In addition, these periarticular lesions were not statistically associated with pain. Hill *et al.* by means of using MRI found no association between peripatellar lesions (prepatellar, infrapatellar superficial and deep bursitis) and pain. However, other periarticular lesions such as anserine bursitis, tibioperoneal synovial cyst and bursitis of the collateral medial ligament did relate to pain[19]. Perhaps our findings did not reach statistical significance due to the population size.

No factors studied were associated with the severity of pain although higher mean pain VAS scores were obtained in patients with anserine tendinobursitis and infrapatellar bursitis. Other authors did find an association between the severity of pain and BMI, sex[39,40] and protrusion of the medial anterior meniscus horn and bulging of the medial collateral ligament[20]. Nonetheless, many factors influence the severity of pain thereby no cause can be established as the more relevant one.

Finally, one limitation of the current study is that more control subjects would have been desired.

In conclusion, we believe that the ultrasound scan is useful for the clinical evaluation of painful flare in the knee OA. From our experience, suprapatellar effusion, Baker's cyst, and high BMI seem to be risk factors of painful flare in the knee OA.

The authors have declared no conflicts of interest.

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