

Knee joint diseases diagnosed by ultrasound and magnetic resonance imaging

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Abstract

Introduction: A great number of people all over the world suffer from knee joint problems. The benefits of ultrasound (US) when compared to magnetic resonance imaging (MRI) are that the US is noninvasive, freely available, well-accepted by patients, cheap and that it has the advantage of dynamic evaluation and real-time imaging. In this study, there is a comparison between uUS and MRI in characterization of knee joint diseases using. **Materials and Methods:** This is an observational cross-sectional study of 200 patients, who attended the Radiological Center, College of Applied Medical Sciences, King Khalid University, Saudi Arabia, from October 2011 to August 2013. The US technique has been carried out according to the protocol of American Institute of Ultrasound in Medicine, using a linear probe transducer with high frequency 7.5-12 MHz. **Results:** The range of the patients' age was 12-80 years. The most common presenting symptoms were painful swelling of the knee joint and inability to move. In 125 of them US and MRI revealed variable diseases: Effusion (81), loose body (2), synovial cyst (4), quadriceps tendon rupture (1), meniscus tear (6), tumor (1) bursitis (8), arthritis (5), baker cyst (4) deep vein thrombosis (3) diagnosed with both US and MRI, and anterior cruciate ligament tear (6), posterior cruciate ligament tear (4) seen with MRI only. **Conclusion and Recommendations:** The study suggested that US can evaluate cystic lesions, as well as menisci, ligaments, tendons, and muscles tear. Most of the knee joint disorders were degenerative in origin. Since MRI is not easily available in developing countries and rural areas. US can be used routinely for the diagnoses of most knee joint diseases, shortening the list of MRI indications.

Key words: Arthritis, effusion, knee joint, magnetic resonance imaging, ultrasound

INTRODUCTION

The use of ultrasound (US) as a clinical investigative tool started in 1950's. US application in imaging remained underutilized until 1980's. It is a noninvasive, freely available, well-accepted by patients, affordable and dynamic evaluation in real time.^[1] Recent advances in US system instrumentation and transducer technology allowed better demonstration

of musculoskeletal diseases. The most known clinical application is the ability to obtain a clear anatomical overview of the superficial structures around the bones. Soft tissue pathology of the knee represented one of the common uses since the nineties of the last century.^[2,3] The majority of adults, all over the world, complain of knee joint pain, that is routinely investigated by conventional X-ray, US and magnetic resonance imaging (MRI). The latter provides conclusive diagnosis, but the disadvantage of being an expensive option, well beyond the capabilities of most developing countries. The efficiency of US has not been studied in comparison with MRI in knee disorders like anterior cruciate ligament/posterior cruciate ligament (ACL/PCL) ruptures, collateral ligament injuries, quadriceps tendon rupture, cellulitis, soft tissue abscesses, septic arthritis, aneurysm, nerve sheath tumor, meniscal

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10.4103/1858-5000.144640

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tears, joint effusions and other fluid collections such as bursitis and Baker's cysts.^[4] (US) and MRI is the primary modalities currently used for synovium assessment.^[5]

MATERIALS AND METHODS

A total of 200 patients with knee joint symptom participated in this study, which has taken place between September 2011 and June 2014, in the Radiology Department, College of Applied Medical Sciences, King Khalid University, Saudi Arabia (Abha, Aseer Region).

Ultrasound examination

The knee joint US examination has performed with GE-USA Medical System Logic 3 Expert 2007, using linear probes with high frequency of 7.5-12 MHz. The technique protocol meet the standard by American Institute of Ultrasound in Medicine.

Magnetic resonance imaging examination

The MRI machine was a GE 1.5 Tesla field of view 14 cm, using 4/0.2 mm thickness/gap and about 20 min total time [without Gradient Echo (GRE)]. 5 or 6 sequences were used: (1) Axial fast spin echo (FSE) T2-weighted Fatsat, (2) Coronal FSE T1-weighted, (3) Coronal FSE proton density-weighted (PDW) Fatsat, (4) Sagittal spin echo PDW, (5) Sagittal FSE T2-weighted Fatsat, (6) $\pm$ Sagittal Elective T2 relaxation time (T2*).

Data collection and analysis

Data will be collected in the tabulated database sheet and will be analyzed by Statistical Package for Social Studies (SPSS) Version 22 (SPSS Inc., 233s. Wacker Drive, Chicago, IL, 60606-6412, USA). The data included the age, gender, weight, height, mass index, US findings, MRI findings, US and MRI characterizations.

RESULTS

The age of the patients and subjects ranged from 12 to 80 years. Males were 166 (83%) and females were 34 (17%) as shown in Table 1. The symptoms included painful swelling and restriction of movements. 125 patients (102 males [81.4%] and 23 females [18.4%]) had definite disease as revealed by US and MRI. US and MRI revealed the disorders shown in Table 2: 81 effusions (64.8%) [Figure 1a-c], loose body 2 (1.6), synovial cyst 4 (3.2%), quadriceps tendon rupture 1 (0.8), meniscus tear 6 (4.8%) [Figure 2a and b], tumor 1 (0.8%) and bursitis 8 (6.4%) [Figure 3], arthritis 5 (4%), baker cyst 4 (3.2%) [Figure 4], and deep vein thrombosis 3 (2.4%) also seen in both US and MRI and ACL tear 6 (4.8%), PCL tear 4 (3.2%) seen in MRI only. Knee joint pathological entities diagnosed with US and MRI. US was as good as MRI except for ACL and PCL rupture. Figures 1-4 demonstrate some lesions as shown by MRI and US.

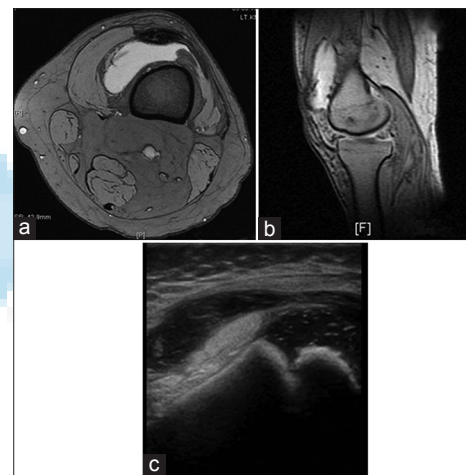


Figure 1: Knee joint effusion: (a) Axial T2-weighted magnetic resonance imaging (MRI), (b) sagittal T2-weighted MRI, (c) ultrasound

Table 1: Age group according to the frequent incidence of the diseases

Age group	10-20	21-30	31-40	41-50	51-60	61-70	71-80	Total	Percentage
Effusion	2	4	19	33	15	5	3	81	64.8
Bursitis	0	1	2	5	0	0	0	8	6.4
Meniscus tear	0	2	3	1	0	0	0	6	4.8
Loose body	0	0	1	1	0	0	0	2	1.6
Baker cyst	0	0	0	1	3	0	0	4	3.2
Synovial cyst	0	0	0	1	1	2	0	4	3.2
Quadriceps tendon rupture	0	1	0	0	0	0	0	1	0.8
Arthritis	0	0	0	0	1	2	2	5	4
DVT	0	0	0	1	1	1	0	3	2.4
Tumor	0	0	0	0	1	0	0	1	0.8
ACL tear	0	2	2	1	1	0	0	6	4.8
PCL tear	0	2	2	0	0	0	0	4	3.2
Total	2	12	29	44	23	10	5	125	100
Percentage	1.6	9.6	23.2	35.2	18.4	8	4	100	

DVT = Deep vein thrombosis; ACL = Anterior cruciate ligament; PCL = Posterior cruciate ligament

Table 2: Knee joint disorder seen by ultrasound and MRI

Pathology finding	No.	Variable diseases were reveal by U/S and MRI 125	
		Seen in ultrasound	Seen in MRI
Effusion	81	√	√
bursitis	8	√	√
Meniscus tear	6	√	√
Loose body	2	√	√
Baker cyst	4	√	√
Synovial cyst	4	√	√
Quadriceps tendon rupture	1	√	√
Arthritis	5	√	√
DVT	3	√	√
Tumor	1	√	√
ACL tear	6	×	√
PCL tear	4	×	√

MRI = Magnetic resonance imaging; DVT = Deep vein thrombosis; ACL = Anterior cruciate ligament; PCL = Posterior cruciate ligament

DISCUSSION

In this study, out of 200 patients presenting with knee joint symptoms males constituted 83% and female 17%, a finding shared by many previous studies, though higher in this study which has been carried out where males are more active and out. The most common clinical complaints were found to be knee joint pain and swelling, similar to what has been observed by other investigators. Effusion was the commonest finding observed in 81 patients (64.8%). Esen *et al.*, in 2013^[6] found effusion by US to be 55% of consecutive patients presenting with painful knee. Despite inherent limitations, joint US examination identified subclinical abnormalities of HJ in young subjects with severe hemophilia.^[7]

Because meniscal injury is associated with sporting activities especially football, a common sport in Saudi Arabia, a 4.8% of cases showed meniscal degeneration and tear. US showed all cases demonstrable with MRI. This was the conclusion of Court-Payen^[8] who listed suspected meniscal tears as one of the important indications. This is also in line with the concluding remarks of the recent (2013) meeting of the American Association of Orthopedic Surgeons^[9] the US is a useful tool for diagnosis of meniscal pathology, with potential advantages over MRI. The availability, affordability and portability are invaluable at moment-of-injury in athletes. Reports reveal that majority of cases developed knee joint meniscal tears because the meniscus has such important functions in load bearing and stability of the knee, loss of this structure in the young is associated with significant degenerative changes, which may also be depicted with US

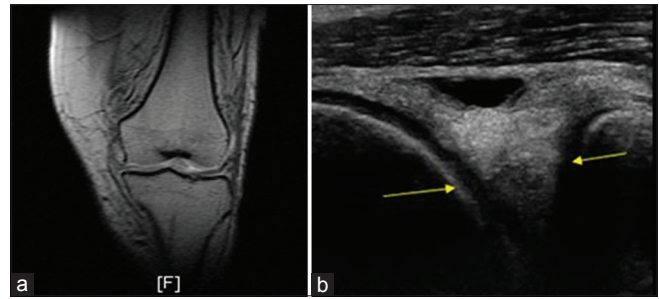


Figure 2: Medial meniscal tear: (a) Coronal T1-weighted magnetic resonance imaging, (b) ultrasound

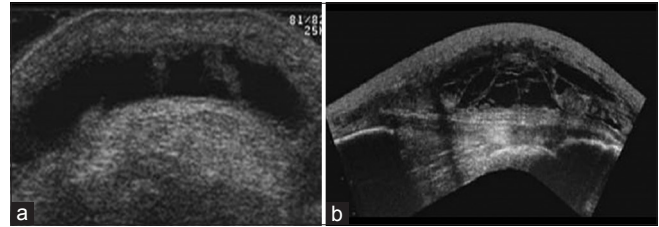


Figure 3: Ultrasound prepatellar bursitis (a) and a septal pattern (b)

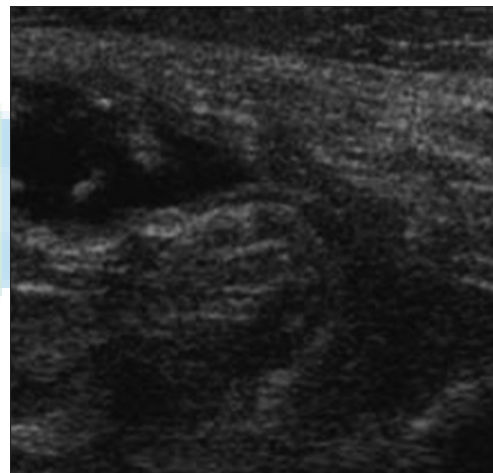


Figure 4: Baker's cyst, transverse

and MRI. Such justification exactly matches our findings in this study.

Studies done by Teefey Eric^[1] and Ward *et al.*^[10] had shown that identification of fluid between the semimembranosus and medial gastrocnemius tendons in communication with a posterior knee cyst indicates Baker's cyst with 100% accuracy. These features have been demonstrated in all cases where the Baker's cysts were found. The gender distribution is the same three females (75%) and one male (25%). This has been attributed to the fact that females stand more than male in the kitchen, and they are more obese.

According to Swamy *et al.*,^[11] ruptures of the patellar and quadriceps tendon are rare injuries requiring immediate

repair to allow extensor movement. US is extensively used as a diagnostic tool before surgery on acute traumatic tears of the patellar tendon and quadriceps tendons. In obese and muscular patients US may not be reliable without confirmation with MRI. In this study, the percentage of tendon rupture is also rare due to the cold nature of the cases presented.

This study confirmed that US offers little or no diagnostic information for deep internal structures such as the cruciate ligaments. If this is suspected, MRI is the technique of choice.

CONCLUSION AND RECOMMENDATION

Ultrasound can be used to evaluate the knee joint diseases especially cystic lesions, effusions, menisci, ligaments, tendons, and muscles tears. Most of these knee joint disorders were either traumatic or degenerative in etiology. MRI is not wide available and is expensive, for that reason the study recommends the use of US in painful knee joint in routine patient care in developing countries. When ACL or PCL rupture is suspected, MRI is inevitable.

ACKNOWLEDGMENTS

The authors would like to express their appreciation to Administrative Manager of College of Applied Medical Sciences, Abha, KSA for giving the opportunity to conduct the study in the Radiological Center. Special thanks for Technical Radiological Staff in the Department for their cooperation.

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How to cite this article: Yousif EA, Ahmed BH, Abdella AA, Ali QM. Knee joint diseases diagnosed by ultrasound and magnetic resonance imaging. *Sudan Med Monit* 2014;9:1-4.

Source of Support: Nil. **Conflict of Interest:** None declared.

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