

Research Article

Accuracy of High Frequency Ultrasound in Meniscal Tears

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ABSTRACT

Objective: To determine the accuracy of high frequency ultrasonography in meniscal tears of knee joint in adult patients confirmed on MRI.

Methods: This cross sectional study was conducted at Department of Radiology, Bahawal Victoria Hospital, Bahawalpur from November 2014 to November 2015. A total of 100 patients with suspicion of meniscal injury between 15-50 years of age of either gender were included in the study. Patients with follow up of previous meniscal tear or surgery and with diseases mimicking meniscal injury and with open wound over the knee were excluded. Ultrasound findings were correlated with findings of magnetic resonance imaging which was performed and interpreted by consultant radiologist.

Results: Out of these 100 patients, Ultrasonography showed meniscal injury in 75.0% patients. MRI confirmed meniscal injury in 77.0% cases where as 23.0% patients revealed no meniscal injury. In ultrasound positive patients, 72.0% were true positive and 3.0% were False Positive. Among, 25 ultrasound negative patients, 5.0% (False Negative) had meniscal injury on MRI where as 20.0% (True Negative) had no meniscal injury on MRI. So, the sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of ultrasound in diagnosing meniscal injury was 93.50%, 86.96%, 96.0%, 80.0% and 92.0% respectively.

Conclusion: This study concludes that high resolution ultrasonography appears to be a reliable, accurate, easily available and cost effective method for the evaluation of meniscal injury in low resourced areas where magnetic resonance imaging (MRI) is expensive and accessible only to a few patients.

Keywords: Meniscal Tear, Magnetic Resonance Imaging, Diagnostic Accuracy, Ultrasonography.

INTRODUCTION

The knee is one of the most important joints of our body. Meniscal injuries can be divided into traumatic and degenerative types. Confirmation of meniscal injuries requires further evaluation by various diagnostic tools such as ultrasonography, CT scan, arthroscopy or MRI.¹ Ultrasonography is a feasible, inexpensive and accurate method for evaluating musculoskeletal injuries, which can

be used as the first complementary diagnostic method. US is more sensitive than radiography when evaluating cartilage damage.² High Resolution Ultrasound (HRUS) is emerging as a viable imaging modality in the diagnosis and assessment of the musculoskeletal system. Advantages of High Resolution Ultrasound include its easy availability and multiplanar capability, as well

as economic advantages. Unlike magnetic resonance imaging, ultrasound demonstrates the fibrillar microanatomy of tendons, ligaments and muscles, enhancing its diagnostic capability. The ability to compress, dynamically assess structures and compare easily with the contra lateral side is advantageous.³⁻⁴The advantages of HRUS include low cost, no radiation exposure, direct visualization of soft tissues, and a readily available dynamic study.⁵

Magnetic resonance imaging (MRI) is the most powerful, accurate, and noninvasive method for diagnosing meniscal tears. It is still gold standard imaging modality and more accurate than physical examination, ultrasonography and has influenced clinical practice and patient care by eliminating unnecessary diagnostic arthroscopies or by identifying alternative diagnosis that may mimic meniscal tears.⁶⁻⁷Despite the fact that MRI has very good sensitivity and specificity in diagnosing meniscal tears, yet it is an expensive diagnostic test and still not available at many centers. Thus, recent trends towards cost reduction have made ultrasonography an attractive alternative to more expensive imaging methods, such as MR imaging.⁸ Besides in patients having a contraindication to MR imaging, such as cardiac pacemakers, cerebral clips, orbital metallic foreign bodies or non-titanium metallic prostheses, ultrasonography could be the best imaging modality. Sonography is also easily applicable in very heavy patients who cannot be examined by MRI.

So, keeping in mind all the above facts, this study is conducted to determine the diagnostic accuracy of high frequency ultrasonography in the detection of meniscal tears so that patients could be provided with simple, economical and readily available alternative to MRI.

MATERIALS AND METHODS

This Cross-sectional study was conducted at Department of Radiology, Bahawal Victoria

Hospital, Bahawalpur from November 2014 to November 2015. Total 100 cases of both genders and age between 15 to 50 years were included in the study. Clinically suspected cases of meniscal tears with any of the following signs and symptoms lasting for 1 to 8 weeks Knee pain, Swelling of knee (Stiffness), Tenderness when pressing on the meniscus and Limited motion of the knee joint. Patients with diagnosed cases of meniscal injury, inflammatory arthritis and synovial lesions and open wounds over knee were excluded. After taking permission from the ethical review committee, 100 patients who were admitted in orthopedic department of Bahawal Victoria Hospital, Bahawalpur and referred by clinician to the radiology department for MRI scan fulfilling the inclusion/exclusion criteria were enrolled in the study. Sonographically using high frequency linear probe under the direct supervision of consultant radiologist prior to undergo an MRI examination. Sonographic examination was performed on General Electric Logiq P-5 ultrasound machine using 10 MHz frequency linear probe. Then Magnetic Resonance Imaging (MRI) of injured knee was performed in every patient on 1.5 T Philips whole body MR system using standard imaging coil. Each MRI was reviewed by consultant radiologist. Collected data was analyzed through computer software SPSS 18 and analyzed Mean and standard deviation was calculated for neumarical data .Frequency and percentage was calculated for categorical data.

RESULTS

Age range in this study was from 15 to 50 years with mean age of 30 ± 2.65 years. Majority of the patients 46.0% were between 25 to 35 years of age as shown in Table I. Out of these 100 patients, 76 (76.0%) were male and 24 (24.0%) were females with ratio of 3.17:1 (Figure 1).

Majority of patients 62 (62.0%) were

presented with indirect trauma while 38.0% with direct trauma to knee as shown in Table II. The duration of symptoms in patients ranged from 01 to 08 weeks with an average of 02 ± 1.65 days.

All the patients were subjected to high frequency ultrasonography of the affected knee. Ultrasound supported the diagnosis of meniscal injury in 75 (75.0%) patients. MRI confirmed meniscal injury in 77 (77.0%) cases where as 23 (23.0%) patients revealed no meniscal injury. In ultrasound positive patients, 72 (72.0%) (True Positive) had meniscal injury and 03 (3.0%) (False Positive) had no meniscal injury on MRI. Among, 25

ultrasound negative patients, 05 (5.0%) (False Negative) had meniscal injury on MRI whereas 20 (20.0%) (True Negative) had no meniscal injury on MRI as shown in Table III. Stratification of age group and gender according to the presence of meniscal injury on ultrasonography was shown in Table IV. Stratification of patients according to duration of symptoms was shown in Table V. So, the sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of ultrasound in diagnosing meniscal injury was 93.50%, 86.96%, 96.0%, 80.0% and 92.0% respectively (Table VI)

Table-I: %age of patients according to Age distribution (n=100).

Age (years)	Male		Female		Total	
	No.	%age	No.	%age	No.	%age
15-25	21	21.0	08	8.0	29	29.0
26-35	37	37.0	09	9.0	46	46.0
36-45	11	11.0	04	4.0	15	15.0
45-50	07	7.0	03	3.0	10	10.0
Total	76	76.0	24	24.0	100	100.0

Figure-I: %age of patients according to Gender (n=100).

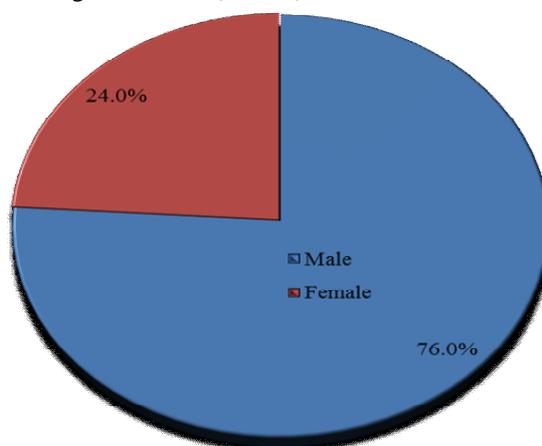


Table-II: %age of patients according to Type of Trauma (n=100).

Type of Trauma	Male		Female		Total	
	No. of pts	%age	No. of pts	%age	No. of pts	%age
Direct	47	47.0	15	15.0	62	62.0
Indirect	29	29.0	09	9.0	38	38.0

Table-III: Summary of Results.

	Positive result on Ultrasonography	Negative result on Ultrasonography
Positive MRI findings	72 (TP)*	05 (FN)***
Negative MRI findings	03 (FP)**	20 (TN)****

*-TP=True positive **-FP=False positive ***-FN=False negative ****-TN=True negative

Table-IV: % age of patients with positive meniscal injury on ultrasound according to Age groups and Gender (n=75)

Age (years)	Male		Female		Total	
	No.	% age	No.	% age	No.	% age
15-25	15	20.0	04	5.33	19	25.33
26-35	25	33.33	08	10.67	33	44.0
36-45	11	14.67	02	2.67	13	17.33
45-50	09	12.0	01	1.33	10	13.33
Total	60	80.0	15	20.0	75	100.0

Table V: Stratification of patients according to duration of symptoms (n=100)

Duration of Symptoms (1-8 weeks)	Meniscal injury			
	Present (n=77)		Absent (n=23)	
	No.	% age	No.	% age
1-4 weeks	46	59.74	10	43.47
>4-8 weeks	31	40.26	13	56.52

Table VI: Evaluation of Ultrasonography in diagnosing meniscal injury.

Evaluation of Ultrasonography	Values (%)
• Sensitivity	93.50
• Specificity	86.96
• Positive Predictive Value (PPV)	96.0
• Negative Predictive Value (NPV)	80.0
• Diagnostic Accuracy	92.0
• Likelihood ratio for Positive test result	7.16
• Likelihood ratio for Negative test result	0.07

Sensitivity: TP / TP + FN

Specificity: TN / TN + FP

Positive Predictive Value (PPV): TP / TP + FP

Negative Predictive Value (NPV): TN / TN + FN

DISCUSSION

The majority of meniscal tears affect the medial meniscus and tend to involve the posterior horn. Since trials should be performed to find a diagnostic tool that is non-invasive, inexpensive and easily available. Sonography has all these advantages but it can substitute routine methods only if it has acceptable sensitivity and specificity. In this study, high frequency ultrasonography have shown better sensitivity and specificity in the detection of meniscal tears, which was confirmed on MRI reports.⁹

In this study, age range was from 15 to 50 years with mean age of 30 ± 2.65 years which is comparable to studies of Forouzmehr A et

al¹⁰ and Khan RA et al¹¹ i.e. 32 and 29 years respectively. Mahmoud MZ et al¹² has shown a much larger mean age i.e. 39 years, because he included patients with much larger age range in his study as compared to this study. In their studies done by Mahmoud MZ et al¹² and Sharma UK et al¹³ meniscal injury was more frequent in females, while in this study we had male preponderance. Studies done by EL-Monem SA et al¹⁴ and Forouzmehr A et al¹⁰ also showed male dominance. So, this study showed that patients having meniscal injuries of knee joint were mostly males (76%) with 46 % patients ranging between ages of 26–35. This indicated that meniscal injuries prevail mostly in young males. This is

in accordance with national & international studies which favour young male predilection for meniscal injuries.^{10,15} The advantages of HRUS include low cost, no radiation exposure, direct visualization of soft tissues, and a readily available dynamic study.¹⁶ In this study, the sensitivity, specificity, diagnostic accuracy of ultrasonography in medial meniscus tear was 95.43%, 88.0% and 94.0% respectively while for lateral meniscus tear was 91.83%, 88.96% and 90.0% respectively. Silvestri E et al¹⁷ the sensitivity of sonography of the medial meniscus using linear probes is 81%, and for the lateral meniscus it is 41%.

Conclusion: This study concludes that high frequency ultrasound is a reliable, accurate, easily available and cost effective method for the evaluation of meniscal tears in low resourced areas like Bahawalpur where MRI is expensive and not easily accessible to all patients. Moreover, ultrasound also gives high accuracy & sensitivity which nearly approaches that of MRI. So it is preferable to use high frequency ultrasound as a preliminary investigation for diagnosing meniscal injury, as the patient can avoid performing the high cost MRI. So, in patients with knee trauma and clinical suspicion of meniscal injury, we recommend to start with high frequency ultrasound examination as a screening tool.

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