Accuracy of magnetic resonance imaging in diagnosis of knee injuries

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Abstract

Introduction: Apart from clinical examination multiple modalities (conventional radiography, MRI and arthroscopy) are currently used to evaluate knee injuries. This study is intended to compare the sensitivity and specificity of MRI in correlation of arthroscopy in diagnosing of knee injuries.

Material & Methods: This is a prospective study involving 51 patients with history of knee injuries who were admitted in the Department of Orthopaedics, in a tertiary care hospital of Kolkata between April 2013 and June 2014. MRI of the knee joint was done for all these patients either before or after admission. The patients were then subjected to diagnostic and therapeutic arthroscopy. Statistical analysis was used to calculate the sensitivity, specificity, positive predictive value and the negative predictive value, in order to assess the reliability of the MRI results.

Results: The sensitivity and specificity of MRI with respect to arthroscopy in anterior cruciate ligament tear is 87.5% and 66.6%. Positive predictive value is 87.5%. Negative predictive value is 66.6%. Accuracy is 81.82%. The sensitivity and specificity of MRI with respect to arthroscopy in medial meniscal tears is 85.7% and 70.8% respectively. Positive predictive value is 63%; Negative predictive value is 89.4%; Accuracy is 76.3%.

Conclusion: The present study supports that MRI is helpful in diagnosing medial meniscal and anterior cruciate ligament injuries. The negative predictive value of a MRI was found to be high for all structures of the knee joint and hence a MRI can be used to exclude a pathology, thus sparing patients from expensive and unnecessary surgery.

Keywords: Knee injuries, MRI, arthroscopy

1. Introduction

Multiple imaging modalities are currently used to evaluate pathologic conditions of the knee like conventional radiography, fluoroscopy, sonography, nuclear medicine and MR imaging. The use of fluoroscopy and sonography to guide interventional procedures and Computerised Tomography (CT) to evaluate complex fractures has become a routine practice [1]. Magnetic resonance imaging has a better soft tissue contrast, bone marrow involvement and multi planar slice capability which has revolutionized and has become the ideal modality for imaging complex anatomy of the knee joint [2,3]. Another advanced modality in the management of internal derangement of knee joint is Arthroscopy, which can be used in its dual mode, either as diagnostic and or as therapeutic tool [4]. Menisci and anterior cruciate ligaments (ACL) are commonly injured in knee trauma, especially in road traffic accident and amongst young males in the sports field. Medial Meniscus is more commonly injured than lateral meniscus and sometime associated with anterior cruciate ligament tear. Individuals who experience a blunt trauma knee with suspected internal derangement usually complain of pain and swelling as their primary symptoms. However, sometime they may be confusing and delay in diagnosis may result in a worse prognosis. Therefore, confirmation of injuries requires further evaluation by arthroscopy or magnetic resonance imaging. The clinical examination and standard tests to determine instability and internal derangements still stands as preliminary and gold standard, more reliable and cost effective way of diagnosing such knee problems. Hence this study is intended to determine the benefits of arthroscopy directly and also to compare the sensitivity and specificity of MRI and arthroscopy in diagnosing internal derangements of the knee.
2. Materials and Methodology
This is a prospective study involving 51 patients with history of knee injuries who were admitted in the Department of Orthopaedics, in a tertiary care hospital of Kolkata between April 2013 and June 2014. Informed consent and approval of institutional Ethical committee was taken for the study. Purposive random technique was used to select 51 patients with history of knee trauma admitted and treated in the department of Orthopaedics. MRI of the knee joint was done for all these patients either before or after admission. The patients were then subjected to diagnostic and therapeutic arthroscopy in the department of orthopedics at this hospital. Study participants were patients suffering from knee problems like pain, instability for more than 6wks duration, patients with recent symptoms of locking of knee or effusion, patients who have undergone MRI due to any other indication which confirms IDK, patients with chronic knee pain and doubtful knee injury and patients aged between 18-60yrs. Patients with signs of acute infections, cases with severe osteoarthritis, cases with ankylosed knee, cases who have undergone previous arthroscopy, cases treated for chronic septic arthritis or doubtful TB KNEE and patients below the age of 18yrs and above 60yrs were excluded from study. Complete examination of knee was carried out with particular emphasis on tests for meniscal tears like medial joint line tenderness, McMurrays test, Apleys grinding tests, tests for cruciate ligament tears like Lachman test, anterior and posterior drawer tests, Pivot shift tests. Pre- Operative workup included routine-hemogram, urine routine, biochemical parameters of blood, ECG. The protocol for imaging the knee (MRI Knee) included; localizer sequences in sagittal, coronal and axial planes, fat suppressed T2 axial turbo spin echo, T1 spin echo sagittal, T1W, PD/T2W & STIR coronal and sagittal. and Pre-anaesthetic check-up for fitness for arthroscopy. Operative findings were documented in the operation theatre, which included the survey of the entire joint and anatomical structure, lesions involved with the presence or absence of tear, its location, status of the articular cartilage and others. The composite data was tabulated and studied for correlation with MRI findings and grouped into four categories: 1. True-positive -if the MRI diagnosis was confirmed by arthroscopic evaluation, 2. True-negative -when MRI negative for lesion and confirmed by arthroscopy, 3. False-positive – when MRI shows lesion but the arthroscopy was negative, 4. False- negative- result when arthroscopy was positive but the MRI showed negative. Statistical analysis was used to calculate the sensitivity, specificity, positive predictive value (PPV) and the negative predictive value (NPV), in order to assess the reliability of the MRI results. Data was analyzed for the significant correlation between MRI knee and arthroscopic findings by kappa statistics.

3. Results
The study had 51 patients, of which 40 (78.43%) were males and 11 (21.57%) were females. The patients who suffered injury were with age ranging from 18 to 60 years. Mean age of patients was 38.17 years with standard deviation 8.66 years. Maximum number 22 (43.14%) of patients who suffered knee injuries were in the age group of 30-40 years followed by 40-50 years age group (33.33).Right Knee was involved in 32 (62.75%) cases and left knee was involved in 19 (37.25%) cases and there were no cases with bilateral knee involvement. Mode of injury was sports in 36(70.59%) cases, motor vehicle accident in 3(5.89%) cases, and domestic falls in 6 (11.76%) cases and others in 6(11.76%) cases. ACL was detected in 32 cases by MRI and arthroscopy. Medial meniscus was injured in 19 cases as per MRI and 12 cases as per arthroscopy. Diagnosis of anterior cruciate ligament tears by MRI and Arthroscopy has been shown in table 1 to calculate sensitivity and specificity. The sensitivity and specificity of MRI with respect to arthroscopy in ACL tear is 87.5% and 66.6%. Positive predictive value is 87.5%. Negative predictive value is 66.6%. Accuracy is 81.82%. Kappa value is 0.526. and P value is 0.0009 and it is significant. Diagnosis of medial meniscus tear by MRI and arthroscopy has been shown in table 2. The sensitivity and specificity of MRI with respect to arthroscopy in medial meniscal tears is 85.7% and 70.8% respectively. Positive predictive value is 63%; Negative predictive value is 89.4%; Accuracy is 76.3%; Kappa = 0.526; and P value is 0.0019 which is very significant. Accuracy of MRI in diagnosis of ACL and medial meniscus tear was 81.8% and 76.3% respectively (table3).

Table 1: Diagnosis anterior cruciate ligament tears by MRI and Arthroscopy

<table>
<thead>
<tr>
<th>MRI</th>
<th>Arthroscopy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>Negative</td>
</tr>
<tr>
<td>Positive</td>
<td>28</td>
</tr>
<tr>
<td>Negative</td>
<td>4</td>
</tr>
</tbody>
</table>

Sensitivity – 87.5%; Specificity – 66.67%; Positive predictive value – 87.5%
Negative predictive value – 66.6%; Accuracy – 81.82%; Kappa – 0.542 – moderate
P value – 0.0009 – extremely significant

Table 2: Diagnosis medial meniscus tears by MRI and arthroscopy

<table>
<thead>
<tr>
<th>MRI</th>
<th>ARTHROSCOPY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>Negative</td>
</tr>
<tr>
<td>Positive</td>
<td>122</td>
</tr>
<tr>
<td>Negative</td>
<td>02</td>
</tr>
</tbody>
</table>

Sensitivity – 87.5%; Specificity – 70.8%; Positive predictive value – 63%;
Negative predictive value – 66.6%; Accuracy – 81.82%; Kappa = 0.526 – moderate; P value 0.0019 – very significant

Table 3: Accuracy of MRI in diagnosis of ACL and medial meniscus tear

<table>
<thead>
<tr>
<th>Structure</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACL</td>
<td>87.5%</td>
<td>66.7%</td>
<td>81.8%</td>
</tr>
<tr>
<td>Medial meniscus</td>
<td>85.7%</td>
<td>70.8%</td>
<td>76.3%</td>
</tr>
</tbody>
</table>

4. Discussion
In the everyday practice, based on clinical examination that comes first, surgeons decide whether must proceed to further laboratory tests, MRI, conservative or surgical treatment. But how precise can clinical examination be? There seems to be disagreement regarding the answer to this question. Magnetic resonance imaging (MRI) has a great role in the diagnosis of knee lesions. Most diagnostic studies comparing MRI and arthroscopy have shown good diagnostic performance in detecting lesions of the menisci and cruciate ligaments. The sensitivity for diagnosing isolated medial meniscal tears in Rubin’s series [5] was 98% and it decreased when other structures were also injured. The specificity in isolated lesions was 90%. In a multicentric analysis Fisher [6] reported an accuracy of 78-97% for the anterior cruciate ligament and 64-95% for medial meniscus tears. The menisci are composed of fibrocartilage and appear as low signal structures on all pulse sequences. The sensitivity and specificity of MRI in detecting
The present study supports that MRI is helpful in diagnosing medial meniscal and anterior cruciate ligament injuries. Taking into account that MRI false or misleading results can be as high as 20-30 percent in specific knee pathologies, it is concluded that arthroscopy still remains the gold standard in diagnosing the internal knee lesions. The routine use of MRI scan to confirm diagnosis is not indicated, as the positive predictive value of the scan is low for all lesions. The negative predictive value of a scan was found to be high for all structures of the knee joint and hence a ‘normal’ scan can be used to exclude a pathology, thus sparing patients from expensive and unnecessary surgery.

6. References