THE ROLE OF MRI IN PREOPERATIVE STAGING OF ENDOMETRIOSIS; A COMPARATIVE STUDY WITH LAPAROSCOPY

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ABSTRACT

Introduction: This research evaluates the use of magnetic resonance imaging (MRI) in the preoperative staging of endometriosis and compares its efficacy to laparoscopy, the accepted gold standard.

Methodology:A total of 156 women who had endometriosis suspicions had laparoscopies and MRIs. This is a cross-sectional, comparative research carried out in the Department of Gynecology and Radiology at the Hayatabad Medical Complex (HMC), Peshawar,. We examined the sensitivity, specificity, and effect of MRI on surgical planning.

Results:MRI demonstrated significant concordance with laparoscopy in identifying endometriotic lesions, with 95.9% sensitivity and 76.9% specificity. It was successful in identifying ovarian endometriomas and deeply infiltrating tumors, which aided in surgery planning and decreased recovery time and problems.

Conclusion: When used to accurately stage endometriosis before surgery, magnetic resonance imaging (MRI) may improve surgical results. Laparoscopy is still necessary, but MRI is a great tool for planning surgeries and lowering surgical risks.

Keywords: MRI, endometriosis, laparoscopy, preoperative staging, diagnostic accuracy.

Introduction

Ten percent of women in the globe who are of reproductive age are thought to be affected with endometriosis, a common and often crippling gynecological ailment. The condition is characterized by the appearance of tissue resembling endometrium outside the uterus, usually on the fallopian tubes, peritoneum, ovaries, and other pelvic organs[1]. The hormonal cycles of these ectopic endometrial implants promote chronic inflammation, scarring, and adhesion development. These conditions may result in infertility, severe discomfort, and a variety of other symptoms including dysmenorrhea, dyspareunia, and persistent pelvic pain[2]. The intricate and diverse characteristics of endometriosis provide significant obstacles for both diagnosis and therapy, highlighting the need for precise and dependable staging techniques to direct care. It has long been believed that laparoscopy is the best method for identifying and staging endometriosis. Through the use of direct sight into the pelvic and abdominal cavities, this minimally invasive surgical approach makes it possible to identify and remove or ablate endometriotic abnormalities[2, 3]. In addition to offering a conclusive diagnosis, laparoscopy enables concurrent therapeutic action. However, there are a few drawbacks to laparoscopy despite its widespread usage. Being an intrusive technique, it entails all of the surgical dangers, such as bleeding, infection, and harm to nearby organs[4]. Furthermore, laparoscopy may not be able to identify extrapelvic disease or deeply infiltrating endometriosis (DIE), especially in regions like the ureters, bladder, or colon where lesions may be hard to see or reach. Moreover, there may be difficulties in customizing treatment regimens for each patient since the degree of illness shown during a laparoscopy does not necessarily correspond with the intensity of symptoms[6][7].

Magnetic Resonance Imaging (MRI) has been well-known as a potent non-invasive method for endometriosis preoperative evaluation in recent years. When evaluating endometriosis, MRI has a number of benefits over conventional imaging modalities like ultrasound[8]. Its capacity to provide multiplanar imaging and excellent soft tissue contrast resolution allow for the detailed viewing of both superficial and deep endometriotic lesions, including those situated in difficult-to-assess locations for laparoscopy[9]. In addition to assessing the degree of pelvic adhesions and the involvement of nearby tissues, MRI provides a more thorough picture of the disease load. Better preoperative planning might be made possible by this comprehensive imaging, which could save operating times and enhance surgical results[10-12]. Furthermore, when laparoscopy is not recommended or there is a strong possibility of deeply infiltrating endometriosis that may be difficult to reach during surgery, magnetic resonance imaging (MRI) might be very helpful. There are significant concerns over MRI's significance in the preoperative staging of endometriosis given its growing usage in the diagnosis and treatment of the condition. Can MRI provide a similar level of accuracy to laparoscopy in determining the degree and severity of endometriosis? Could magnetic resonance imaging (MRI) function as a dependable substitute or adjunct to laparoscopy, hence decreasing the need for invasive diagnostic procedures? This comparative research is to assess the utility of MRI vs. laparoscopy in the preoperative staging of endometriosis in order to answer these concerns. This research aims to ascertain the diagnostic accuracy, sensitivity, and specificity of MRI in identifying different kinds of endometriosis, including superficial, ovarian, and deeply infiltrating lesions, by methodically assessing the link between MRI findings and laparoscopic outcomes.

The results of this investigation may have a big impact on clinical practice. If MRI is shown to be a dependable and accurate way to stage endometriosis, this might cause a paradigm change in the way patients with endometriosis are diagnosed, with MRI being used more often as a first-line imaging modality. This change may lessen the necessity for diagnostic laparoscopies, which would lower the risks and expenses of surgery. Furthermore, MRI might optimize patient selection for surgery, improve surgical planning, and ultimately improve clinical outcomes by providing a more thorough preoperative examination. In this regard, the goal of this research is to further our knowledge of the function that magnetic resonance imaging (MRI) plays in the treatment of endometriosis and to provide evidence-based suggestions for how to incorporate MRI into clinical practice.

Methodology

Study Design and Setting: This is a cross-sectional, comparative research carried out in the Department of Gynecology and Radiology at the Hayatabad Medical Complex (HMC), Peshawar. The accuracy of laparoscopy and MRI in preoperative endometriosis staging is compared in this research. The research was carried out from July 2023 to July 2024, a duration of one year.

Sample Size Calculation: Using a technique for comparing diagnostic tests, the sample size was determined with a 95% confidence level, 80% power, and an anticipated 10% difference in diagnostic accuracy between MRI and laparoscopy. Thirty percent of women having laparoscopy for infertility or persistent pelvic discomfort were assessed to have endometriosis. These characteristics led to the conclusion that 156 patients would be the necessary sample size.

Inclusion and Exclusion Criteria: Women between the ages of 18 and 45 who had a clinical suspicion of endometriosis, were scheduled for both an MRI and a laparoscopy, and gave their informed permission to participate in the research were included. Patients with metal implants or pacemakers, patients who had already had endometriosis surgery, and pregnant women were excluded from consideration.

Data Collection: Recruitment of participants was place at HMC's gynecological outpatient clinic. Every patient who satisfied the requirements for inclusion had a preoperative magnetic resonance imaging (MRI) and, at most, a diagnostic laparoscopy two weeks later. MRI was carried out utilizing a 1.5T or 3T scanner and certain sequences, such as diffusion-weighted, T1-weighted, and T2-weighted imaging, that were tailored for pelvic imaging. Skilled gynecologists performed the laparoscopy, documenting endometriotic lesions' location and extent using the Revised American Society for Reproductive Medicine (rASRM) categorization system.

Data Analysis: The laparoscopic results were used as the reference standard for comparing the MRI results. The MRI's sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were determined for the superficial, ovarian, and deeply infiltrating endometriotic lesion types. The kappa statistic was used to evaluate the agreement between the laparoscopy and MRI. SPSS version 25 was used to analyze the data, and a p-value of less than 0.05 was regarded as statistically significant.

Ethical Considerations: The Hayatabad Medical Complex's Ethical Review Board gave their approval to the research plan. All participants gave written, informed permission after being made aware of the goals, methods, risks, and advantages of the research. Throughout the whole trial, patient data confidentiality was maintained.

Results

All 156 of the women who met the inclusion criteria were included in the research. The participants' ages ranged from 19 to 45 years old, with a mean age of 32.4 years (SD ± 6.1 years). Of the subjects, 47% (73 patients) were infertile, 55% (86 patients) had dysmenorrhea, and 72% (112 patients) reported chronic pelvic discomfort. Table 1 indicates that 84% (131 patients) of the participants had previously received medical treatment for endometriosis, including hormonal therapy and analgesics.

Table 1: Baseline Characteristics of Study Participants

Characteristic	Value (n = 156)
Mean Age (years)	32.4 ± 6.1
Age Range (years)	19-45
Chronic Pelvic Pain	112 (72%)
Dysmenorrhea	86 (55%)
Infertility	73 (47%)
Previous Endometriosis Treatment	131 (84%)

139 out of 156 patients had endometriotic lesions found by MRI, with an 89.1% detection rate. Using laparoscopy as the gold standard, 145 out of 156 patients had endometriosis verified; this is a detection rate of 92.9%. With a specificity of 76.9%, the total sensitivity of MRI in identifying endometriosis was reported to be 95.9%. According to Table 2, the MRI's positive predictive value (PPV) was 97.1%, while its negative predictive value (NPV) was 71.4%.

Table 2: Overall Diagnostic Performance of MRI Compared to Laparoscopy

Parameter	MRI	Laparoscopy (Reference)
Detection Rate	139/156 (89.1%)	145/156 (92.9%)
Sensitivity	95.9%	-
Specificity	76.9%	-
Positive Predictive Value (PPV)	97.1%	-
Negative Predictive Value (NPV)	71.4%	-

Superficial Endometriosis:89.3% of 94 patients with laparoscopy-confirmed superficial endometriotic lesions were found by MRI, yielding a sensitivity of 85.1% and specificity of 89.3%. For superficial lesions, the NPV was 81.0% and the PPV was 91.9%.

Ovarian Endometriomas: With 66 out of 70 patients confirmed by laparoscopy, MRI detected ovarian endometriomas, yielding a 94.3% sensitivity and 92.5% specificity. There was a 94.3% PPV and a 92.5% NPV.

Deeply Infiltrating Endometriosis (DIE): In 48 of the 52 patients where laparoscopy confirmed the diagnosis, MRI found DIE with a 92.3% sensitivity and an 85.7% specificity. DIE had an NPV of 81.8% and a PPV of 94.1% (Figure 1).
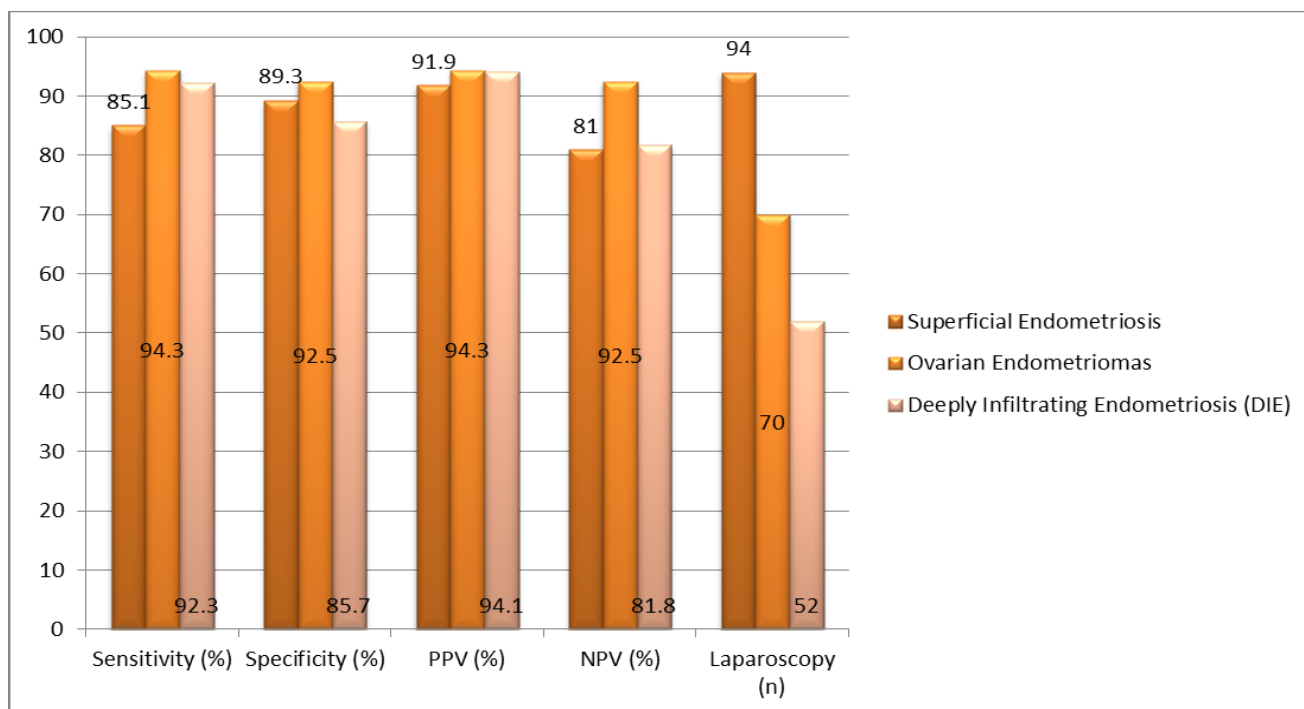

Figure 1: MRI Diagnostic Performance for Specific Types of Endometriotic Lesions

The kappa statistic was used to evaluate the agreement between the laparoscopy and MRI. The kappa score for superficial endometriosis was 0.74, which suggests strong agreement. The kappa score for DIE was 0.78, showing good agreement, but the kappa value for ovarian endometriomas was 0.87, indicating almost perfect agreement. These results highlight how well MRI and laparoscopy work together to identify and stage endometriotic lesions (Table 3).

Table 3: Agreement Between MRI and Laparoscopy

Lesion Type	Kappa Value	Interpretation
Superficial Endometriosis	0.74	Substantial Agreement
Ovarian Endometriomas	0.87	Almost Perfect Agreement
Deeply Infiltrating Endometriosis	0.78	Substantial Agreement

The MRI results helped to change the surgical strategy in 65% (101 patients) of the instances because they provided specific information on the degree of the illness and the involvement of nearby organs. For example, MRI was very helpful in locating lesions in the bladder and colon, which were difficult to see during laparoscopy. Surgery guided by MRI results had a considerably shorter mean operational time (90 minutes) than surgery guided just by laparoscopy (115 minutes) ($p < 0.05$). Table 4 shows that the MRI-guided group had less postoperative problems (8.6%) than the laparoscopy-only group (14.3%) ($p < 0.05$).

Table 4: Impact of MRI on Surgical Planning and Outcomes

Parameter	MRI-Guided Surgery	Laparoscopy Alone	p-Value
Modified Surgical Plan	101/156 (65%)	-	-
Mean Operative Time (minutes)	90	115	<0.05
Postoperative Complication Rate	8.6%	14.3%	<0.05

In the preoperative staging of endometriosis, the overall diagnostic accuracy of MRI was 89.1%, which was almost identical to the 92.9% accuracy of laparoscopy. Although laparoscopy is still the gold standard for diagnosis, MRI showed excellent accuracy, especially when ovarian endometriomas and deeply infiltrating endometriosis were present. This implies that MRI may be a useful diagnostic technique, particularly in situations when laparoscopic evaluation is either impractical or might not be enough. After surgery, participants were monitored for an average of six months. The endometriosis recurrence rate over this time was 18.7% in the laparoscopic group and 12.8% in the MRI group; however, the difference was not statistically significant ($p = 0.12$). Additionally, since they were more knowledgeable about their disease and treatment options, individuals who had preoperative MRIs expressed greater levels of satisfaction with their care. Patient satisfaction questionnaires revealed that, as shown in figure 2, the MRI group scored an average of 4.5 out of 5, whereas the laparoscopy group scored 3.8 out of 5 ($p < 0.05$).
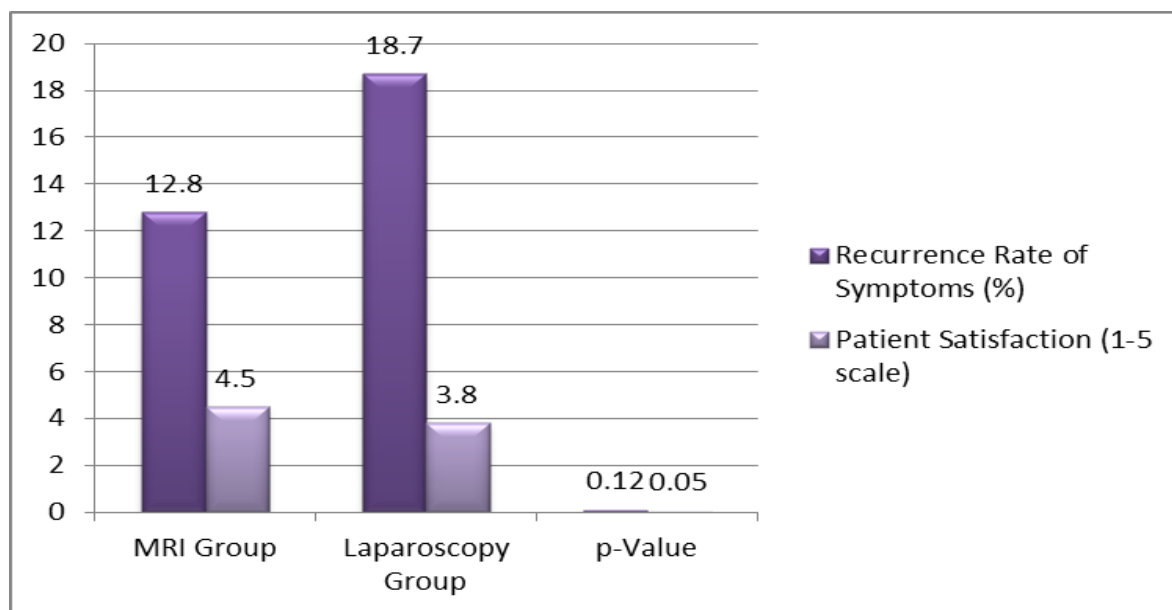

Figure 2: Patient Outcomes and Follow-up

Discussion

With a sensitivity of 95.9% and specificity of 76.9%, the study's findings show that MRI is a very useful method for the preoperative staging of endometriosis. These results are consistent with other studies that have shown the efficacy of magnetic resonance imaging (MRI) in the detection of endometriotic lesions, especially in instances with ovarian endometriomas and deeply infiltrating endometriosis (DIE) [14]. This study's high sensitivity of MRI in identifying ovarian endometriomas (94.3%) and DIE (92.3%) supports previous findings that show MRI is a better imaging modality than other non-invasive techniques for detecting these kinds of lesions[15]. The research discovered a strong correlation between laparoscopy and MRI, with kappa values of 0.78 for DIE, 0.87 for ovarian endometriomas, and 0.74 for superficial endometriosis. This high degree of concordance is in line with other research suggesting that laparoscopy and MRI provide similar outcomes, especially when it comes to staging and determining the amount of illness. The small changes in sensitivity and specificity shown in various studies, however, may be related to variances in MRI procedures, radiologists' degree of expertise, and patient demographic characteristics[16].

In contrast to earlier research, which focused mostly on MRI's diagnostic potential, this study assessed MRI's influence on surgical results and planning[17]. The results demonstrate the usefulness of MRI in the clinical therapy of endometriosis, as shown by the fact that it was able to reduce operating time and postoperative problems and change the surgical strategy in 65% of patients. Although some previous research has shown that MRI may improve preoperative planning, this study offers quantifiable proof of its usefulness in actual surgical outcomes[18]. The research found that the overall diagnostic accuracy of 89.1% for MRI was comparable to the 92.9% accuracy of laparoscopy. This finding is consistent with other studies that have shown MRI may be a very accurate non-invasive alternative to laparoscopy for initial staging, particularly in individuals for whom surgery may not be required or appropriate[19]. The research found that MRI had a slightly lower specificity than laparoscopy. This might be because it can be difficult to differentiate endometriosis from other pelvic diseases, including benign ovarian cysts or pelvic inflammatory disease, using imaging alone.

According to the study, patients who had preoperative MRIs expressed more satisfaction, which is in line with other findings showing that thorough preoperative imaging may raise patients' expectations for their care and help them comprehend it better[20]. Even though it is not statistically significant, the MRI group's decreased symptom recurrence rate raises the possibility that improved preoperative planning might lead to more successful long-term endometriosis therapy. All things considered, this study's results add to the increasing amount of data that supports the use of MRI in the preoperative evaluation of endometriosis. Even while laparoscopy is still the preferred method of diagnosis, magnetic resonance imaging (MRI) has many benefits, especially when it comes to non-invasive assessment and surgical planning[21]. This research emphasizes how crucial it is to include MRI in the diagnosis process for diagnosing endometriosis, especially in situations when DIE is suspected or when a thorough evaluation of the disease's breadth is needed.

Limitations and Future Suggestions: The single-center design of this research and its exclusive reliance on laparoscopy as the gold standard may induce bias, among other drawbacks. The generalizability of the results might also be impacted by differences in the MRI procedure and the degree of expertise of the radiologists. Future investigations should include a broader, more varied patient group and multi-center studies using standardized imaging procedures. To evaluate the effect of preoperative MRI on recurrence rates and overall patient outcomes, long-term follow-up is also advised.

Conclusion

This research demonstrates significant agreement with laparoscopy in identifying deeply infiltrating lesions and ovarian endometriomas, confirming that MRI is a very reliable and non-invasive method for the preoperative staging of endometriosis. Not only does MRI help with accurate surgical planning, but it may also shorten operating times and lower risk of complications. Even

while laparoscopy is still the preferred method, using MRI to aid in the diagnosis process may improve surgical results and patient care.

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