Original Article

Evaluating the Correlation Between Pelvic Magnetic Resonance Imaging and Intra- Operative/Histopathological Findings in Female Infertility at a Tertiary Care Centre

Vineet Mishra[1], Harish Meena[2], Neha Gulia[3], Gargi Singh[3], Paresh Kumar Sukhani[4], Neha Sharma[2]

[1]Associate Professor, Department of Radio-Diagnosis, Mahatma Gandhi Hospital, Jaipur, Rajasthan, India. [2]3rd Year Resident, Department of Radio-Diagnosis, Mahatma Gandhi Hospital, Jaipur, Rajasthan, India. [3]2nd Year Resident, Department of Radio-Diagnosis, Mahatma Gandhi Hospital, Jaipur, Rajasthan, India. [4]Professor and Head of Department of Radio-Diagnosis, Mahatma Gandhi Hospital, Jaipur, Rajasthan, India.

Abstract

Background: Female infertility has multifactorial pelvic causes, including Müllerian duct anomalies, endometriosis, uterine fibroids, adenomyosis, and tubal-peritoneal disease. Accurate preoperative characterisation is critical for selecting appropriate management and counselling. Pelvic magnetic resonance imaging (MRI) offers high soft-tissue contrast, multiplanar capability, and comprehensive assessment of uterine, ovarian, and adnexal pathology. This study is designed to evaluate how well pelvic MRI findings align with intra-operative and/or histopathological (IO/HP) findings in women with infertility at a tertiary care centre.

Material and Methods: Setting and design: Prospective observational study at Mahatma Gandhi Medical College and Hospital, Jaipur, following institutional ethics approval and written informed consent. Population: All women meeting the WHO criteria for infertility referred for MRI work-up. Study period: October 2021 to October 2024. Imaging protocol: Pelvic MRI on a 3.0 T Siemens Vida (S.No. 175971). Core sequences included axial T1-weighted, axial T2-weighted, axial STIR, sagittal T2-weighted, coronal T1-weighted, and diffusion-weighted imaging (DWI) with corresponding ADC maps, per standardised pelvic protocols. Clinical data collection: Detailed history and relevant laboratory/clinical parameters were recorded. Reference standards: IO findings and/or histopathology, where available, served as the gold standard for correlation. Outcomes: Diagnostic concordance measures (e.g., sensitivity, specificity, accuracy, and agreement) for key etiologies of infertility were planned. **Results:** MRI evaluation of 50 patients revealed a total of 66 pathologies, with the most common findings being Müllerian duct anomalies (31.82%), fibroids (27.27%), polycystic ovarian syndrome (10.61%), hydrosalpinx (7.58%), and both endometrial polyps and endometriosis (9.09% each). When correlated with operative findings, MRI demonstrated excellent diagnostic accuracy. For fibroids, the sensitivity was 100%, specificity 88.9%, and overall accuracy 92%. In endometriosis, MRI achieved a sensitivity of 83%, specificity of 100%, and accuracy of 98%, while in polycystic ovarian syndrome, sensitivity reached 87.5% with 100% specificity and 98% accuracy. Remarkably, for Müllerian duct anomalies, endometrial polyps, and hydrosalpinx, MRI showed perfect diagnostic performance with 100% sensitivity, specificity, and accuracy. **Conclusion:** MRI should be prioritised in complex or inconclusive infertility evaluations. It excels in soft tissue resolution and multiplanar anatomical detail. MRI exhibits exceptional diagnostic accuracy and agreement with operative and histopathological findings in evaluating primary female infertility.

Keywords: Infertility, Pelvic MRI, Histopathology, Female, Correlation.

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Introduction

WHO defines infertility as a disease of the male or female reproductive system, marked by failure to achieve pregnancy after ≥12 months of regular, unprotected intercourse. [1] Causes include fallopian tube damage, ovulatory or fertilisation problems, and hormonal disorders. For many women, difficulty conceiving causes significant physical and psychological distress.[2]

Infertility is classified as primary or secondary. Primary infertility is the inability of a couple to conceive after at least one year of regular, unprotected intercourse, with no prior pregnancies or live births. Secondary infertility is the inability to conceive after one year of unprotected intercourse despite a previous pregnancy, with some studies extending this to two years.

Female infertility has several causes, with ovulatory disorders being the most common. Polycystic ovarian syndrome (PCOS) leads to irregular or absent ovulation and is linked to insulin resistance and metabolic syndrome.[3] Ovarian insufficiency (premature ovarian failure) causes early loss of ovarian function before age 40, while luteal phase deficiency results from hormonal imbalances that impair implantation.[4]

Fallopian tube obstruction, often due to infections or inflammation, prevents egg and sperm from meeting or embryo transport.[5] Endometriosis, where endometrial tissue grows outside the uterus, causes pelvic pain and infertility by disrupting ovulation and implantation.[6] Uterine abnormalities like fibroids, polyps, adenomyosis, or intrauterine adhesions can block implantation or cause pregnancy loss.

Magnetic Resonance Imaging (MRI) effectively delineates pelvic morphology and orientation. It is non-invasive and

Address for correspondence: Dr. Harish Meena, 3rd Year Resident, Department of Radio-Daignosis, Mahatma Gandhi Hospital, Jaipur, Rajasthan, India.
E-mail: harish.meena.24@gmail.com

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radiation-free, but limited by high cost, restricted availability, and long examination time, making repeat studies difficult. Limitations include poor detection of sub-centimetre uterine lesions and difficulty characterising endometriomas at certain stages. MRI is contraindicated in patients with pacemakers or cochlear implants. Despite these drawbacks, MRI is valuable in detecting pathological conditions such as tubal lesions and pituitary adenomas. It also aids in assessing prognosis and treatment planning in conservatively managed cases of leiomyoma, adenomyosis, and endometriosis.[7]

Materials and Methods

This is a retrospective and prospective observational study comprising all female patients who came to Mahatma Gandhi Hospital, Jaipur, for infertility evaluation and underwent diagnostic/therapeutic operative procedures from October 2021 to October 2024. They were evaluated using MRI pelvis, and the findings were correlated with intraoperative and histological findings wherever possible.

Patients were made aware of the purpose of the study and were selected only after their written consent. Symptoms such as pelvic pain, dysmenorrhoea, etc., were noted. A serum HCG test was done before the examinations. MRI pelvis was performed on a 3.0 T (Siemens Vida S.no 175971). [Table 1]

Inclusion criteria & Exclusion criteria:

A female patient with infertility was referred to our department for an MRI of the pelvis and underwent a diagnostic/therapeutic operative procedure with or without providing a histopathological sample for the same. Patients who do not give consent and patients with contraindications for MRI were excluded.

Institute ethical committee approval was obtained before starting of study. Approval No./MGMC&H/IEC/JPR/2023/1421.

Methodology

MRI: MRI Pelvis was performed on a 3.0 T (Siemens Vida S.no 175971).

Results

This study aimed to evaluate the diagnostic accuracy of pelvic MRI in comparison with intra-operative or histopathological findings among female patients with infertility.

Descriptive Profile: Most patients were between 21 and 35 years, with the highest proportion (36%) in the 31-35 age group.

Pelvic MRI findings showed Mullerian duct anomalies in 21 cases (31.82%), Fibroids in 18 cases (27.27%), PCOS in 7 cases (10.61%), Endometrial polyps in 6 cases (9.09%), Endometriosis in 6 cases (9.09%), Hydrosalpinx in 5 cases (7.58%), and Adenomyosis in 3 cases (4.55%). Note: Findings/pathology overlapped in 15 cases. [Table 2]

Anomaly distribution: Mullerian agenesis was seen in 11 cases (22%), bicornuate uterus was seen in 4 cases (8%), septate uterus was seen in 4 cases (8%), hypoplastic uterus was seen in 1 case (2%), absent uterus was seen in 1 case (2%), and 29 cases were normal. [Table 3]

Hormonal Profiles and Reproductive Characteristics

- Most patients showed luteal phase dominance in progesterone profiles.
- Patients with PCOS showed increased AMH levels. Prolactin and androgen levels varied widely.
- 54% of patients had diabetes, and thyroid abnormalities were seen in 44% of cases.
- Vaginal discharge (64%) was frequently observed.

Menstrual and Infertility Patterns

- 54% of patients had irregular cycles. Cycle lengths most commonly ranged from 28 to 35 days.
- The duration of infertility was most frequently between 16 and 25 months.
- Heavy (32%) and light (34%) menstrual flow were more common than normal.

Compartmental Involvement:

- Middle compartment (uterus): Highest involvement
- Posterior compartment (rectouterine pouch): Often in endometriosis
- Anterior compartment: Least affected

Diagnostic Accuracy:

1. **Müllerian Duct Anomalies (MDA):** Out of 21 cases, only 8 required surgical intervention, while the rest were medically managed. Operative and histopathology findings were in line with MRI findings in all 8 cases. [Figure 1a & 4b, 2a,b &c, & 3a &b]
2. **Fibroid:** Out of 18 cases, 14 were confirmed postoperatively; in the rest of the cases, the findings were not in line with MRI. [Figures 4 & 5]
3. **PCOS:** Out of 7 cases, only 2 needed surgical intervention rest were medically managed. Operative and histopathology findings were in line with MRI findings in both cases.
4. **Endometrial Polyp:** In all 6 cases, the MRI findings were confirmed postoperatively, with histopathology also confirming the diagnoses of endometrial polyps.
5. **Endometriosis:** Out of 6 cases, 5 were confirmed postoperatively; in the rest of the cases, the findings were not in line with MRI. [Figure 6]
6. **Adenomyosis:** In all 3 cases, the MRI findings were confirmed postoperatively, with histopathology also confirming the diagnoses of Adenomyosis. [Figure 7]
7. **Hydrosalpinx:** In all 5 cases, the MRI findings were confirmed laparoscopically.

MRI showed outstanding performance with:

- **MDA, Polyps, Hydrosalpinx:** All 100% in sensitivity, specificity, and accuracy
- **Fibroids:** Sensitivity 100%, Specificity 88.9%, Accuracy 92%
- **PCOS:** Sensitivity 87.5%, Specificity 100%, Accuracy 98%
- **Endometriosis:** Sensitivity 83%, Specificity 100%, Accuracy 98%.

Table 1: MRI Sequences

Axial	T2 and T1 TSE AXIAL 6 MM LARGE FOV T2 TSE AXIAL OBLIQUE 3MM SFOV OF UTERUS T1 TSE FAT SAT AXIAL OBLIQUE 3MM SFOV OF UTERUS DWI EPI3SCAN TRACE AXIAL 3MM SFOV
Sagittal:	T2 TSE SAGITTAL 3MM SFOV T1 VIBE DIXON 3D SAGITTAL DYNAMIC 1 PRE & POST
Coronal:	T2 STIR CORONAL 5 MM LARGE FOV T2 TSE CORONAL OBLIQUE 3MM SFOV OF UTERUS

Table 2: MRI pathologies

Type of MRI Pathology	Frequency (n)	Percentage (%)
Adenomyosis	3	4.55
Endometrial polyp	6	9.09
Fibroids	18	27.27
Hydrosalpinx	5	7.58
PCOS	7	10.61
Mullerian duct anomaly	21	31.82
Endometriosis	6	9.09
Grand Total	66	100

Table 3: Anomalies Distribution

Anomalies	Frequency(n)	Percentage(%)
Absent Uterus	1	2
Bicornuate	4	8
Hypoplastic uterus	1	2
Müllerian agenesis	11	22
Normal	29	58
Septate	4	8
Grand Total	50	100

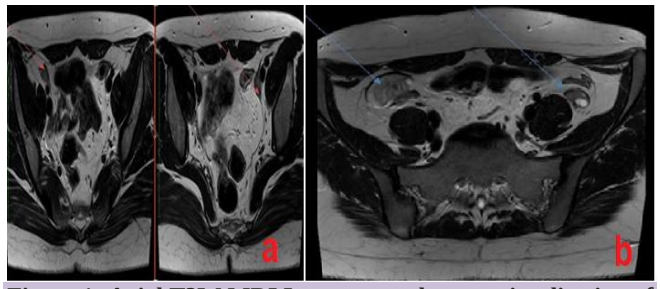

Figure 1: Axial T2W MRI Images reveal – non-visualization of uterus with rudimentary uterine buds and fibrous tissue (red arrows). Bilateral ovaries are high located in the bilateral iliac fossa regions (blue arrows).

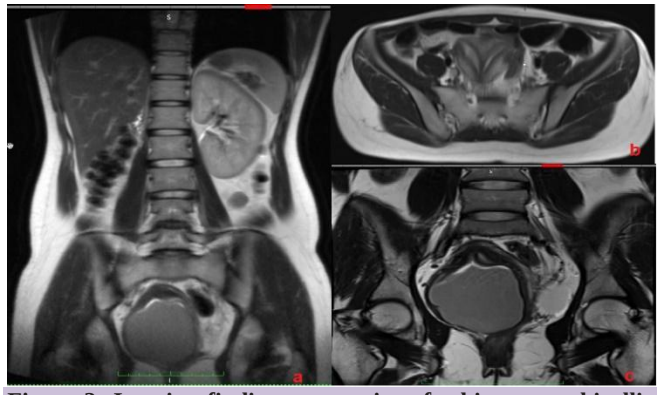

Figure 2: Imaging findings suggestive of a bicornuate bicollis uterus with obstructed right hemi-vagina and ipsilateral right renal agenesis—Obstructed hemi-vagina with ipsilateral renal agenesis (OHVIRA syndrome)

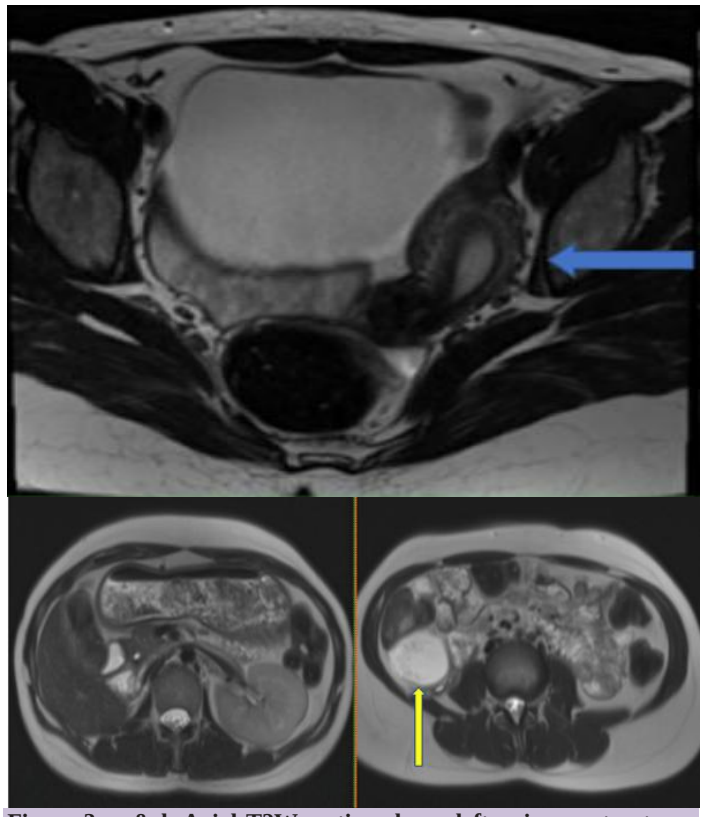

Figure 3: a & b-Axial T2W section shows left unicornuate uterus (arrow showing left horn). Axial T2W image with absent right kidney and empty right renal fossa and maldescended right ovary in the right lumbar region posterior to the fossa (yellow arrow)

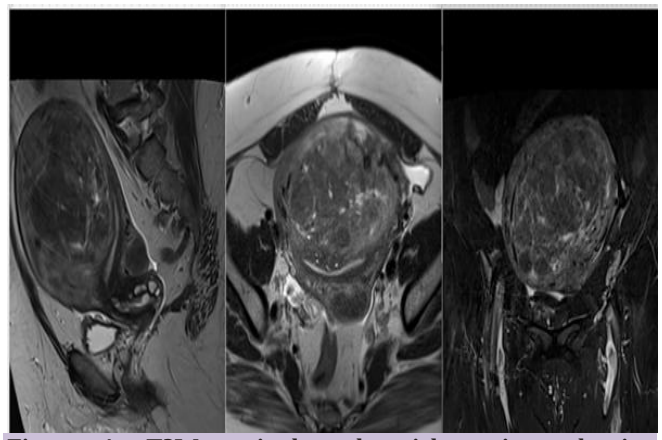

Figure 4: T2W sagittal and axial sections showing heterogeneous signal intensity mass in the anterior body and fundus of the uterus, showing few STIR hyperintense cystic areas within the mass, which is displacing the endometrium posteriorly. It is reaching till the serosal surface, causing its bulge- [likely FIGO 2-5]

Figure 5: Laparoscopic view of multiple uterine fibroids.

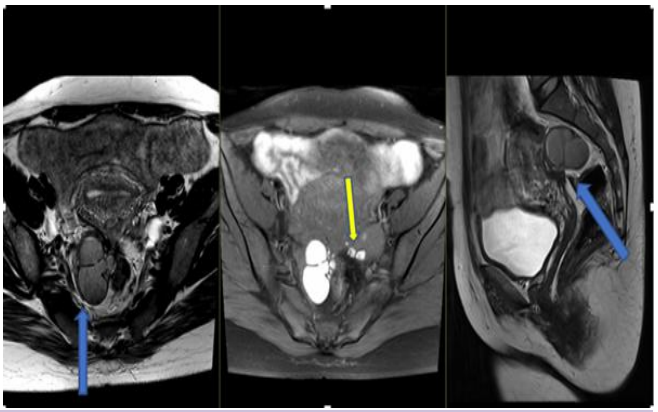

Figure 6: T2W Axial and Sagittal images showing a hypointense lesion in the right ovary, which is closely abutting the torus uterinus and showing T2 shading suggestive of deep pelvic endometriosis (blue arrow). T1FS axial image showing a T1 hypointense focus in the left ovary (yellow arrow) -Suggestive of deposits

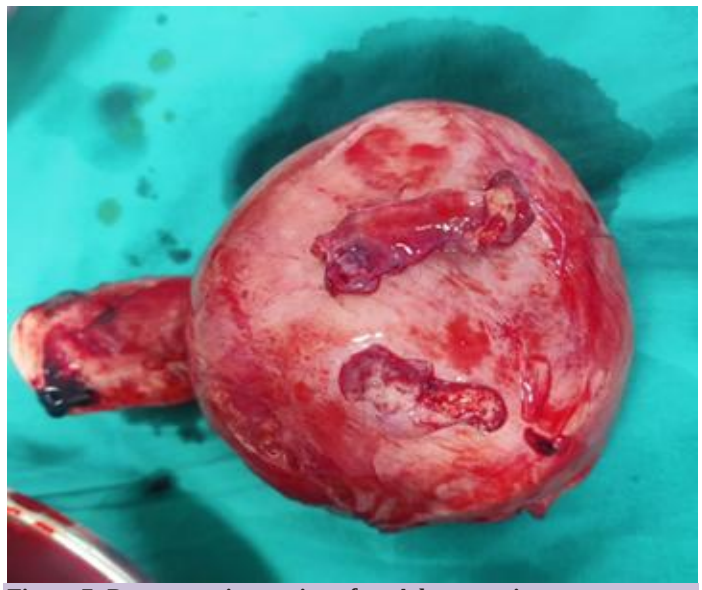

Figure 7: Post-operative section of an Adenomyotic uterus.

Discussion

This study explores the diagnostic utility of MRI pelvis in evaluating primary female infertility by comparing its findings with intraoperative, histopathological, and hormonal data.

MRI has evolved into a highly valuable diagnostic modality. It offers non-invasive, radiation-free imaging, an important advantage for women of reproductive age. With advances such as phased-array coils, MRI achieves excellent spatial resolution, superior tissue contrast, and multiplanar imaging, making it ideal for assessing pelvic anatomy, particularly the morphology and orientation of reproductive structures.

Victoria Wu et al. (2022) in their study concluded that Pelvic MRI can be helpful in the workup of female infertility, particularly in cases of Müllerian duct anomalies, fibroids, adenomyosis, endometriosis, and tubal disease.[8]

Na Liu et al. (2021) conducted a study to explore the diagnostic value of MRI image features based on a convolutional neural network for tubal unobstructed infertility in 30 infertile female patients. They found that the accuracy of MR-HSG was 33.33% and the accuracy of MRI was 46.67%.[9]

Grover SB et al (2020) in their study stated that Uterine filling defects and contour abnormalities may be discovered at HSG but usually require further characterization with pelvic ultrasound (US), sono-hysterography or pelvic magnetic resonance imaging (MRI), when US remains inconclusive. The major limitation of hysterographic US is its inability to visualize extraluminal pathologies, which pelvic we and MRI better evaluate. Although pelvic US is a valuable modality in diagnosing entities comprising the garden variety, extensive pelvic inflammatory disease, complex tubo-ovarian pathologies, deep-seated endometriosis deposits with its related complications, Mullerian duct anomalies, uterine synechiae, and adenomyosis often remain unresolved by both transabdominal and transvaginal US.[10]

The study highlights MRI as a robust diagnostic modality for identifying fibroids, Müllerian duct anomalies (MDA), polyps,

endometriosis, polycystic ovary syndrome (PCOS), and hydrosalpinx. MRI demonstrated 100% accuracy in diagnosing MDA, endometrial polyps, and hydrosalpinx, with over 92% accuracy for all other pathologies. Hormonal profiles confirmed luteal phase hormone elevation, elevated androgens, and variable prolactin levels, which are commonly observed in PCOS cases. MRI showed strong agreement with intraoperative findings in diagnostic accuracy. Socioeconomic and lifestyle variables did not have a statistically significant impact on the duration of infertility. Compartmental MRI analysis enabled precise anatomical mapping, facilitating targeted clinical or surgical management. Notably, 46% of patients proceeded to surgery based on MRI findings, underscoring its valuable role in pre-intervention planning. Overall, the study confirms MRI as a multi-utility diagnostic tool capable of simultaneously assessing uterine, tubal, ovarian, and anatomical compartments in a single, non-invasive scan.

Conclusion

MRI should be prioritised in complex or inconclusive infertility evaluations. It excels in soft tissue resolution and multiplanar anatomical detail. MRI exhibits exceptional diagnostic accuracy and agreement with operative and histopathological findings in evaluating primary female infertility. Its ability to detect fibroids, PCOS, hydrosalpinx, endometrial polyps, and Müllerian duct anomalies makes it an indispensable tool in modern infertility workups. Given its non-invasive nature, superior tissue resolution, and high negative predictive value, MRI should be considered a frontline modality, particularly in complex or inconclusive infertility cases.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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