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Role of USG and MRI in Evaluation of Uterine Pathologies at Tertiary Care Center (A Study of 100 Cases)

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Abstract: ***Introduction:*** ***The uterine pathologies constitute one of the most common problems among women. The primary imaging modalities for assessing the female pelvis include Ultrasonography (USG), Magnetic Resonance Imaging (MRI), and Computed Tomography (CT). Ultrasound is typically the first-line imaging tool due to its accessibility, affordability, lack of radiation exposure, and ability to assess vascularity and guide procedures. However, it has limitations, including operator dependency, restricted field of view, difficulty in evaluating parametrial lesions, and challenges in staging malignancy. MRI provides several advantages, including no radiation or iodinated contrast, a greater field of view, superior contrast resolution, multiplanar imaging capabilities, and the ability to distinguish between recurrence, residual disease, and postoperative scarring. As such, MRI plays a vital role in the diagnosis, prognostication, management planning, and follow-up of various pelvic conditions.*** ***Materials and methods:*** ***Following ethical committee approval and written informed consent from female patients who had suspected uterine lesions, referred from the Gynaecology Department to the Radiology Department at PDU Government Hospital, underwent both Ultrasonography (USG) and Magnetic Resonance Imaging (MRI) to evaluate and correlate various findings of the lesions between October 2023 and March 2025. Eligible participants include patients of all ages with radiologically suspected or diagnosed with uterine pathologies. Exclusion criteria encompass patients with normal imaging outcome, non-willing to give consent or having contraindication to MRI. The study method involves initial evaluation with ultrasonography (transabdominal / transvaginal) followed by MRI evaluation using selected sequences. Contrast and other special sequences like diffusion and gradient imaging were used as and when required. Subsequent comparison of MRI and USG findings for each patient was carried out.*** ***Results:*** ***Among 100 patients majority of the patients were premenopausal (76%) with majority of them falling under 31-40 years age group (32%) and had lower abdominal pain as most common complaint (53%). Majority of the patients were having benign lesions (82%) with fibroids being the most common etiology (56%). In detection of fibroid USG and MRI were equally effective however, detection of exact number and type of fibroids was better done on MRI. 86 fibroids were detected on MRI and 67 on USG. The most common characteristics of fibroids on USG was hypoechoic echopattern (56%) with peripheral vascularity (60%) while on MRI T1 isointense (45%) and T2 hypointense (54%). MRI correctly diagnosed 16 adenomyotic cases while USG was able to diagnosed adenomyosis only in 10 patients. Both MRI and USG correctly diagnosed every patients with endometrial polyp and cervical cancer. MRI showed 100% sensitivity, specificity, PPV and NPV for fibroids, adenomyosis, endometrial polyp and cervical cancer.*** ***Conclusion:*** ***USG and MRI shows no significant difference in diagnosing various uterine pathologies. However, for detailed evaluation of lesion like localization, number of lesions, extension of lesions and other characteristics MRI showed upper hand because of its capability of distinguishing the unique characteristics of various lesions with greater accuracy.***

Keywords: Fibroids, Adenomyosis, Endometrial Polp, Uterine Pathologies, MRI, USG

1. Introduction

The uterine pathologies constitute one of the most common problems among women. Among the reproductive age group 15 to 20% of the women are said to have lesions of uterus.[1] Imaging plays a critical role in diagnosing and managing gynecological conditions. The primary imaging modalities for assessing the female pelvis include Ultrasonography (USG), Magnetic Resonance Imaging (MRI), and Computed Tomography (CT).[2]

Ultrasound is typically the first-line imaging tool due to its accessibility, affordability, lack of radiation exposure, and ability to assess vascularity and guide procedures. However, it has limitations, including operator dependency, restricted field of view, difficulty in evaluating parametrial lesions, and challenges in staging malignancy.[3] Transvaginal ultrasonography (TVS) is helpful in diagnosing certain lesions. However, TVS have a few disadvantages such as small FOV and obscuration of acoustic window due to bowel gas.[4]

To address these limitations, MRI is increasingly used to assess pelvic pathologies. MRI provides several advantages, including no radiation or iodinated contrast, a greater field of view, superior contrast resolution, multiplanar imaging capabilities, and the ability to distinguish between recurrence, residual disease, and postoperative scarring. As such, MRI plays a vital role in the diagnosis, prognostication, management planning, and follow-up of various pelvic conditions.[5]

Magnetic Resonance Imaging (MRI), with its high resolution and multiplanar capabilities, is becoming the preferred

modality for assessing gynaecological pathologies.[3] MRI provides detailed imaging, offering a high precision rate (91-93%) in diagnosing uterine conditions, especially when contrast techniques are used.[1] MRI's limitations include its availability, higher cost, and unsuitability for patients with metallic implants or claustrophobia.[4]

MRI is usually considered as a next step in the evaluation of a lesion after USG. There is always a significant difference between MRI and USG considering the cost of the investigation. Physicians referring cases and the general radiologists are usually in dilemma in choosing the appropriate patients for MRI.[1]

In this study, detailed evaluations of uterine mass lesions were evaluated using transabdominal/transvaginal USG and MRI with respect to number, location, size, other measurements, degenerative changes within the lesions, extent of the lesion etc. Final diagnosis by imaging was compared with histopathological reports in available patients.

Although, there are many studies comparing USG and MRI in detecting adenomyosis and fibroids individually, most of them have not included all the uterine pathologies. This is a comprehensive study of detecting intermodal correspondence across all spectrums of uterine pathologies. This would be useful for both radiologists and referring clinicians for correct identification of the modality needed for diagnosis of specific uterine pathologies.

Aims & Objectives

To compare role of MRI and USG in detection of uterine lesions and in differentiation and characterization of uterine lesions.

2. Materials and Methods

This prospective study was conducted from October 2023 to March 2025, with ethical approval and written consent from 100 female patients, referred from the Gynaecology Department to the Radiology Department at PDU Government Hospital. All patients had suspected uterine lesions, and both Ultrasonography (USG) and Magnetic Resonance Imaging (MRI) were performed to evaluate and correlate these lesions. Pathologies were classified into fibroids, adenomyosis, polyps, endometrial hyperplasia, endometrial malignancies, and cervical malignancies. The patients were followed up to correlate the findings with clinical outcome or operative findings or correlation with histopathology in available patients.

Transabdominal USG was done with full bladder with optimal settings while transvaginal USG was done with an empty bladder only in married females.

MRI was performed using 1.5 Tesla Siemens Magnetome Sempra machine. The following sequences were included: T1 WI, T2 WI, T2 WI fat sat and STIR in axial plane, T2 WI fat sat and STIR in coronal plane and T2 WI and STIR in sagittal plane. Contrast and other special sequences like diffusion and gradient imaging were used as and when required.

The comparison was made between USG and MRI for detection of each of pathologies with histopathology as gold standard. In case of fibroids, in patients who were not operated, MRI was considered gold standard and comparison was done between USG and MRI for detection of fibroids. The statistical parameters including sensitivity, specificity, positive and negative predictive value were calculated for both the modalities in all pathologies.

Inclusion Criteria:

All patients referred to the Department of Radiology with clinically suspected uterine lesions and found to have uterine pathology in USG or MRI and giving consent for the study.

Exclusion Criteria:

- All patients who had normal imaging outcome.
- All patients in who are unwilling to give consent for study.
- All patients who had contraindications to MRI including those with metallic fixations, cardiac pacemakers and claustrophobic patients.

Study Procedures:

a) **Patient Consent:** Written consent was obtained.
b) **History and Examination:** Proper clinical history and examination were taken.
c) **Laboratory Tests:** Kidney function tests were performed.
d) **Imaging Procedures:**
   - Transabdominal USG (full bladder required)
   - Transvaginal USG (empty bladder required)
   - MRI was performed with high-field strength 1.5 Tesla Siemens Magnetome Sempra machine with or without contrast agent (Gadolinium dimeglumine).

MRI Evaluation:

MRI sequences included T1 WI, T2 WI, T2 WI fat sat and STIR in axial plane, T2 WI fat sat and STIR in coronal plane and T2 WI and STIR in sagittal plane. Contrast and other special sequences like diffusion and gradient imaging were used as and when required. The study lasted 20-30 minutes.

Results Interpretation:

MRI results were compared with USG findings for assessment of uterine lesions.

Ethical Considerations:

Data were anonymized, and patient confidentiality was ensured. Informed consent was obtained in Arabic, including date and time. Only the investigator had access to the patient's identity through an assigned number.

Conflict of Interest:

The candidate declared no conflicts of interest. The study costs were covered by the candidate.

Statistical Analysis:

Sensitivity, specificity, and predictive values were calculated using following formulas:

Sensitivity = TP / (TP + FN)
Specificity = TN / (TN + FP)
PPV = TP / (TP + FP)
NPV = TN / (TN + FN)

TP = True positives
TN = True negatives
FP = False positives
FN = False positives

Cohen's kappa coefficient is calculated by following formula:
k = (Po – Pe) / (1 – Pe)
Po = probability of agreement observed
Pe = probability of agreement by chance

Cohen's Kappa	Interpretation
0	No agreement
0.10 - 0.20	Slight agreement
0.21 - 0.40	Fair agreement
0.41 - 0.60	Moderate agreement
0.61 - 0.80	Substantial agreement
0.81 - 0.99	Near perfect agreement
1	Perfect agreement

3. Limitation

There are a few limitations in this study such as smaller sample size Lack of transvaginal sonography study in unmarried / unwilling women and in cases of carcinoma cervix, lack of MRI study in patients with metallic implants and cardiac pacemakers and also that some of benign lesions could not be followed by histopathology.

4. Review of Literature

Bazot M, Cortez A, Darai E, Rouger J, Chopier J, Antoine JM, et al. Ultrasonography compared with magnetic resonance imaging for the diagnosis of adenomyosis: Correlation with histopathology. *Hum Reprod*, 2001;16(11):2427-33.[7] This study aimed to compare the diagnostic accuracy of transabdominal (TAUS), transvaginal sonography (TVUS), and magnetic resonance imaging (MRI) for adenomyosis, correlating imaging findings with histological results. MRI was as accurate as TVUS, though less sensitive in women with myomas. TVUS is effective for diagnosing adenomyosis in women without myomas, while MRI is recommended for those with associated leiomyomas.

Munusamy MM, Sheelaa WG, Lakshmi VP. Clinical presentation and prevalence of uterine fibroids: a 3-year study in 3-decade rural South Indian women. International Journal of Reproduction, Contraception, Obstetrics and Gynecology. Published in 2017.[8] A three-year study at Gynecology OPD enrolled 362 women aged 26-55 presenting with abdominopelvic masses, pain, or menstrual irregularities. The study aimed to investigate the clinical presentation, diagnosis, and management of uterine fibroids. Of the 136 women with uterine fibroids, 66% experienced menorrhagia with severe anemia, and 23% required blood transfusions. Menorrhagia was the most common menstrual pattern (58.8%). Asymptomatic fibroids with large abdominopelvic masses were found in 46 women (33%). The mean age of the women was 46 years. Treatment included abdominal hysterectomy (67%), polypectomy (16 women), and myomectomy (22 nulliparous women). The study highlights the need for further research into the biological factors contributing to fibroid development, as well as the importance of routine screening, early detection, and increased awareness to reduce morbidity and improve quality of life.

Shankar MPS, Kumar SR, Dhar T, Venkateshwaran KN, Balaji R. Role of Magnetic Resonance Imaging in Evaluation of Uterine Pathologies and its Correlation with Ultrasound,2019.[1]A prospective study of 92 patients with suspected uterine pathologies was conducted to compare the diagnostic accuracy of MRI and USG in detecting and characterizing uterine lesions. The patients underwent USG and subsequent MRI examination if USG findings were positive or suspicious. Uterine pathologies were categorized into four groups: fibroids, adenomyosis, endometrial pathologies, and cervical malignancies. Histopathology served as the gold standard for comparison. The results showed that MRI significantly outperformed USG in diagnosing adenomyosis, detecting 100% of cases compared to USG's 37.5% (chi-sq=32, p=0.0001). MRI also detected a higher number of fibroids, identifying 96 fibroids compared to USG's 68, with improved detection of smaller and submucosal fibroids. Furthermore, MRI demonstrated superior diagnostic accuracy in cervical carcinoma, correctly diagnosing all 20 cases (chi-sq=32, p=0.0001), whereas USG correctly diagnosed only 10 cases (chi-sq=0.85, p=0.358). In endometrial lesions, MRI correctly diagnosed 10 out of 12 cases (chi-sq=17.21, p=0.0001), outperforming USG's correct diagnosis of 8 out of 12 cases (chi-sq=6.97, p=0.008). The study concludes that MRI is more precise and reliable than USG for localizing, characterizing, and evaluating uterine lesions, including both benign and malignant pathologies, and is particularly advantageous in detecting endometrial invasion in endometrial carcinoma and staging cervical carcinoma.

Bhatnagar S, Bansal A, Mathur M. Role of magnetic resonance imaging in evaluation of uterine pathologies and its correlation with ultrasound. *Asian Journal of Pharmaceutical and Clinical Research*, 2023.[4]Uterine pathologies, encompassing both benign and malignant conditions, are prevalent among females of reproductive age and postmenopausal women. This study aimed to evaluate the efficacy of magnetic resonance imaging (MRI) in assessing uterine pathologies and correlate its findings with ultrasonographic (USG) results. A prospective study was conducted at the Department of Radiodiagnosis, Government Medical College and Rajindra Hospital, Patiala, involving 45 females referred from the obstetrics and gynaecology department with suspected uterine pathologies. The mean age of patients was 38.9 years, with 82% being premenopausal. MRI and USG diagnoses revealed various uterine pathologies, including fibroids (19), adenomyosis (9), endometrial polyps (2), cervical carcinoma (5), endometrial carcinoma (5), and Mullerian anomalies (4). Notably, MRI detected more fibroids and accurately predicted myometrial invasion in endometrial carcinoma and parametrial extension in cervical carcinoma. MRI also identified Mullerian anomalies, including bicornuate bicollis uterus and septate uterus. The study demonstrated excellent correlation between USG and MRI findings, with a Kappa coefficient of 0.823 ($p<0.001$). The study concludes that MRI is the preferred radiological imaging modality for evaluating uterine

pathologies, complemented by USG. Combining USG and MRI can enhance diagnostic accuracy, facilitating better decision-making and patient management, particularly in cases of diagnostic uncertainty.

Tsuda H, Kawabata M, Nakamoto O, Yamamoto K. Clinical predictors in the natural history of uterine leiomyoma: Preliminary study. *Journal of Obstetrics and Gynaecology Research*, 2021.[14] This prospective study aimed to evaluate the role of magnetic resonance imaging (MRI) in diagnosing uterine pathologies and compare it with ultrasonography (USG) findings. The study included 45 females referred with suspected uterine pathologies. The mean age was 38.9 years, with 82% premenopausal. Diagnoses included fibroids, adenomyosis, endometrial polyps, cervical and endometrial carcinoma, and Mullerian anomalies. MRI identified more fibroids and accurately assessed myometrial invasion in endometrial carcinoma and parametrial extension in cervical carcinoma. MRI also detected bicornuate and septate uteri, which USG missed. A strong correlation was found between USG and MRI (Kappa = 0.823, p<0.001). The study concluded that MRI is the preferred imaging modality for uterine pathologies and should be used alongside USG for improved diagnostic accuracy and patient management,

Raghda Asaad Abdel Wahab; Laila Hosny Mahmoud; Mohamed Amin Nassef And Ahmed Mohamed Bassiouny MRI Evaluation Of Uterine Mass Lesions In Correlation With Transabdominal And Transvaginal Ultrasound.[5] This prospective study aimed to compare the diagnostic accuracy of magnetic resonance imaging (MRI) and ultrasonography (USG), including transabdominal and transvaginal approaches, in evaluating uterine masses. The study enrolled 25 female patients with suspected uterine lesions, and the results showed that ultrasonography detected endometrial hyperplasia as the most frequent finding, occurring in 32.0% of cases, followed by myoma (28.0%), adenomyosis (16.0%), polyp (12.0%), carcinoma (8.0%), and normal findings (4.0%). In contrast, MRI evaluation revealed that myoma was the most frequent finding, occurring in 28.0% of cases, followed by adenomyosis (24.0%), polyp (5.0%), endometrial hyperplasia (16.0%), and carcinoma (12.0%). Notably, the study found a statistically significant perfect agreement between MRI evaluation and final diagnosis by hysteroscopy and histopathology regarding the overall diagnosis of uterine lesions, with a p-value of less than 0.001. Furthermore, the study revealed that MRI had a sensitivity and specificity of 100% for diagnosing all uterine lesions, including uterine myomas, adenomyosis, polyp, hyperplasia, and carcinoma. This suggests that MRI is a highly accurate diagnostic tool for evaluating uterine masses, with a sensitivity of 100% and a superior modality compared to ultrasonography. Overall, the study highlights the importance of MRI in the diagnosis and management of uterine lesions, and its potential to improve patient outcomes.

Tao J, Wang Y, Liang Y, Zhang A. Evaluation and monitoring of endometrial cancer based on magnetic resonance imaging features of deep learning. *Frontiers in Oncology*, 2023.[17]This study aimed to compare MRI findings of endometrial cancer (EC) with surgical pathological results and explore MRI's role in diagnosing and staging EC. A total of 80 EC patients underwent preoperative MRI using T1WI and T2WI imaging. The ResNet network was utilized to optimize MRI image recognition, enhancing accuracy and efficiency. The results showed that T2-weighted imaging and enhanced scans achieved 88.75% accuracy, 95% specificity, 87.5% sensitivity, 93.75% negative predictive value, and 86.25% positive predictive value. MRI identified 72 out of 80 EC cases (90%) at stage I, with features of endometrial thickening and uneven enhancement. In conclusion, MRI proves to be highly valuable for staging EC and improving diagnostic accuracy.

5. Observations and Results

Among 100 patients, majority were diagnosed with fibroids 56 (56%), 12 (12%) were diagnosed with carcinoma of cervix, 12(12%) had adenomyosis, 7 (7%) had endometrial polyp and 6 (6%) had endometrial carcinoma. 3 patients had fibroid with adenomyosis, 3 had endometrial hyperplasia and 1 had endometrial polyp with fibroid and adenomyoma.

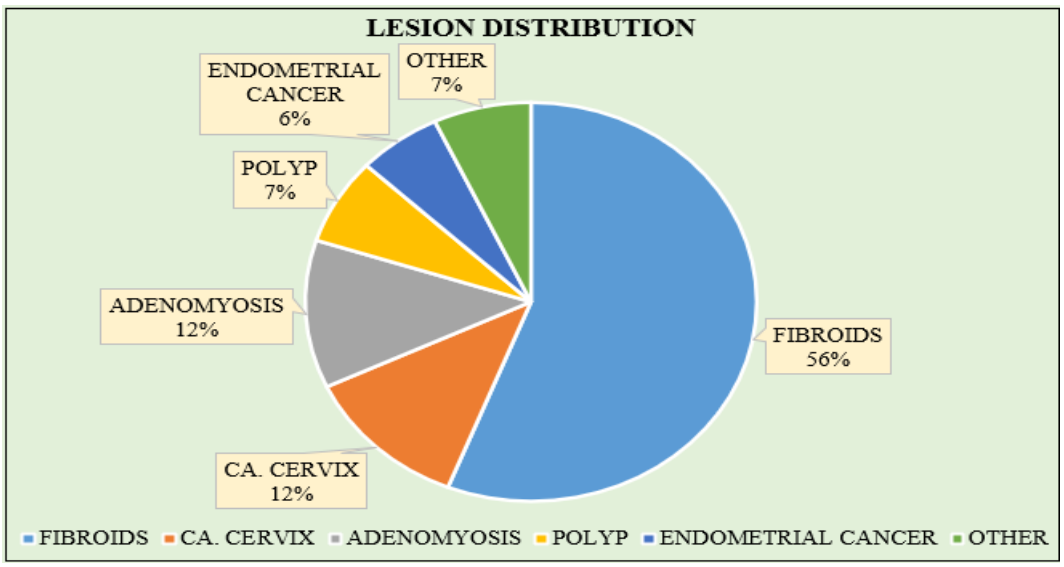
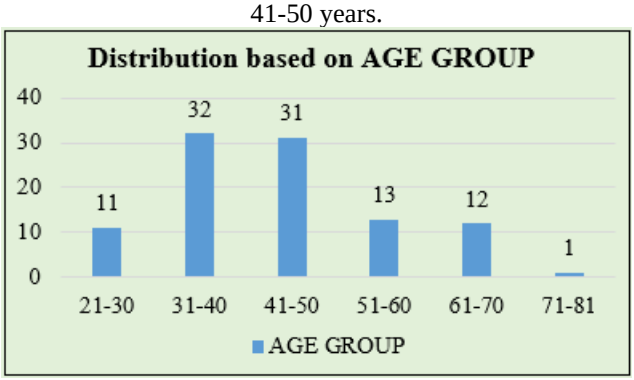


Figure 1: Pie chart showing various uterine pathologies observed in 100 patients. Most common pathology diagnosed was fibroids

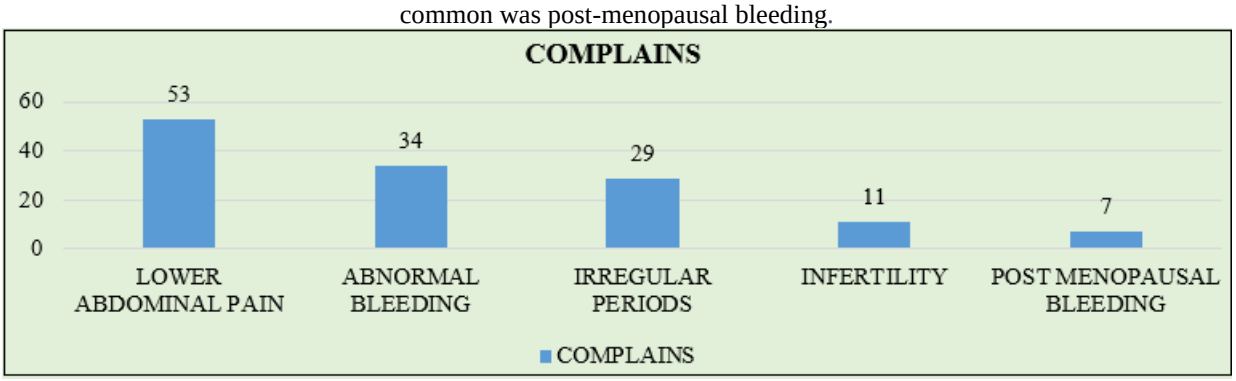
We included a total number of 100 patients between 20 and 81 years of age. Mean (±SD) age of the participants was 44.2 ± 12.1 years. Most of the patients belonged to the age group of 30–40years. Seventy patients (70%) were in the premenopausal group and the rest of the 30 (30%) patients were postmenopausal.

Table 1: Distribution of patients according to age group. Most common age group being 31-40 years followed by 41-50 years.



Out of 100 patients, 53 (53%) suffered with lower abdominal pain, 34 (34%) suffered with abnormal bleeding, 29 (29%) were suffering from irregular periods, 11 (11 %) patients with infertility and 7 (7%) patients had post-menopausal bleeding.

Table 2: Presenting complaints among the 100 patients. Most common complain was lower abdominal pain while least common was post-menopausal bleeding.



A total of 18 (18%) patients were found to be malignant whereas 82 (82%) patients were found to be benign. Out of 18 patients, 12 (66.7%) patients were diagnosed with carcinoma cervix and 6 (33.3%) patients were diagnosed with endometrial carcinoma.

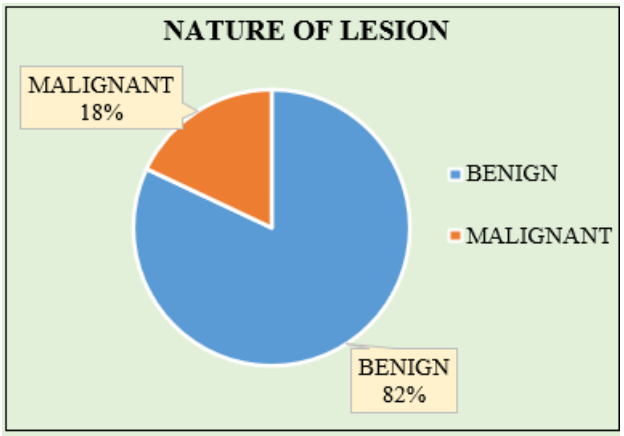


Figure 2: Pie chart showing nature of lesions observed within the patients

Result of USG:

Majority of the patients (57 patients, 57%) were diagnosed with fibroids on USG. 28 (27%) patients had intramural fibroids. 13 patients (13%) had subserosal fibroids, 6 patients (7%) had submucosal fibroids, and 10 patient (10%) had both subserosal /submucosal and intramural fibroids. Six patients were found to have adenomyosis and three had concomitant adenomyosis with fibroids. Five patients were characterized with bulky uterus. One patient was found to have fibroid with adenomyosis and endometrial polyp. Endometrial polyp was observed in 7 cases (7%). 5 patients were diagnosed with endometrial hyperplasia. 4 patients (6%) were diagnosed with endometrial carcinoma and 12 patients (12%) were diagnosed with cervical carcinoma. A total of 92 patients were correctly diagnosed on USG.

Ultrasonography diagnosis among the studied cases.

Table 3: Ultrasonographic diagnosis among the studies cases. Fibroid is the most frequent finding followed by cervical cancer.

Findings	Number of patients (100)
Fibroid	57
Adenomyosis/ adenomyosis with other features	10
Polyp	7
Endometrial hyperplasia	5
Endometrial cancer	4
Cervical cancer	12
Bulky Uterus	5

Result of MRI:

56 patients were diagnosed with fibroids on MRI. 26 patients were diagnosed with intramural fibroids. 11 patient had subserosal fibroids, 7 patients had submucosal fibroids, and 12 patients had both subserosal / submucosal and intramural fibroids. 11 patients were diagnosed with diffuse adenomyosis, one with focal adenomyosis and 3 patients had concomitant adenomyosis with fibroids. Endometrial polyp was observed in 7 cases. Four patients were diagnosed with endometrial hyperplasia. 5 patients were diagnosed with endometrial carcinoma and 12 patients with cervical carcinoma. A total of 99 patients were correctly diagnosed.

MRI diagnosis among the studied cases

Table 4: MRI diagnosis among the studied cases showing fibroid being the most frequent findings

Findings	Number of patients (100)
Fibroid	56
Adenomyosis/ adenomyosis with other features	16
Polyp	7
Endometrial hyperplasia	4
Endometrial cancer	5
Cervical cancer	12

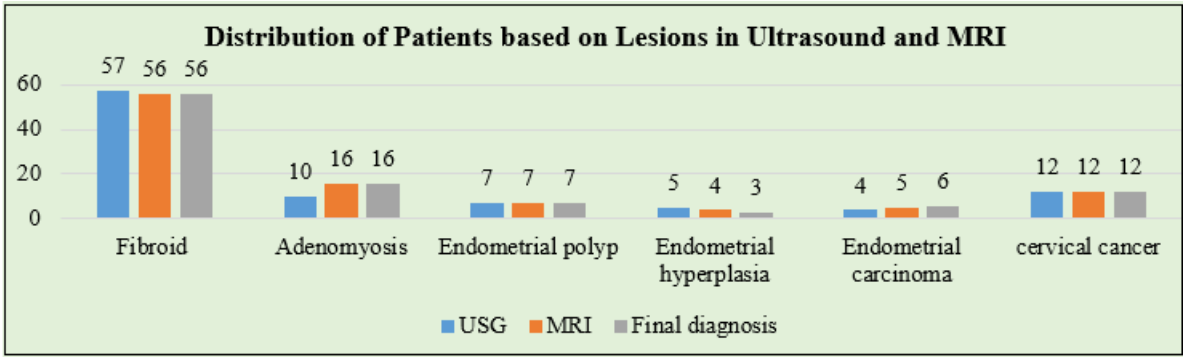


Figure 3: Distribution of patients based on ultrasound and MRI findings.

Fibroid:

On USG, 57 patients were diagnosed with fibroids. A total of sixty-seven lesions were noted. 32 patients (56%) had hypoechoic fibroids, and 12 patients (21%) had heterogeneous fibroids. Twelve (21%) patients showed secondary degenerative changes. One patient (2%) had hyperechoic fibroid. Majority of the patients with fibroids 34 (60%) had peripheral vascularity on color Doppler imaging, 20 patients (35%) did not show any significant vascularity, and 3 patient (5%) had internal vascularity. 28 patients (49%) had intramural fibroids, 13 patients (23%) had subserosal fibroids, six patients (10%) had submucosal fibroids, and ten patients (17%) had both intramural and subserosal /submucosal fibroids. One patient with focal lesion was wrongly diagnosed as a fibroid.

USG findings in patients with fibroids:

Table 5: Shows various characteristics of fibroid evaluated within the patients

Findings	No. of patients	Percentage
Hypoechoic Fibroids	32	56%
Heterogenous Fibroids	12	21%
Secondary degenerative changes	12	21%
Hyperechoic fibroids	01	2%
Peripheral vascularity	34	60%
No vascularity	20	35%
Internal vascularity	03	5%

56 patients were diagnosed with fibroids on MRI. A total of 86 lesions were detected on MRI. On T1WI, 18 patients had hypointense fibroids, and 25 patients had isointense fibroids. One patient had a heterogeneously hyperintense fibroid on T1WI. On T2WI, 33 patients had hypointense fibroids, and ten patients had hyperintense fibroids. None of the patients had isointense fibroids on T2WI. 12 patients had heterogeneously hypointense fibroids on T1WI, and 13 patients had heterogeneously hypointense fibroids on T2WI. Twenty-six patients (69%) had intramural fibroids, eleven patients (9%) had subserosal fibroids, seven patients (13%) had submucosal fibroids, and twelve patients (9%) had both intramural and subserosal/submucosal fibroids.

MRI findings in patients with fibroids:

Table 6: Shows distribution of signal characteristics in patients diagnosed with fibroids. Most common appearance of fibroid was isointense on T1WI and hypointense on T2WI.

Findings	T1	T2
Isointense	25	03
Hypointense	17	30
Hyperintense	01	10
Heterogeneously Hyperintense	01	05
Heterogeneously Hypointense	12	08
Total	56	56

Among 56 cases of fibroid and 86 lesions, MRI detected all cases and lesions (100%) with sensitivity, specificity, positive and negative predictive value about 100%. Sensitivity, specificity, positive predictive value, and negative predictive value of USG in detecting patients were 100%, 97.7%, 98.2%, and 100%, respectively while in detecting fibroid lesions were 76.7%, 97.7%, 98.5% and 68.2 % respectively.

Distribution of patients according to location of fibroids as detected by USG and MRI:

Table 7: Shows distribution of patients based on location of fibroids diagnosed by ultrasound and MRI.

Location	USG	MRI
Intramural	28	26
Subserosal	13	11
Submucosal	06	07
Intramural and Subserosal/Submucosal	10	12
Total	57	56
USG: Ultrasonographic, MRI: Magnetic resonance imaging		

Agreement between each USG and MRI with final diagnosis (reference) diagnoses regarding fibroid detection.

Table 8: Shows that regarding fibroid, the agreement between final diagnosis and MRI diagnosis was perfect. The agreement between final diagnosis and USG diagnosis was nearly perfect. The agreement between US and MRI diagnosis was also near perfect. TP-True positives, FP- False positives, TN: True negatives.

USG diagnosis	Final diagnosis	
	Fibroid	No Fibroid
Fibroid	56 (TP)	1 (FP)
No Fibroid	0	43 (TN)
Kappa	0.97	
MRI diagnosis	Final diagnosis	
	Fibroid	No Fibroid
Fibroid	56	0
No Fibroid	0	44
Kappa	1	
USG diagnosis	MRI diagnosis	
	Fibroid	No Fibroid
Fibroid	56	1
No Fibroid	0	43
Kappa	0.97	

Diagnostic characteristics of USG and MRI in the detection of patients with fibroids

Table 9: Shows that in diagnosis of fibroid MRI had perfect diagnostic characteristics while USG has near perfect diagnostic characteristics.

Characteristics	USG	MRI
	Value	
Sensitivity	100%	100%
Specificity	97.7%	100%
Positive predictive value	98.2%	100%
Negative predictive value	100%	100%

Adenomyosis:

Out of 16 cases of adenomyosis detected by histopathology, MRI detected 11 (75%) as diffuse adenomyosis, three as adenomyosis with fibroid uterus and two as focal adenomyosis with one of them having multiple fibroids and endometrial polyp. On the other hand, USG detected six as adenomyosis, five as bulky uterus with heterogeneous myometrium suspicious for adenomyosis or leiomyoma, one as focally thickened myometrium with fibroid and polyp and three as adenomyosis with fibroid. One case was wrongly diagnosed as fibroid. Out of 16 cases USG could detect only ten as adenomyosis and other 6 were either suspicious for adenomyosis or wrongly diagnosed. This explains that there is significant difference in diagnosing adenomyosis by USG and MRI. Among 16 cases of adenomyosis, MRI detected all cases (100%) with sensitivity, specificity, positive and negative predictive value about 100%. On the other hand, USG was positive only in ten cases; in this USG false negatives were 6 with sensitivity- 62.5%, specificity-100%, PPV-100%, NPV-93.3%.

Classification of patients based on USG and MRI diagnosis

Table 10: Shows MRI and USG diagnosis in patients of adenomyosis detected by histopathology.

USG diagnosis	MRI diagnosis			
	Diffuse adenomyosis	Adenomyosis + Fibroid	Focal adenomyosis	Focal adenomyosis + Fibroid + Polyp
Diffuse adenomyosis	06			
Bulky uterus	05			
Adenomyosis + Fibroid		03		
Focal thickening/Fibroid			01	
Adenomyosis + Fibroid + Polyp				01

Diagnostic characteristic of USG and MRI in the detection of patients with adenomyosis

Table 11: Shows that in the diagnosis of adenomyosis, MRI had perfect diagnostic characteristics, while US had perfect specificity and positive predictive value, but low other diagnostic characteristics.

Characteristics	USG	MRI
	Value	
Sensitivity	62.5%	100%
Specificity	100%	100%
Positive predictive value	100%	100%
Negative predictive value	93.3%	100%

All the patients diagnosed with adenomyosis had bulky uterus, heterogeneous myometrial echo-pattern, anechoic cystic lesions in myometrium, and loss of endo-myometrial interface. Seven patients had globular shaped uterus. Four patients had thickened posterior myometrium, and one patient had Venetian lines.

USG findings in patients with adenomyosis:

Table 12: various features of adenomyosis noted on USG

Findings	No. of	Percentage

	patients	
Bulky uterus	16	100
Globular shape	06	37
Heterogeneous echo pattern	16	100
Anechoic cystic lesions in myometrium	06	37
Loss of endo-myometrial interface	06	37
Venetian line	01	6.25
Adenomyosis + Fibroid	03	18.75

On MRI, all the patients diagnosed with adenomyosis had thickened junctional zone and tiny cystic lesions in myometrium. Fourteen patients (93%) had bulky uterus, and ten patients (62%) had thickened posterior myometrium. Two of our patients had T1 hyperintense lesions in the myometrium indicating areas of hemorrhage.

MRI findings in patients with adenomyosis:

Table 13: Various features of adenomyosis noted on MRI.

Findings	No. of Patients	Percentage (%)
Bulky uterus	14	88
Thickened junctional zone	16	100
Thickened posterior myometrium	11	68
Tiny T2 hyperintense cystic lesions in myometrium	11	68
T1 hyperintensity in myometrium (hemorrhage)	02	12.5

Agreement between each USG and MRI with final diagnosis (reference) diagnoses regarding adenomyosis detection.

Table 14: Shows that regarding adenomyosis, the agreement between final diagnosis and MRI diagnosis was perfect. The agreement between final diagnosis and US diagnosis was moderate. The agreement between US and MRI diagnosis was also moderate. TP-True positives, FP- False positives, TN: True negatives, FN- False negatives.

USG diagnosis	**Final diagnosis**	
	Adenomyosis	No Adenomyosis
Adenomyosis	10 (TP)	0 (FP)
No Adenomyosis	6 (FN)	84 (TN)
Kappa	0.74	
MRI diagnosis	**Final diagnosis**	
	Adenomyosis	No Adenomyosis
Adenomyosis	16	0
No Adenomyosis	0	84
Kappa	1	
USG diagnosis	**MRI diagnosis**	
	Adenomyosis	No Adenomyosis
Adenomyosis	10	0
No Adenomyosis	6	84
Kappa	0.74	

Endometrial polyps

Seven patients were diagnosed with endometrial polyps on USG and MRI. On USG, all the patients revealed thickened endometrium and a well-defined round to oval hyperechoic lesion in the endometrial cavity with a vascular pedicle. Interrupted mucosa sign could also be depicted in three of the patients. On MRI, six patients had an endometrial lesion appearing hypointense on T1 and T2WI while one patient had an isointense lesion on T1WI. The sensitivity, specificity, positive predictive value and negative predictive value of both the modality is 100%. Regarding polyp, the agreement between final diagnosis and MRI diagnosis, between final diagnosis and US diagnosis and between US and MRI diagnosis was perfect.

Endometrial hyperplasia:

3 patients were truly diagnosed with endometrial hyperplasia on USG as well as on MRI with endometrial thickness measuring above 16 mm. 2 patients were wrongly diagnosed as having endometrial hyperplasia on USG while MRI diagnosed one case as endometrial hyperplasia with suspicious malignancy likely.

Diagnostic characteristics of USG and MRI in the detection of patients with endometrial hyperplasia

Table 15: Shows that in the diagnosis of endometrial hyperplasia, MRI and USG had perfect sensitivity and negative predictive value characteristics, near perfect specificity characteristics and moderate positive predictive value diagnostic characteristics.

Characteristics	USG	MRI
	Value	
Sensitivity	100%	100%
Specificity	97.9%	98.9%
Positive predictive value	60%	75%
Negative predictive value	100%	100%

Agreement between each USG and MRI with final diagnosis (reference) diagnoses regarding endometrial hyperplasia detection.

Table 16: shows that regarding endometrial hyperplasia, the agreement between final diagnosis and US diagnosis was substantial. The agreement between final diagnosis and MRI diagnosis and between US and MRI diagnosis was near perfect.

USG diagnosis	Final diagnosis	
	Endometrial hyperplasia	No Endometrial hyperplasia
Endometrial hyperplasia	03 (TP)	02 (FP)
No Endometrial hyperplasia	0	95 (TN)
Kappa	0.74	
MRI diagnosis	Final diagnosis	
	Endometrial hyperplasia	No Endometrial hyperplasia
Endometrial hyperplasia	03	01
No Endometrial hyperplasia	0	96
Kappa	0.86	
USG diagnosis	MRI diagnosis	
	Endometrial hyperplasia	No Endometrial hyperplasia
Endometrial hyperplasia	4	1
No Endometrial hyperplasia	0	95
Kappa	0.88	

Endometrial carcinoma

Out of Six patients who were histopathological proven cases of endometrial carcinoma USG correctly diagnosed 4 patients while MRI diagnosed 5 patients. Two patients on USG were diagnosed as having endometrial hyperplasia while 1 patient was diagnosed as endometrial hyperplasia with suspicious for malignancy.

Agreement between each USG and MRI with final diagnosis (reference) diagnoses regarding endometrial carcinoma detection.

Table 17: Shows that regarding endometrial carcinoma, the agreement between final diagnosis and US diagnosis was substantial. The agreement between final diagnosis and MRI diagnosis and between US and MRI diagnosis was near perfect.

USG diagnosis	**Final diagnosis**	
	Endometrial Carcinoma	No Endometrial Carcinoma
Endometrial Carcinoma	04 (TP)	0 (FP)
No Endometrial Carcinoma	02	94 (TN)
Kappa	0.79	
MRI diagnosis	**Final diagnosis**	
	Endometrial Carcinoma	No Endometrial Carcinoma
Endometrial Carcinoma	05	0
No Endometrial Carcinoma	01	94
Kappa	0.90	
USG diagnosis	**MRI diagnosis**	
	Endometrial Carcinoma	No Endometrial Carcinoma
Endometrial Carcinoma	4	0
No Endometrial Carcinoma	1	95
Kappa	0.88	

Diagnostic characteristics of USG and MRI in the detection of patients with endometrial carcinoma

Table 18: Shows that in the diagnosis of endometrial carcinoma, MRI and USG had perfect diagnostic characteristics, while US had perfect specificity, negative predictive value

Characteristics	USG	MRI
	Value	
Sensitivity	66.7%	80%
Specificity	100%	100%
Positive predictive value	100%	75%
Negative predictive value	97.8%	98.9%

On USG, all the patients with endometrial carcinoma had thickened and heterogeneous endometrium with raised internal vascularity. Myometrial invasion was evident on USG in 4 cases (80%). Hydrometra was observed in 2 patients (40%) and hydroureteronephrosis was observed in 1 patient (20%).

USG findings in patients with endometrial carcinoma:

Table 19: Shows ultrasound features of endometrial carcinoma among the patients. Thickened and heterogeneous endometrium with raised vascularity is seen in all patientsm.

Findings	No. of patients	Percentage
Thickened and heterogeneous endometrium	6	100
Raised internal vascularity	6	100
Myometrial invasion	4	67
Hydrometra	2	33
Hydroureteronephrosis	1	17

All the patients with endometrial carcinoma showed heterogeneously enhancing T2 hyperintense mass in the endometrial cavity. Myometrial invasion was also evident in five of the cases. Hydrometra/hematometra was observed in three of our cases (60%). Necrotic / metastatic lymph nodes and parametrial extension were observed in two cases each and cervical stromal invasion and hydroureteronephrosis were observed in one case each. Locoregional staging was done and it was observed that two of our cases were Stage IA, one of Stage IB, two of Stage IIIC, and one of Stage IV.

MRI Findings in Patients with Endometrial Carcinoma:

Table 20: Shows that hyperintense mass in endometrial cavity is seen in all the patients with endometrial carcinoma.

Findings	No. of patients	Percentage
T2Hyper intense mass in endometrial cavity	6	100
Heterogeneous enhancement	6	100
Myometrial invasion	5	83
Cervical stromal invasion	1	17
Hydrometra/hematometra	3	50
Parametrial extension	2	33
Hydroureteronephrosis	1	17
Necrotic/metastatic lymphnodes	2	33

Cervical carcinoma:

Twelve patients who were histopathological proven cases of cervical carcinoma underwent USG and MRI. Lower abdominal pain was the most frequent complaints, observed in 8 (67%) patients. Post-menopausal bleeding was observed in 6 patients (50%). The average age of patients with cervical carcinoma was 56 years.

On USG, ten patients had bulky cervix with hypoechoic mass lesion in 83% of the cases and heterogeneous mass in 17% of the cases. All the cases showed raised internal vascularity within the mass on color Doppler imaging. Five cases (41%) had hydrometra and four cases (33%) had hydroureteronephrosis. On MRI, all the patients showed heterogeneously enhancing mass in cervix. Parametrial extension was observed in eight of our cases (67%) and hydrometra were observed in five cases (42%) and hydroureteronephrosis were observed in four cases each (33%).

The sensitivity, specificity, positive predictive value and negative predictive value of both the modality is 100% suggesting perfect diagnostic characteristics. Regarding cervical cancer, the agreement between final diagnosis and MRI diagnosis, between final diagnosis and US diagnosis and between US and MRI diagnosis was perfect.

USG findings in patients with cervical carcinoma:

Table 21: Shows various features seen in patients with cervical carcinoma on ultrasound

Findings	No. of patients	Percentage
Bulky cervix with hypoechoic mass	10	83
Bulky cervix with heterogeneous mass	2	17
Raised internal vascularity	12	100
Hydrometra	5	41
Hydroureteronephrosis	4	33

MRI findings in patients with cervical carcinoma:

Table 22: Shows various MRI features of cervical carcinoma in patients.

Findings	No. of patients	Percentage
Heterogeneously enhancing mass in cervix	12	100
Hydrometra/hematometra	5	42
Parametrial extension	8	67
Hydroureteronephrosis	4	33
Loss of fat planes with bladder	2	17
Loss of fat planes with rectum	2	17

6. Discussion

Demographic Characteristics

The average age of patients in our study was 44.2 ± 12.14 years, ranging from 20 to 81 years, and the majority of them were premenopausal (76/100) falling under age group of 31-40 years. Bhatnagar et al. reported an average age of 38.9 ± 10.8 years, with ages ranging from 20 to 72 years, and the majority were premenopausal (37/45).[4] Patel et al. (2020) reported that the average age of females with uterine pathologies was 35 years. [3] Muthuswamy et al. had 92 study participants, majority of them were in the age group 31-40 years -31 patients (33.6%) and followed by 41-50 years -30 patients (32.6%). Majority of them were in pre menopause period 63 (68.5%) and the rest in the post menopause period 29 (31.5%).[1] Shankar et al. (2019) reported that many of their patients (68%) were in the premenopausal phase, while only a few patients were in the postmenopausal phase (32%). This suggests that the most common age group suffering from uterine pathologies is 30-40 years i.e. premenopausal.

In our study, 53 (53%) patients suffered with lower abdominal pain, 34 (34%) suffered with abnormal bleeding, 29 (29%) were suffering from irregular periods, 11 (11 %) patients with infertility and 7 (7%) patients had post-menopausal bleeding. Muthuswamy et al. reported that 68 (74.7%) patients suffered with pain, 23 (25.3%) suffered with abnormal bleeding and 26 (29.1%) were suffering from irregular periods. This shows that patients with uterine pathologies tend to have complain of lower abdominal pain frequently associated with / without other complaints.[1]

In our study, out of the 100 patients, 56 had fibroids, 12 had adenomyosis, 4 had both adenomyosis and fibroids, 7 had endometrial polyps, 4 had endometrial hyperplasia, 6 had endometrial cancer, and 12 had cervical cancer. Togashi K et al, did a study on 93 patients, among them 71 had fibroids, 16 had adenomyosis, six had both fibroid and adenomyosis.[6] Muthuswamy et al. reported that out of 92 patients 44 (48%) had fibroid, 20 (22%) with cervical cancer, 16 (17%) had adenomyosis and 12 (13%) were diagnosed with endometrial lesions.[1]

Eighteen of our cases (18%) had benign lesions, while 82 cases had malignant lesions. Bhatnagar et al. reported that thirty of their cases (67%) had benign lesions, 10 cases had malignant lesions, and 4 patients (9%) were diagnosed with Mullerian anomalies.[4] Muthuswamy et al. had a total of 24 (26%) patients with malignant lesions while 68 (74%) patients with benign lesions.[1]

Fibroid

In our study, most of the fibroids detected on USG had a hypoechoic echopattern (56%), followed by a heterogeneous echopattern (23%) and secondary degeneration (21%). Bhatnagar et al. concluded that most of the fibroids detected on USG had a hypoechoic echopattern (71%), followed by a heterogeneous echopattern in the rest of the patients.[4] In our study of leiomyomas, a total of 56 fibroids were diagnosed by MRI, with 28 intramural fibroids, 6 submucosal fibroids, 13 subserosal fibroids, and 10 patients having multiple fibroids. Muthuswamy P. et al. concluded that, in their study of leiomyomas, a total of 96 fibroids were diagnosed by MRI, with 48 intramural fibroids, 12 submucosal fibroids, 14 subserosal fibroids, 10 being both submucosal and intramural, and 12 being both subserosal and intramural.[1]

Daga and Phatak in their study stated that 78% of fibroids had a hypoechoic echopattern, followed by a heterogeneous pattern observed in 10% of fibroids. Most of the patients with fibroids (57%) demonstrated peripheral vascularity on color Doppler imaging.[9]

Tsuda et al. evaluated vascularity in 70 women with uterine leiomyomas. Perifibroidal vascularity was detected in 51.5% of the leiomyomas.[14]

The majority of the fibroids appeared isointense on T1WI (25 patients, 45%) and hypointense on T2WI (30 patients, 54%). Bhatnagar et al. concluded that the majority of fibroids appeared isointense on T1WI (13 patients, 57%) and hypointense on T2WI (18 patients, 78%).[4] Jondal et al. studied the signal characteristics of fibroids in 102 patients and observed that most fibroids appeared isointense on T1WI (84%) and hypointense on T2WI (86%).[15]

Adenomyosis

On USG, all the patients diagnosed with adenomyosis had a bulky uterus and a heterogeneous myometrial echo pattern. Six (37%) patients had anechoic cystic lesions in the myometrium and loss of the endomyometrial interface. Six (37%) patients had a globular-shaped uterus, and one (1%) patient had Venetian lines. Bhatnagar et al. concluded that all patients diagnosed with adenomyosis had a bulky uterus, heterogeneous myometrial echo pattern, anechoic cystic lesions in the myometrium, and loss of the endomyometrial interface. Seven patients had a globular-shaped uterus, four had thickened posterior myometrium, and one patient had Venetian lines.[4] Bromley et al. evaluated the USG findings in patients with adenomyosis. All patients with adenomyosis had a heterogeneous myometrial echo pattern, 95% showed a globular-shaped uterus, 82% had tiny myometrial anechoic areas, and 82% had an indistinct endomyometrial junction.[13]

In our study, all patients diagnosed with adenomyosis on MRI had a thickened junctional zone (>6 mm) and tiny cystic lesions in the myometrium. Fourteen patients (88%) had a bulky uterus, and eleven (68%) patients had thickened posterior myometrium. Eleven (68%) patients had tiny T1 hyperintense lesions in the myometrium indicative of hemorrhage. Bhatnagar et al. concluded that all patients diagnosed with adenomyosis on MRI had a thickened junctional zone (>6 mm) and tiny cystic lesions in the myometrium. Eight patients had a bulky uterus, and six

patients had thickened posterior myometrium. Two of our patients had tiny T1 hyperintense lesions in the myometrium indicative of hemorrhage.[4] Bazot et al. concluded that myometrial spots appearing hyperintense on T2WI and a thickened junctional zone (>12 mm) were the most accurate MRI findings in diagnosing adenomyosis. They observed T1 hyperintense areas in 40% of the patients, which were confirmed to be local hemorrhage by histopathology.[7]

Out of 15 cases detected by USG, a definite diagnosis of adenomyosis was noted in only ten patients, while an indefinite diagnosis was noted in five patients. This explains that there is a significant difference in diagnosing adenomyosis by USG and MRI. Muthuswamy P. et al. concluded that out of 16 cases detected by USG, a definite diagnosis of adenomyosis was noted in only six patients, while an indefinite diagnosis was noted in ten patients, indicating a significant difference between USG and MRI in diagnosing adenomyosis.[1]

In comparison, in our study, 12 cases were diagnosed with diffuse adenomyosis and 4 with focal adenomyosis. Muthuswamy P. et al. concluded that 12 cases were diagnosed with diffuse adenomyosis and 4 with focal adenomyosis.[1]

Endometrial Polyp

On USG, all the patients with endometrial polyps showed thickened endometrium and a well-defined, round to oval hyperechoic lesion in the endometrial cavity with a vascular pedicle. The interrupted mucosa sign was also depicted in one of the patients. Bhatnagar et al. concluded that all patients with endometrial polyps showed thickened endometrium and a well-defined, round to oval hyperechoic lesion in the endometrial cavity with a vascular pedicle. The interrupted mucosa sign was depicted in three (50%) patients.[4] Kwon et al. retrospectively evaluated ultrasound findings in 24 patients with endometrial polyps. They found a well-delineated (100%), rounded (66% of patients), hyperechoic (83%), and solid lesion (87%) with a vascular pedicle (100%).[12]

On MRI, six (85%) patients with endometrial polyps had an endometrial lesion appearing hypointense on T1 and seven (100%) had an endometrial lesion appearing hypointense on T2WI. One (15%) patient with endometrial polyps had an endometrial lesion appearing isointense on T1. On post-contrast scans, these lesions showed homogeneous enhancement. Bhatnagar et al. concluded that on MRI, both patients with endometrial polyps had an endometrial lesion appearing hypointense on T1 and T2WI. On post-contrast scans, these lesions showed homogeneous enhancement.[4]

Endometrial Carcinoma

On USG, all patients diagnosed with endometrial carcinoma had thickened and heterogeneous endometrium with raised internal vascularity. Myometrial invasion was evident on USG in four (80%) cases. Hydrometra was observed in two (40%) patients, and hydroureteronephrosis was observed in one (20%) patient. Bhatnagar et al. concluded that all patients diagnosed with endometrial carcinoma had thickened and heterogeneous endometrium with raised internal vascularity. Myometrial invasion was evident on USG in four cases. Hydrometra was observed in two patients, and hydroureteronephrosis was observed in one patient.[4] Epstein et al. described that the most frequent USG findings were thickened endometrium and a raised color score.[11] Alcazar et al. found that USG could detect myometrial invasion in 80% of cases compared to histopathology.[18]

On MRI, all patients diagnosed with endometrial carcinoma showed a heterogeneously enhancing, T2 hyperintense mass in the endometrial cavity. Myometrial invasion was observed in all cases, detecting invasion. Hydrometra was observed in three of our cases (60%). Necrotic lymph nodes and parametrial extension were observed in two (40%) cases each, and cervical stromal invasion and hydroureteronephrosis were observed in one case (20%) each. Two of our cases were Stage IA, one was Stage IB, two were Stage IIIC, and one was Stage IV. Bhatnagar et al. concluded that all patients diagnosed with endometrial carcinoma showed a heterogeneously enhancing T2 hyperintense mass in the endometrial cavity. Myometrial invasion was observed in all cases, detecting invasion in one more case than USG. Diffusion restrictions were observed in all cases. Hydrometra was observed in three of our cases (60%). Necrotic lymph nodes and parametrial extension were observed in two cases each, and cervical stromal invasion and hydroureteronephrosis were observed in one case each. One case also showed a concomitant anterior myometrial fibroid. Two cases were Stage IB, two were Stage IIIC1, and one was Stage II.[4] Tao et al. found that the most frequent MRI findings in patients with endometrial carcinoma were widening of the endometrial canal and high signal intensity areas causing widening of the body of the uterus. Most cases also showed uneven enhancement on post-contrast scans. In one case in our study, where MRI diagnosed endometrial hyperplasia, histopathology confirmed it as endometrial carcinoma.[17]

Cervical Carcinoma

Among the patients diagnosed with cervical carcinoma, on USG ten (83%) had a bulky cervix with a hypoechoic mass, and two (17%) cases had a bulky cervix with a heterogeneous mass. All cases showed raised internal vascularity within the mass on Doppler imaging. Five cases (41%) had hydrometra, and four cases (33%) had hydroureteronephrosis. Bhatnagar et al. concluded that all patients diagnosed with cervical carcinoma had a thickened and heterogeneous endometrium with raised internal vascularity. Myometrial invasion was evident on USG in four cases. Hydrometra was observed in two patients, and hydroureteronephrosis was observed in one patient.[4]

Li et al. (2021) found that hypoechoic mass lesions were seen in 74% of the study subjects, while heterogeneous mass lesions were observed in the rest. Color Doppler signal was observed in all study subjects. About 20% of patients were also observed to have uterine effusion.[10]

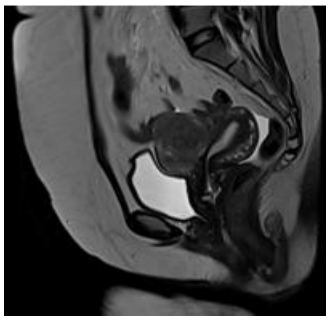
On MRI, all patients diagnosed with cervical carcinoma showed a heterogeneously enhancing mass in the cervix. Parametrial extension was observed in eight of our cases (67%), hydrometra in five cases (42%), and hydroureteronephrosis in four cases (33%). Loss of

intervening fat planes with the rectum and bladder was observed in one (8%) case each. All cases showed restricted diffusion on diffusion-weighted images. Bhatnagar et al. concluded that on MRI, all patients diagnosed with cervical carcinoma showed a heterogeneously enhancing mass in the cervix. Parametrial extension was observed in three of our cases (60%), and hydrometra and hydroureteronephrosis were observed in two cases each (40%). Loss of intervening fat planes with the rectum and bladder was observed in one case each. All cases showed restricted diffusion on diffusion-weighted images.[4] Zand et al. stated that MRI, especially dynamic contrast-enhanced sequences, could accurately detect vaginal and parametrial involvement in most cases.[16]

Cases:

Case 1: Subserosal Fibroid

(A)

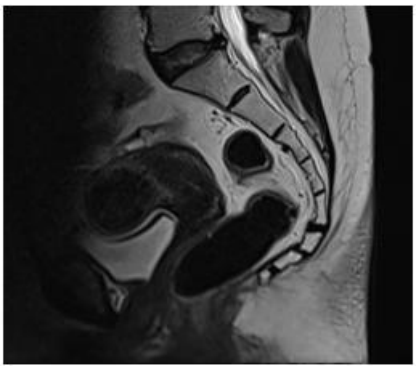


(B)

Anterior wall subserosal fibroid in a 45-year old female. A. Transabdominal ultrasound image of a uterus shows a well-defined heterogeneous hypoechoic lesion with subtle vascularity which appears to be arising from the anterior wall of uterus. B. Sagittal T2W image shows a well-defined hypointense lesion arising from the anterior wall of uterus. The lesion was noted to be iso-hypointense on T1W images.

Case 2: Intramural Fibroid

(A)

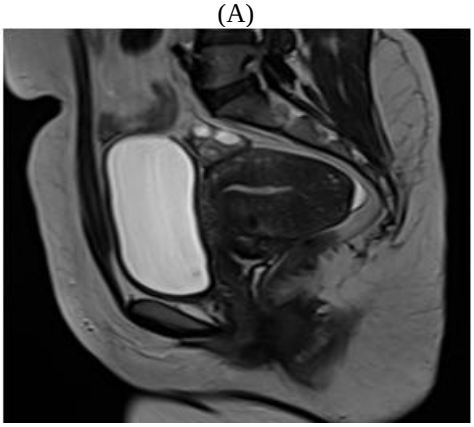


(B)

Anterior wall intramural fibroid in a 50-year-old female. A. Transvaginal ultrasound image of a uterus shows a well defined hypoechoic lesion with subtle vascularity at the fundo-anterior wall of uterus. B. Sagittal T2W image shows a well-defined hypointense lesion within the myometrium in the fundo-anterior wall of uterus. The lesion was noted to be hypointense on T1W images.

Case 3: Adenomyosis

(A)

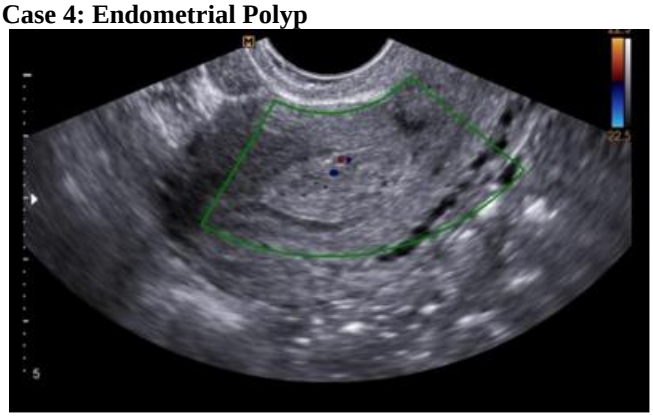


(B)

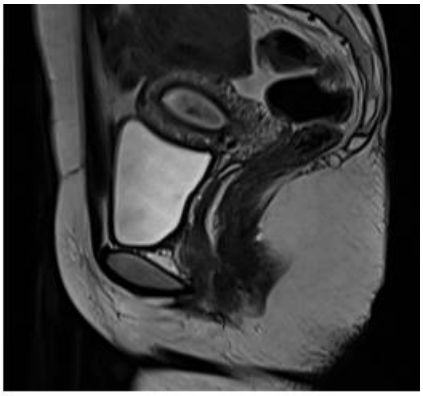
Adenomyosis in a 30-year old female. A. Transabdominal ultrasound image of a uterus shows a bulky globular uterus with heterogenous myometrium, anechoic cystic lesions in myometrium and loss of endometrial-myometrial junction. B. Sagittal T2W image shows a bulky uterus with few

hyperintense foci in myometrium with ill-defined thickening of junctional zone.

Case 4: Endometrial Polyp



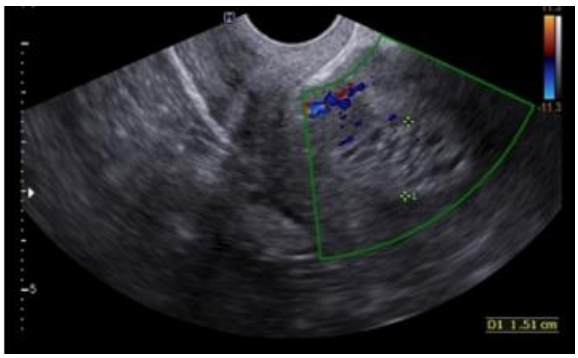
(A)



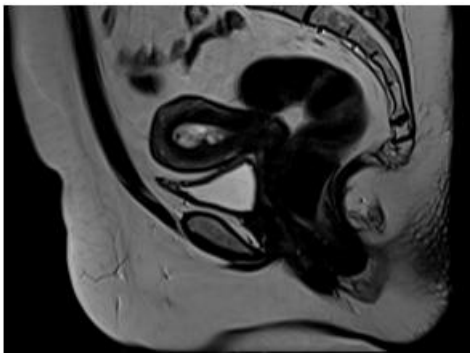
(B)

Endometrial polyp in a 28-year old female. A. Transvaginal ultrasound image shows thickened endometrium with oval hyperechoic lesion within endometrial cavity with vascular pedicle and interrupted mucosa sign. B. Sagittal T2W image shows thickened endometrium with isointense lesion within endometrial cavity which shows tiny hypointensities within, likely suggestive of flow voids and peripheral hyperintense rim.

Case 5: Endometrial Hyperplasia



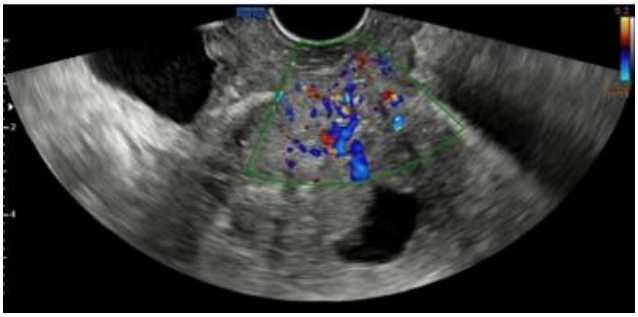
(A)



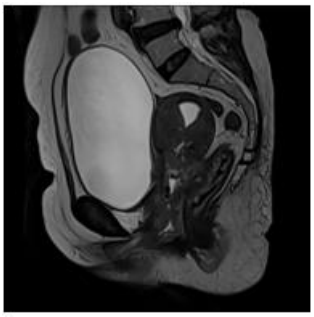
(B)

Endometrial hyperplasia in a 63-year old female. A. Transvaginal ultrasound image shows a thickened endometrium with multiple tiny hypoechoic areas within.B. Sagittal T2W images show a heterogeneously hypointense to isointense thickened endometrium with hyperintense cystic areas within.

Case 6: Cervical Cancer



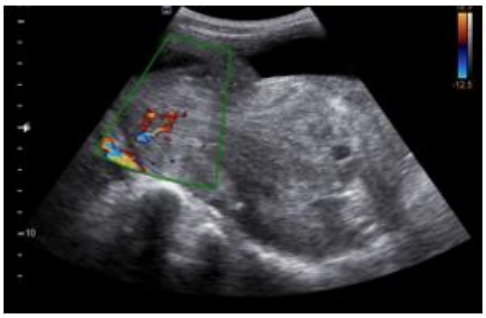
(A)



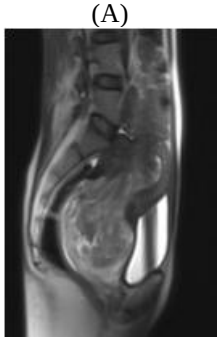
(B)

Cervical cancer in a 65-year-old female. A. Transvaginal ultrasound image shows a bulky and heterogeneously hyperechoic cervix with markedly increased internal vascularity. B. Sagittal T2W images show a bulky heterogeneously isointense to hypointense lesion in the cervix which is which involves the lower uterine segment causing fluid accumulation in the upper segment. The lesion shows suspicious loss of fat plane with the posterior wall of urinary bladder and anterior rectal wall. The features are suggestive of infiltrative type more likely.

Case 7: Cervical Cancer



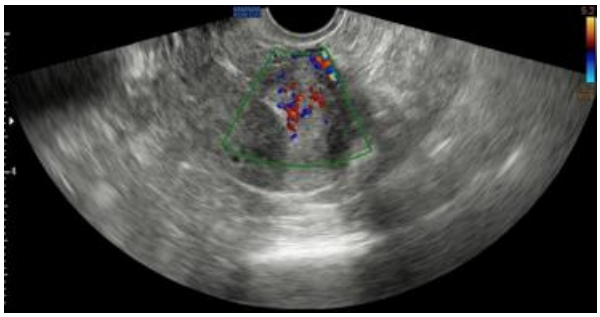
(A)



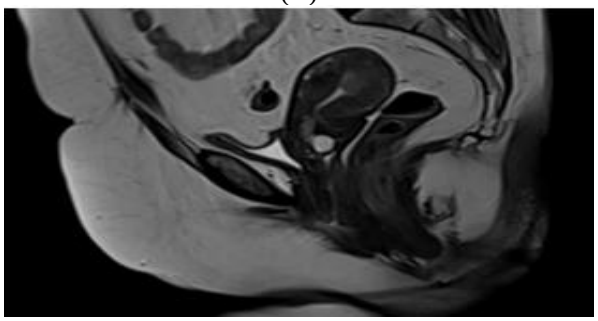
(B)

Cervical cancer in a 41-year-old female. A. Transabdominal ultrasound image shows a bulky and heterogeneous hyperechoic cervix with markedly increased internal vascularity. B. Sagittal T2W images show a bulky isointense to hypointense lesion (with respect to the rest of the cervix) in the cervix with interspersed hyperintense areas. The lesion is extending superiorly, involving the uterine cavity and inferiorly it extends in the lower third of vagina. No pelvic side wall extension is noted. The features are suggestive of endocervical type more likely.

Case 8: Endometrial Cancer



(A)



(B)

Endometrial cancer in a 60-year old female. A. Transvaginal ultrasound image shows a thickened, irregular and heterogeneous endometrium with raised internal vascularity. B. Sagittal T2W image shows an ill-defined heterogeneous hypointense lesion within endometrial cavity which appears to be arising from posterior endometrial wall of upper uterine segment. (The lesion appears heterogeneous hyperintense with thickening of endometrium and evidence of invasion into the myometrium on T1W/T2W STIR images).

7. Summary and Conclusion

Uterine pathologies are prevalent among both reproductive-age and postmenopausal women, with benign conditions being more common in the former, while malignancies are more frequent in the latter. Ultrasound, when combining transabdominal and transvaginal approaches, is an effective tool for diagnosing uterine pathologies. However, MRI is considered the optimal imaging modality for characterizing, localizing, and evaluating both benign and malignant lesions, as well as for staging pelvic pathologies. Compared to ultrasound, MRI is more precise and often serves as the gold standard in these cases.

For conditions like adenomyosis, MRI has proven to be more accurate in diagnosis, whereas ultrasound may struggle to visualize the junctional zone. When evaluating fibroids, MRI outperforms both transabdominal and transvaginal ultrasound in determining their number and location. For endometrial lesions, transvaginal sonography serves as an excellent screening tool, as transabdominal ultrasound has been found to be less specific. MRI, on the other hand, plays a critical role in assessing myometrial invasion.

In cases of endometrial carcinoma, MRI alone cannot replace the need for an endometrial biopsy, as it may not differentiate between early stages of carcinoma and hyperplasia. However, MRI excels in evaluating the extent of cervical carcinoma and its invasion into adjacent organs, providing superior information compared to ultrasound.

In conclusion, while ultrasound is less specific and sensitive than MRI, it remains an invaluable and cost-effective screening tool for initial evaluation and further management. MRI, however, is the more precise preoperative imaging modality, capable of distinguishing the unique characteristics of various lesions with greater accuracy.

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