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Original Research Article

Magnetic Resonance Imaging Spectrum of Uterine Pathologies: A Comprehensive Imaging Evaluation

Article History:

Name of Author:

Riddhi Tandon[1], Ashok Srikar Chowdhary[2] and Gautam Muthu[3]

Affiliation: *[1]Junior Resident, Department of Radiodiagnosis, Rajarajeswari Medical College and Hospital, Bengaluru, Karnataka, India.*

[2]Professor, Department of Radiodiagnosis, Rajarajeswari Medical College and Hospital, Bengaluru, Karnataka, India.

[3]Head of Department and Professor, Department of Radiodiagnosis, Rajarajeswari Medical College and Hospital, Bengaluru, Karnataka, India.

Corresponding Author:

Riddhi Tandon

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Abstract: ***Background:*** Uterine pathologies are commonly encountered gynaecological conditions and include a wide spectrum of benign, malignant, and congenital abnormalities. While ultrasonography is the first-line imaging modality, magnetic resonance imaging (MRI) plays a crucial role in problem-solving and detailed lesion characterization. ***Aim*** To evaluate the role of MRI in the assessment and characterization of clinically suspected uterine pathologies. ***Materials and Methods:*** This hospital-based observational study included 45 patients referred for MRI evaluation of clinically suspected uterine pathologies or sonographically detected uterine anomalies. MRI examinations were performed using a 1.5 Tesla system. Lesions were assessed for number, size, location, morphology, and extent, and classified as benign, malignant, or congenital anomalies. ***Results:*** Among the 45 patients, benign uterine pathologies were identified in 31 patients (68%), malignant lesions in 10 patients (22%), and congenital anomalies in 4 patients (10%). Of the malignant cases, cervical carcinoma and endometrial carcinoma accounted for 5 cases each (50%). Among benign lesions, leiomyomas were the most common (19 cases, 61%), followed by adenomyosis (6 cases, 19%), adenomyosis with coexisting fibroids (3 cases, 10%), and endometrial polyps (3 cases, 10%). MRI accurately delineated the number, size, and location of uterine lesions. ***Conclusion:*** MRI is a highly effective imaging modality for the diagnosis, localization, and characterization of uterine pathologies and is invaluable in evaluating benign and malignant lesions as well as congenital uterine anomalies.

Keywords: Magnetic resonance imaging (MRI); Uterine pathologies; Leiomyoma; Adenomyosis; Gynecological imaging

INTRODUCTION

Uterine pathologies are among the most frequently encountered gynaecological disorders in women and encompass a wide spectrum of conditions that can significantly impact reproductive health and quality of life. These conditions range from common benign lesions such as leiomyomas, adenomyosis, and endometrial polyps to malignant neoplasms including endometrial and cervical carcinomas, as well as congenital anomalies like Müllerian duct anomalies. Imaging plays a central role in the evaluation of these entities, guiding diagnosis, management, and surgical planning.

Ultrasonography (USG) is widely accepted as the initial imaging modality for suspected uterine pathology due to its accessibility, cost-effectiveness, and ease of use. Transvaginal and transabdominal sonography can effectively detect many uterine abnormalities such as leiomyomas and polyps, and provide useful information about lesion size, number, and location. However, USG may be limited in complex or indeterminate cases, particularly when lesions are deep-seated or when there is a need for detailed tissue characterization.[1]

Magnetic resonance imaging (MRI) has emerged as a superior problem-solving tool in such scenarios, owing to its excellent soft tissue contrast resolution, multiplanar imaging capability, and ability to differentiate between tissue types without ionizing radiation. MRI is particularly valuable when

sonographic findings are equivocal, in preoperative evaluation, and for detailed mapping of complex uterine lesions. It is also the preferred modality for characterization and staging of malignancies such as endometrial and cervical carcinoma, including evaluation of myometrial invasion, cervical stromal involvement, and lymph node assessment. [2]

Among benign uterine lesions, leiomyomas (fibroids) are the most prevalent, often appearing as well-circumscribed masses with low signal intensity on T2-weighted MRI and varied appearances depending on degeneration, location, and size. MRI outperforms ultrasound in accurately determining the number, size, and exact location of fibroids, which is crucial for surgical planning. [3]

Similarly, adenomyosis — characterized by the presence of ectopic endometrial glands and stroma within the myometrium — demonstrates distinctive MRI features such as thickening of the junctional zone, which aid in differentiation from other myometrial pathologies. [4]

Endometrial polyps and hyperplasia also benefit from MRI assessment, where signal characteristics and enhancement patterns help differentiate them from malignant endometrial lesions. MRI evaluation of Müllerian duct anomalies is considered ideal due to its ability to delineate complex uterine anatomy and guide reproductive and surgical management.[5]

Overall, while ultrasound remains the first-line imaging approach for uterine pathologies, MRI significantly enhances diagnostic confidence, improves lesion characterization, and informs appropriate management strategies, especially in cases with inconclusive ultrasonographic findings or suspected malignancies.[6]

IMAGING FEATURES OF UTERINE PATHOLOGIES ON MRI

Magnetic resonance imaging plays a pivotal role in the characterization of uterine pathologies owing to its excellent soft tissue contrast and multiplanar capability.[7]

Leiomyomas typically appear as well-defined myometrial masses that are isointense on T1-weighted images and characteristically hypointense on T2-weighted images, reflecting their fibrous smooth muscle content.[8,9] Degenerative changes may result in heterogeneous signal intensity and variable post-contrast enhancement.[9]

Adenomyosis is best demonstrated on MRI as diffuse or focal thickening of the junctional zone exceeding 12 mm, with ill-defined low signal intensity on T2-weighted images and punctate hyperintense foci representing ectopic endometrial glands.[10,11]
Endometrial polyps appear as focal endometrial masses with intermediate signal intensity on T1-weighted images and heterogeneous T2 signal, often showing early and persistent enhancement following contrast administration.[12]

In endometrial carcinoma, MRI typically demonstrates a mass of intermediate to high signal intensity on T2-weighted images replacing the normal endometrium, with restricted diffusion and reduced enhancement compared to the myometrium, aiding in assessment of myometrial invasion.[13]

Cervical carcinoma appears as a lesion of intermediate to high T2 signal intensity disrupting the normal low-signal cervical stroma, and MRI is essential for accurate local staging and evaluation of parametrial invasion.[14]

MRI is also the imaging modality of choice for the evaluation of Müllerian duct anomalies, as it accurately delineates uterine morphology and endometrial cavity configuration.[15]

AIMS AND OBJECTIVES

1. To assess the role of MRI in the evaluation of clinically suspected uterine pathologies.
2. To categorize uterine lesions as benign or malignant based on MRI morphological features.
3. To evaluate the role of MRI in lesion localization and assessment of disease extent.

MATERIALS AND METHODS

This was a **prospective, hospital-based observational study** conducted in patients referred to the radiology department with clinically suspected uterine pathologies or uterine abnormalities detected on ultrasonography. A total of 45 patients were included in the study. MRI examinations were performed using a 1.5 Tesla Siemens Avanto scanner.

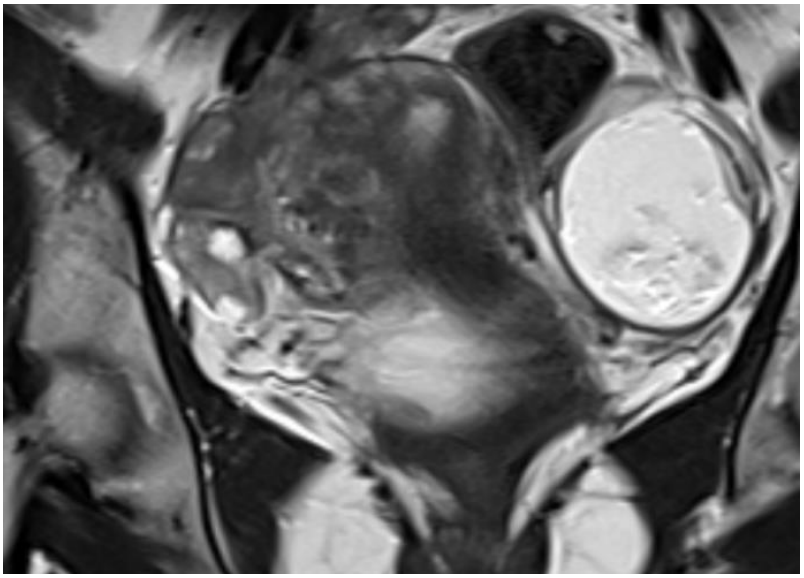

Figure 1. T2 weighted coronal image showing intramural fibroid on the right of endometrium in a 32-year-old woman.

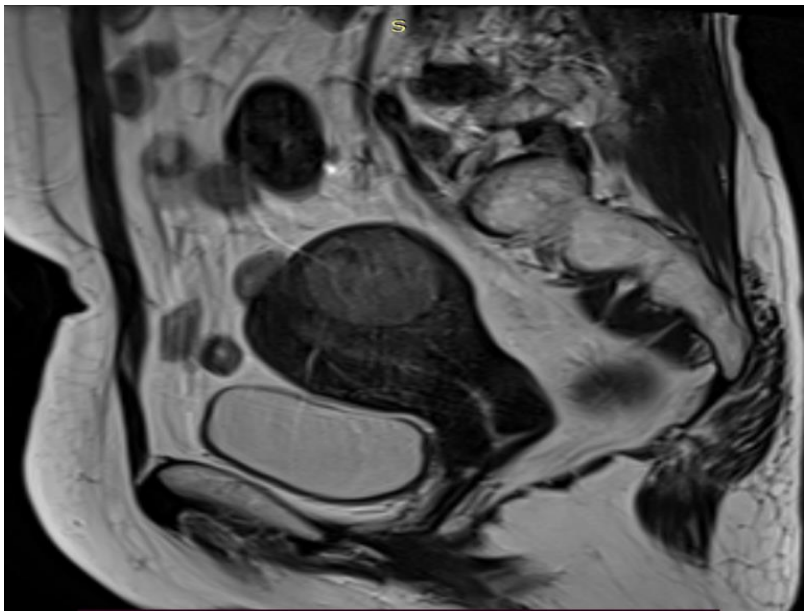

Figure 2. T2 weighted sagittal image of a 65-year-old postmenopausal female showing intramural fibroid in posterior myometrium which is displacing the endometrium anteriorly

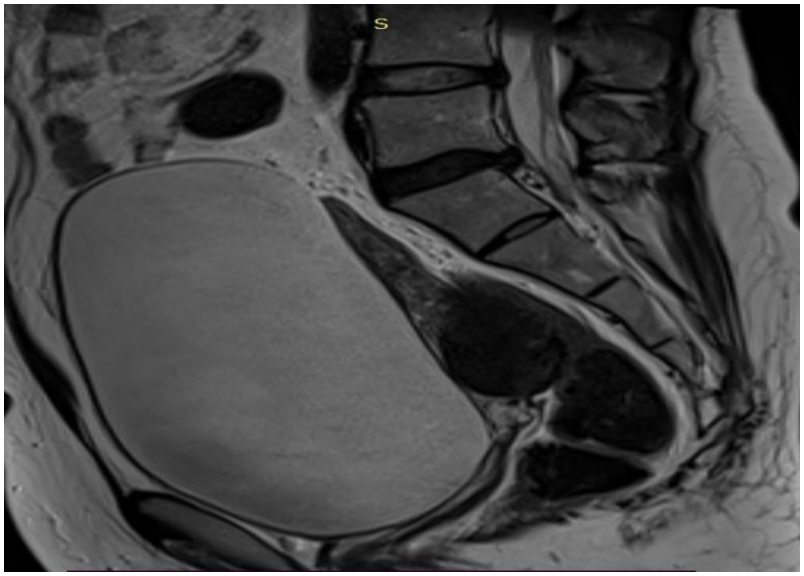

Figure 3. Sagittal MR T2WI of 55 years old woman showing subserosal fibroid arising from posterior myometrium of body of uterus.

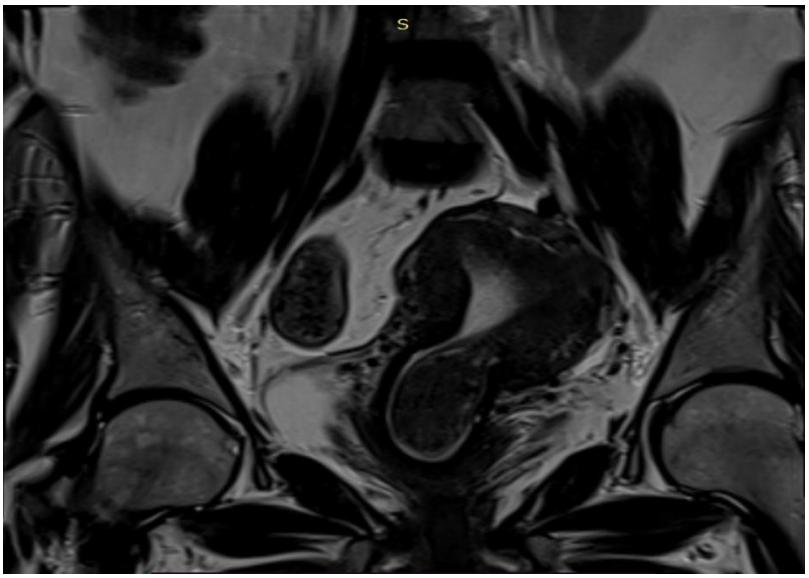

Figure 4. Coronal MR T2WI of a 43-year-old woman showing submucosal fibroid within the endometrial cavity in body of uterus

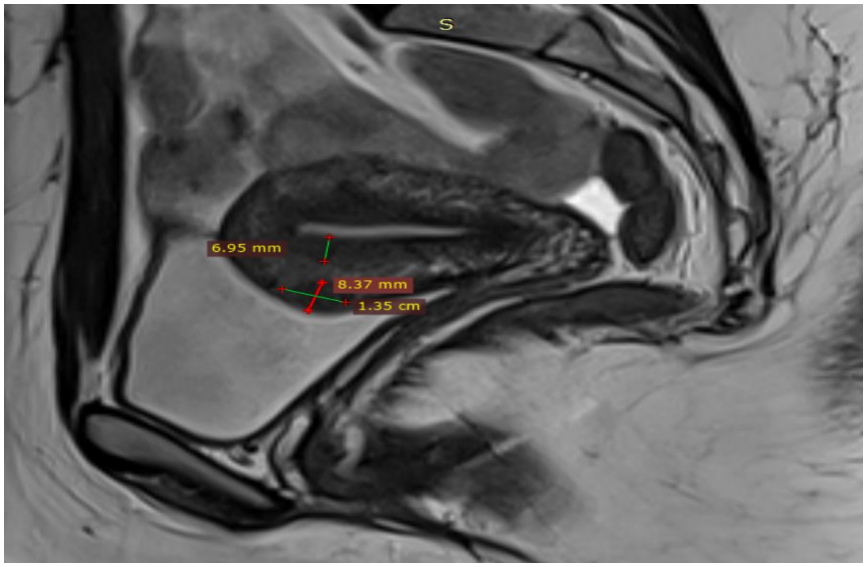

Figure 5. T2 weighted sagittal image showing **thickened junctional zone** suggestive of **Adenomyosis** and **intramural fibroid** in anterior myometrium in 38 years old woman.

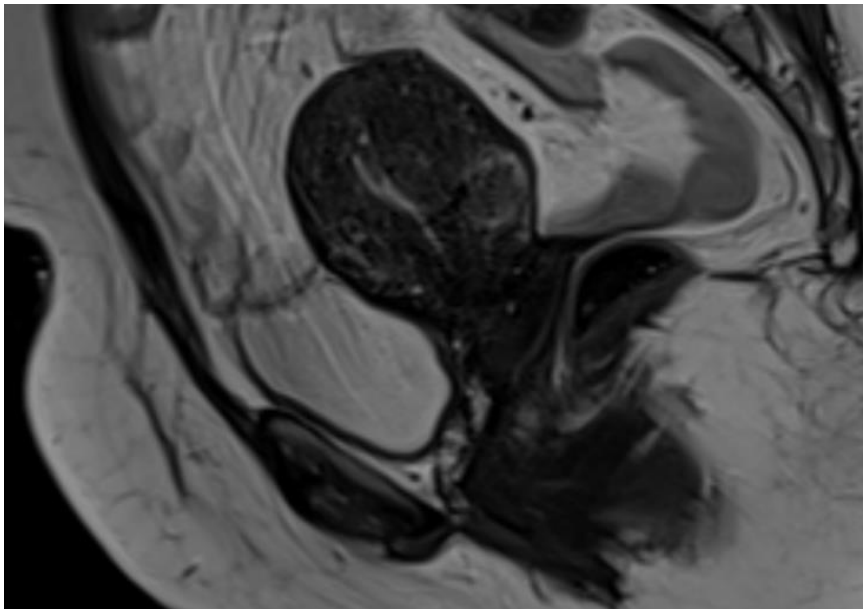

Figure 6. T2 weighted sagittal image of a 50-year-old postmenopausal female with globular uterus with **thickened posterior myometrium** suggestive of **Adenomyosis** and **intramural fibroid**

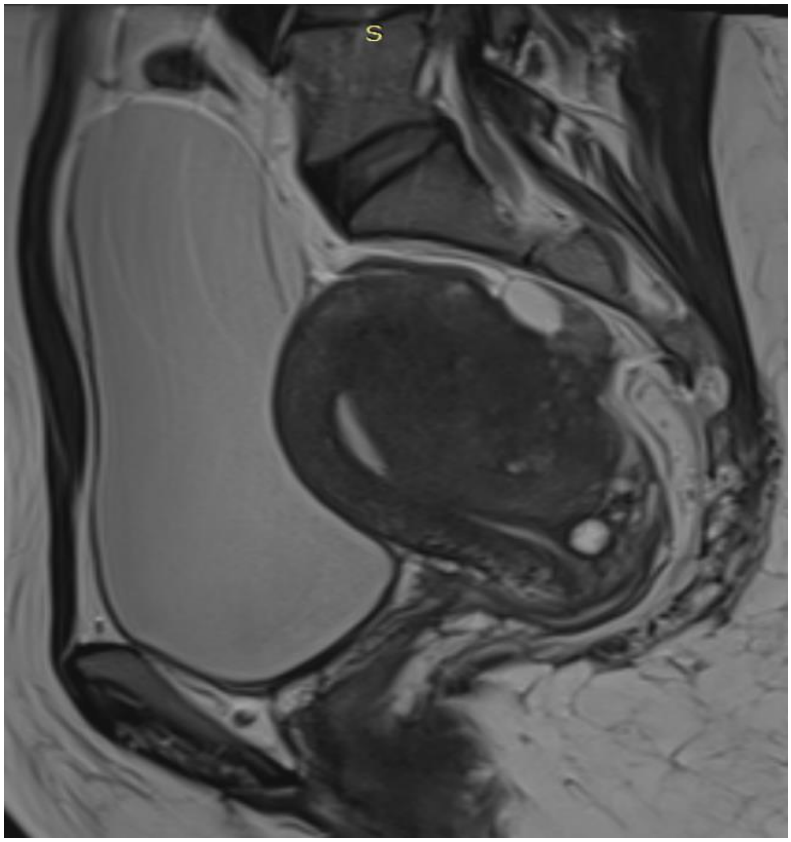

Figure 7. Sagittal MR T2WI showing **thickened posterior myometrium** with few **T2 hyperintense cysts** within it denoting ectopic endometrial glands. There is loss of endo-myometrial interface at places

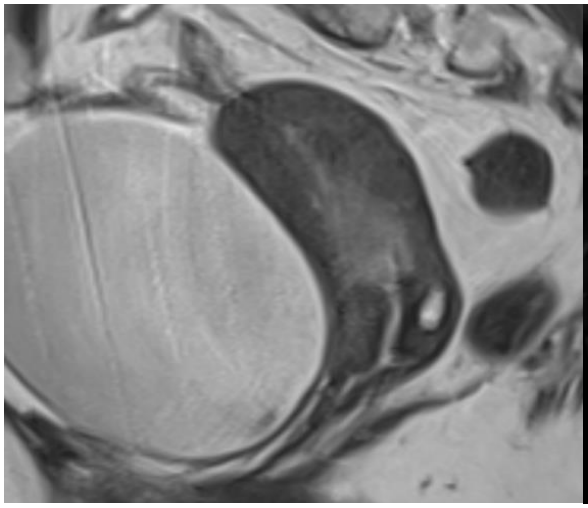

Fig. 8A.

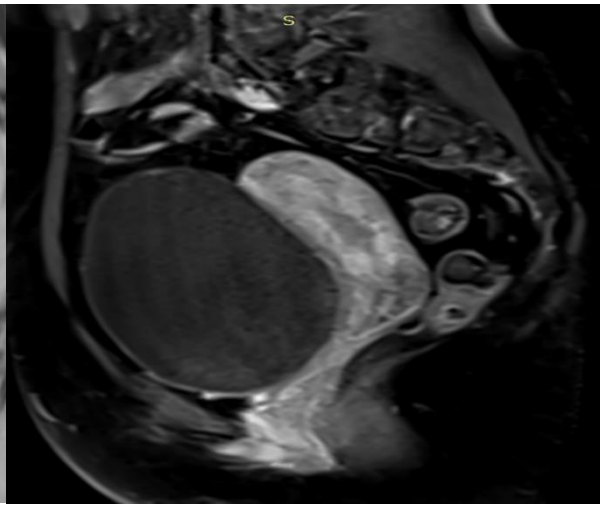

Fig. 8B.

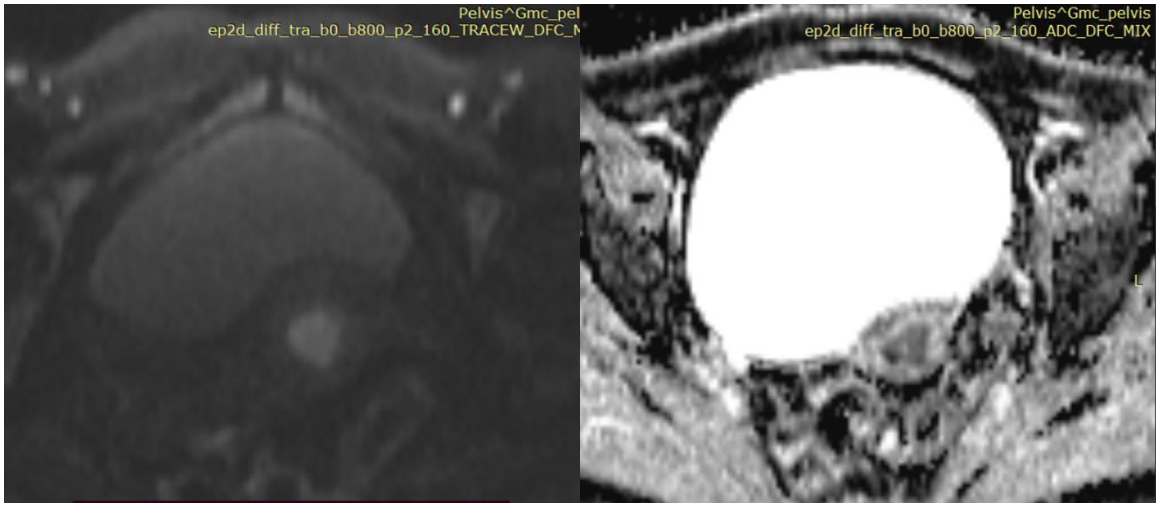

Fig. 8C. **Fig. 8D.**

Figure 8. Sagittal T2WI (8A) shows a **hyperintense area** in the endometrial canal showing **heterogenous enhancement** on post contrast scan (8B). The mass depicts **restricted diffusion** on DWI (8C) with corresponding low signal on ADC map (8D) - Biopsy was positive for **Endometrial Adenocarcinoma.**

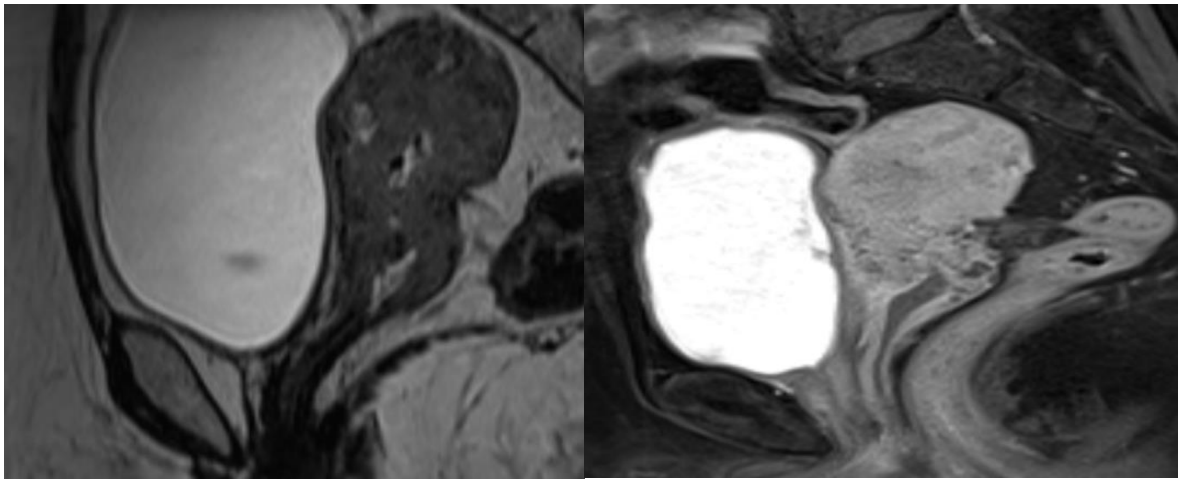

Fig. 9A. **Fig. 9B**

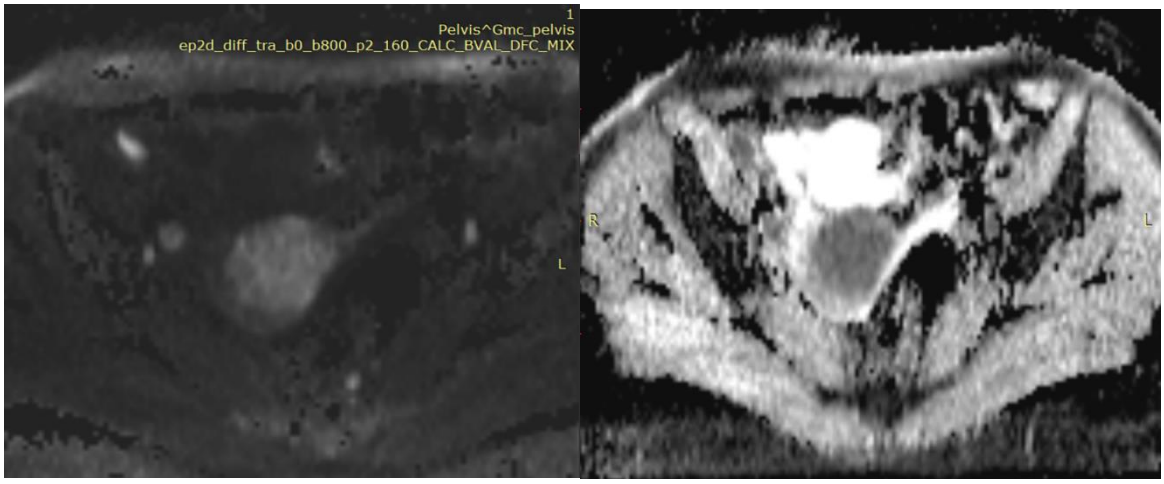

Fig.9C. **Fig.9D.**

Figure 9. Sagittal T2WI (9A) shows an ill-defined **hyperintense area** in the cervical canal extending into body of uterus showing **heterogenous enhancement** on post contrast scan (9B). The mass depicts **restricted diffusion** on DWI (9C) & ADC (9D) - Biopsy was positive for **Squamous cell carcinoma Cervix**

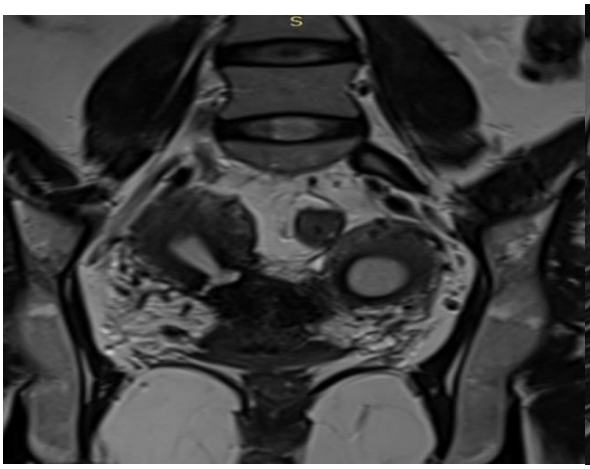

Fig. 10A.

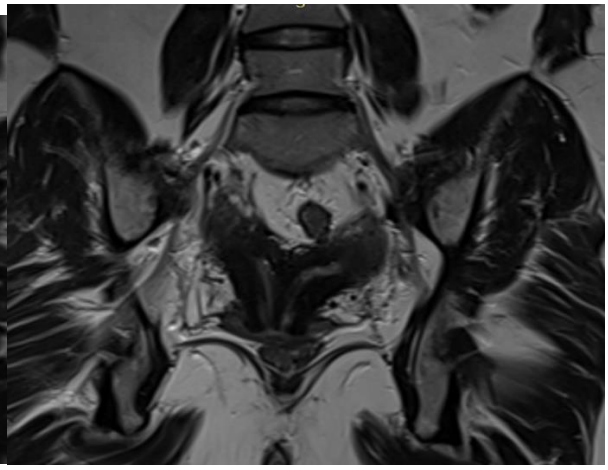

Fig. 10B.

Figure 10A & B. Coronal T2 weighted MR images show two uterine horns with two cervical canals, therefore the diagnosis of Bicornuate bicollis uterus was made.

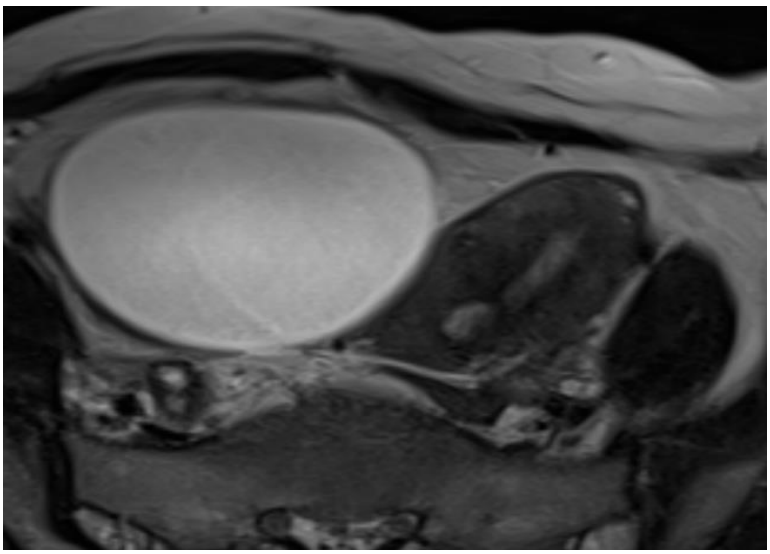

Fig 11A and 11B

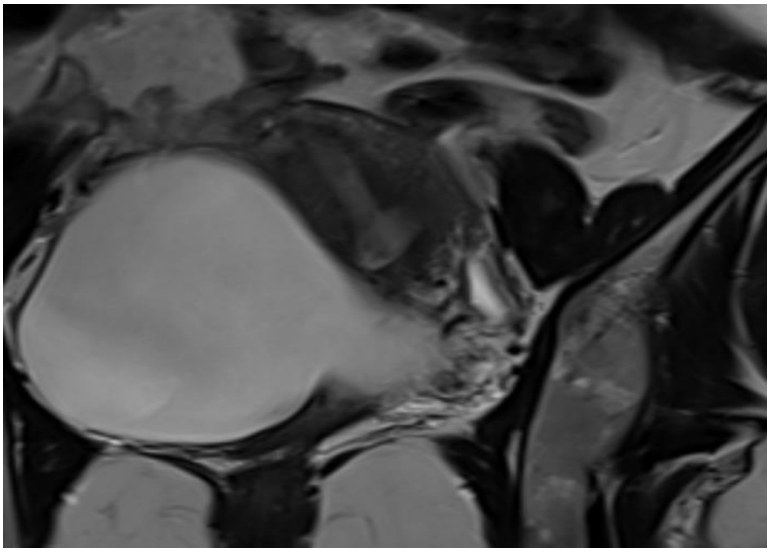

Figure 11A & B. Axial (Fig. 11A) and Coronal (Fig. 11B) images show separation of endometrial cavities in the fundal region with fundal dip < 1cm indicating Septate Uterus.

RESULTS

A total of 45 cases were studied. Among the 45 patients included in the study, benign uterine pathologies were identified in 31 patients (68%), malignant lesions in 10 patients (22%), and congenital anomalies in 4 patients (10%).

Of the malignant cases, cervical carcinoma was observed in 5 patients (50%), while endometrial carcinoma was identified in 5 patients (50%).

Among the benign uterine pathologies, leiomyomas (fibroids) constituted the majority, seen in 19 patients (61%). Adenomyosis was observed in 6 patients (19%), adenomyosis coexisting with fibroids in 3 patients (10%), and endometrial polyps in 3 patients (10%).

The tables illustrate the nature and distribution of uterine pathologies, categorizing lesions into benign, malignant, and congenital anomalies, along with their respective frequencies as observed on MRI.

NATURE OF PATHOLOGY	NUMBER OF PATIENTS	PERCENTAGE OF PATIENTS
BENIGN	31	68%
MALIGNANT	10	22%
CONGENITAL	4	10%

Table 1 shows distribution of patients based on the nature of pathology.

MALIGNANT DISEASE	NUMBER OF PATIENTS	PERCENTAGE OF PATIENTS
Cervical Carcinoma	5	50%
Endometrial Carcinoma	5	50%

Table 2 shows distribution of patients based on the malignant diseases.

BENIGN DISEASE	NUMBER OF PATIENTS	PERCENTAGE OF PATIENTS
Fibroid	19	61%
Adenomyosis	6	19%
Adenomyosis with Fibroid	3	10%
Endometrial Polyp	3	10%

Table 3 shows distribution of patients based on the benign diseases.

CONCLUSION

The present study classified uterine pathologies into benign, malignant, and congenital anomalies. MRI accurately delineated the number, size, and location of lesions and demonstrated high sensitivity and specificity in their diagnosis and localization. These findings underscore the importance of comprehensive knowledge of MRI appearances of uterine pathologies among radiologists to facilitate accurate diagnosis and guide appropriate clinical management.

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