

# Evaluation of Uterine Pathologies using A 1.5 Tesla Magnetic Resonance Scanner

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## A B S T R A C T

**Introduction:** The multiplanar capabilities of the magnetic resonance imaging (MRI) with 3D depiction of anatomy and soft-tissue contrast of the pelvis offers excellent depiction of the female uterine anatomy and often lead to specific diagnosis. Hence, is increasingly used to evaluate uterine pathologies. Thus, the present study was conducted to identify uterine pathologies with the help of 1.5T MRI and to establish the impact of diagnosis on treatment with the help of 1.5T MRI.

**Material and Methods:** The study was conducted among 40 female patients who came to the radiology department with uterine pathologies. MRI was conducted on 1.5 Tesla GE HDXT 16 Channel system. Data so obtained was analysed using SPSS-18 and was expressed as number and percentage as required.

**Results:** In the present study, approximately 82.5% patients were between 35 – 65 years of age. The most common complaint was seen in post-menopausal women in the form of post-menopausal bleeding. In general myometrium was most common structure to be involved along with cervix. In the present, among patients of carcinoma of endometrium, maximum patients were in Stage IB disease (41.66%), followed by Stage IA (25%), Stage IIIA (16.66%). 8.33% patients were in Stage IIA and Stage IVA disease each. Stages IIIB and IVB were not found in our study patients.

**Conclusion:** The present study concluded that 3T MRI proved to be a very useful non-invasive tool in accurately diagnosing the abnormalities of uterus. MRI also helped in staging of the gynaecological malignancies, in identifying early invasion of adjacent structures as well as lymph nodal infiltration, thus further proved useful in further management of the patient.

**Keywords:** Gynaecological Pathologies; Magnetic Resonance Imaging; Radiodiagnosis

## INTRODUCTION

Ultrasound is one of the imaging modality of preference for the diagnosis of diseases of female pelvis. It is a familiar test for patients as is widely available and is relatively inexpensive. MRI with its high contrast resolution, its ability to provide good tissue characterization, and its multiplanar imaging capabilities, is increasingly used to evaluate pelvic pathology. There is a significant difference, however, in the inherent costs of MRI and ultrasound.<sup>1</sup>

The multiplanar capabilities of the magnetic resonance imaging (MRI) with 3D depiction of anatomy and soft-tissue contrast of the pelvis offers excellent depiction of the female uterine anatomy and often lead to specific diagnosis. MRI is often used as a problem-solving tool in patients where ultrasound is inconclusive or suboptimal<sup>2</sup> However, MRI has proven to be a significant modality for the staging of known endometrial carcinoma.<sup>3</sup> MRI can differentiate between superficial and deep-muscle invasive tumors by using a combination of T2W imaging and

contrast-enhanced MRI. It is a diagnostic approach of choice chiefly for preoperative categorization and staging of endometrial and cervical cancer and, thus, it plays a crucial role in stratifying patients into required treatment options. The role of MRI in endometrial cancer includes the evaluation of depth of myometrial invasion, cervical invasion, and nodal metastasis. MRI has shown superior results to CT and ultrasound in assessing myometrial invasion, cervical extension, and nodal involvement. MRI also has an important role in staging cervical cancer in women previously diagnosed by a Pap smear or biopsy.<sup>4</sup> MR imaging can also evaluate gynecologic conditions during pregnancy as well as in the postpartum period. The advancement has led to faster imaging sequences with parallel imaging which has enabled to attain images of a moving fetus and dynamic assessment of the entire female pelvic floor. MRI is the modality of choice in evaluating leiomyomas before and after treatment with uterine artery embolization.<sup>5,6</sup> Studies have shown that MRI is superior

to ultrasound for the diagnosis of adenomyosis.<sup>7</sup> Thorough information of the spectrum of MR imaging characteristics of various physiologic variations as well as pathologic conditions affecting female pelvis is necessary for determining a correct diagnosis and hence managing further treatment. Thus, the present study was conducted to identify uterine pathologies with the help of 1.5T MRI and to establish the impact of diagnosis on treatment with the help of 1.5T MRI.

## MATERIAL AND METHODS

The present study was conducted at department of Radiodiagnosis Breach Candy Hospital Trust, Mumbai including 40 female patients who came to the radiology department with uterine pathologies in the age group of 29 – 83 years. MRI was carried out on 1.5 Tesla GE HDXT 16 Channel system.

Standard MRI of the female pelvis at our institution includes coronal single-shot fast spin-echo (FSE), axial T2-weighted (T2W) FSE, axial in-phase and opposed-phase T1-weighted (T1W) gradient-recalled echo (GRE), sagittal T2W FSE fat-suppressed sequences using a dedicated pelvic phased-array coil (FOV : 200 mm). Fat-suppressed axial 3-dimensional T1W GRE dynamic imaging following intravenous administration of 10 mL of gadolinium contrast is routinely obtained. Delayed fat-suppressed 2-dimensional (2D) GRE imaging is then obtained in an additional plane. Gadolinium-Gadodiamide was used as the contrast media in the present study. If artifact from the intestines is apparent as problematic on initial sequences, buscopan may be administered by intramuscular injection Procedure was

explained to patients and consent taken. Risk of contrast examination (less likely) explained. Detailed history of contraindication (cochlear implants) if any was taken. Proper positioning of the patient was done (head first, supine). Sedation was given as and when required (very young patients with chances of motion during the study, claustrophobic patients).

40 female patients from Breach Candy Hospital, Mumbai of all age groups with clinical presentation of abnormal uterine bleeding, viz menorrhagia, post menopausal/post partum bleeding, per vaginal discharge, pelvic pain were included in this study. Patients having prosthetic heart valves, cardiac pacemakers, cochlear implants or any metallic implants; patients with history of adverse reaction to contrast agents used were excluded from the study. Data so obtained was analysed using SPSS-18 and was expressed as number and percentage as required.

## RESULTS

Table 1 shows age wise distribution of 40 cases with uterine pathologies according to the nature of the pathology. Out of the total 25 purely benign pathologies, 4% were seen in age group of 25 – 35 years (group A), 32% in age group of 35 – 45 years (group B), 48% in age group of 45 – 55 years (group C), 12% in age group of 55– 65 years (group D), 4% in age group of 65 – 75 years (group E), while none in the age group of 75 and above (group F). Out of the total 6 patients having purely malignant pathologies, 16.6% were seen each in group C and F; while 33.3% were seen in group D and E each. Out of the total 9 patients having a combination of benign and malignant pathologies, 11.1% each were seen in group B and F, 55.5% were seen in group C, while 22.2% were seen in group D. Group C contained maximum patients who had purely benign pathologies (48%) as well as combination of benign and malignant pathologies (55.5%), group D and E had maximum patients with purely malignant pathologies (33.3% each). Patients in group F had purely benign pathologies, and did not have benign pathologies.

Figure 1 shows symptoms which were seen in 40 of our patients. The most common symptom was seen in post menopausal women who had complaints of per vaginal bleeding, seen in 16 of our patients. The next most common symptoms were menorrhagia and pelvic pain,

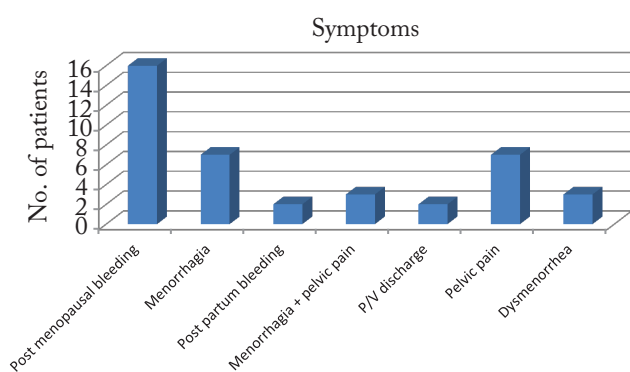


Figure-1: Symptoms among patients

Group No.	Age distribution	No. of patients	Percentage	Benign	%	Malignant	%	Benign and Malignant	%
A	25 – 35	1	4%	1	4	0	0	0	0
B	35 – 45	9	22.5%	8	32	0	0	1	11.1
C	45 – 55	18	43.5%	12	48	1	16.6	5	55.5
D	55 – 65	7	17.5%	3	12	2	33.3	2	22.2
E	65 – 75	3	7.5%	1	4	2	33.3	0	0
F	75 and above	2	5%	0	0	1	16.6	1	11.1
	Total			25		6		9	

Table-1: Age wise distribution of patients

seen in 7 of our patients. Menorrhagia and pain in lower abdomen as well as dysmenorrhea were not very common symptoms seen in only 3 of our patients each; followed by post partum bleeding and per vaginal discharge which was seen only in 2 of our patients.

Table 2 is showing the distribution of 40 cases with uterine pathologies according to the uterine structures involved. Only endometrium was involved in 4 cases, only myometrium in 9 cases, while only cervix was involved in 3 cases. The percentage involvement was 10%, 22.5% and 7.5% respectively. In 7 patients there was involvement of both endometrium and myometrium, which was 17.5%, whereas 11 patients had involvement of both myometrium and cervix (27.5%). 6 patients had involvement of all three structures i.e endometrium, myometrium and cervix, the percentage of which was 15%.

Figure 2 shows the list of benign uterine pathologies seen in our study of 40 patients. According to our observation the most common benign pathology was Nabothian cysts which was seen in 16 patients, followed by leiomyomas - seen in 15 patients, and adenomyosis which was seen in 7 out of the total 40 patients. 5 patients had both adenomyosis as well as leiomyomas, while 2 patients had retained products of conception and endometrial polyps each. Endometrial hyperplasia was the least common benign pathology found in only one of the 40 patients.

Table 3 shows out of the total 20 patients having leiomyomas, 14 patients had non - degenerated myomas (70%), whereas 6 patients had a combination of degenerated and non - degenerated myomas (30%).

Figure 3 shows out of the total 20 patients with leiomyomas, intramural leiomyomas were found in maximum number (16), the percentage being 80%. 2 patients had a combination of intramural and submucosal leiomyomas (10%), whereas intramural + subserosal and a combination of all three were found in only 1 patient each (5% each).

Figure 4 shows in our study, out of the total malignant pathologies, 80% of patients had carcinoma of endometrium, 13.33% had carcinoma cervix, while only 6.66% patients had uterine sarcoma.

Table 4 shows that 12 out of 12 patients having carcinoma of endometrium, showed restricted diffusion on diffusion weighted images. Similarly both patients with cervical cancer and a patient who had uterine sarcoma showed restricted diffusion on diffusion weighted images with corresponding drop on ADC images.

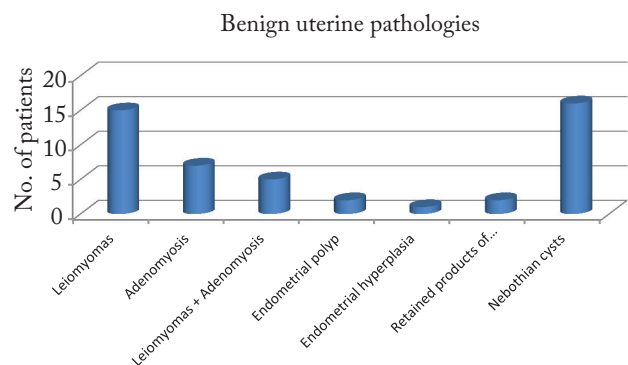
Figure 5 shows that out of total patients suffering from carcinoma of endometrium, maximum patients had Stage IB disease (41.66%), followed by Stage IA (25%), Stage IIIA (16.66%). 8.33% patients had Stage IIA and Stage IVA disease each. Stages IIIB and IVB were not found in our study patients.

Sr. No	Structure involved	No. of patients	Percentage
1	Endometrium	4	10
2	Myometrium	9	22.5
3	Cervix	3	7.5
4	Endometrium + myometrium	7	17.5
5	Myometrium + cervix	11	27.5
6	Endometrium, myometrium and cervix	6	15

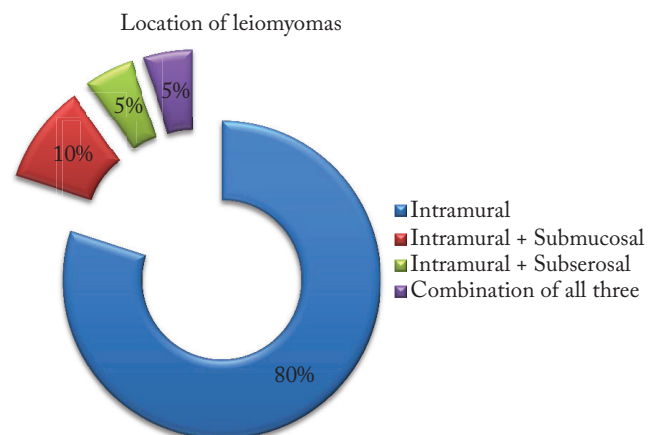
**Table-2:** Distribution of 40 cases with uterine pathologies according to the uterine structures involved

Sr. No	Type of leiomyomas	No. of patients	Percentage
1	Non - degenerated	14	70%
2	Degenerated and non - degenerated	6	30%
	Total	20	

**Table-3:** Type of leiomyomas



**Figure-2:** Benign uterine pathologies



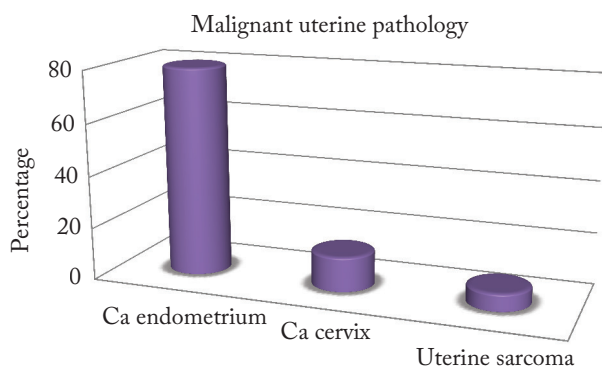
**Figure-3:** Location of Leiomyomas

## DISCUSSION

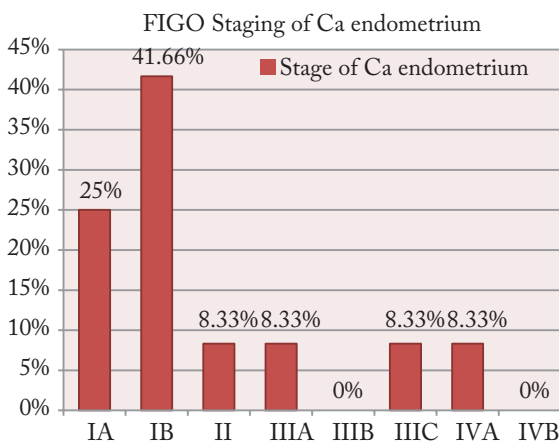
MRI plays role in the pre and post procedural assessment for uterine artery embolization, diagnosis of adenomyosis, staging of known endometrial and cervical carcinoma, evaluation of suspected mullerian ductal anomalies, and presurgical workup for uterine prolapse. Introduction of newer techniques like Diffusion-weighted imaging improves not only the detection and

Sr. No	Type of uterine pathology	No. of patients	No. of patients showing restricted diffusion
1	Leiomyoma	20	0
2	Adenomyosis	12	0
3	Endometrial polyp	2	0
4	Endometrial hyperplasia	1	0
5	Retained products of conception	2	0
6	Nabothian cysts	16	0
7	Endometrial Ca	12	12
8	Uterine sarcoma	1	1
9	Ca cervix	2	2

**Table-4:** Malignant pathologies showing restricted diffusion on DWI



**Figure-4:** Malignant uterine pathologies



**Figure-5:** Showing FIGO Staging of Ca endometrium

potentially the characterization of small uterine tumors, but also the visualization of small implants of peritoneal carcinomatosis, which could significantly impact patient management. ADC measurement may be useful for monitoring the therapeutic outcome after uterine arterial embolization, chemotherapy and/or radiation therapy.<sup>7-11</sup> In the present study, approximately 82.5% patients were between 35 – 65 years of age. The most of the cases were seen in patients of age group 45-55 years. Study conducted by Imaoka et al<sup>12</sup> found that most cases were in the age

group of 30-55 years. The most common complaint in our study was seen in post-menopausal women in the form of post-menopausal bleeding. In general myometrium was most common structure to be involved along with cervix. A study conducted by Ascher SM et al<sup>13</sup> also found similar findings.

In the present study, in most patients Nabothian cyst was incidental finding or associated with other uterine pathologies. Most patients were not having any complaints or were with non specific complaints. In patients with gynecological complaints, leiomyoma was the most common finding. Study done by Togashi et al<sup>14</sup> also revealed that leiomyoma is more common than rest of uterine pathologies.

In the present, among patients of carcinoma of endometrium, maximum patients were in Stage IB disease (41.66%), followed by Stage IA (25%), Stage IIIA (16.66%). 8.33% patients were in Stage IIA and Stage IVA disease each. Stages IIIB and IVB were not found in our study patients. Study conducted by Lee et al showed similar findings with maximum patients in stage IB group (43%) followed by stage IA(34%).<sup>15</sup>

Amongst the gynaecological malignancies, cases of carcinoma endometrium was seen more commonly than carcinoma cervix. These figures don't correlate with higher incidence rates of carcinoma cervix than carcinoma endometrium seen in the Indian population in comparison to the Western population. We infer that this reflects the patient population visiting our institution which predominantly hails from the high socio-economic strata The National Cancer Registry Programme stated in their 2009 report that there were 90,708 cases of carcinoma cervix in 2007 in India making carcinoma cervix the commonest malignancy affecting the female genital tract.<sup>16</sup>

In a study by Zawin M et al,<sup>17</sup> magnetic resonance imaging (MRI) and real-time transabdominal ultrasonography (US) was performed on 23 women with uterine leiomyomas. Accurate determination of uterine volume was possible in all cases by MRI, but was inadequate on ultrasound in case of uteri larger than 140 cc. The study concluded that MRI was found to be better to ultrasound in evaluation of the entire pelvis in females with leiomyomas. Ascher S M et al<sup>18</sup> compared conventional spin-echo magnetic resonance imaging and transvaginal sonography for the diagnosis of adenomyosis. The correct diagnosis was achieved with MR imaging in 15 of 17 cases out of 20 cases whereas 9 of 17 cases of adenomyosis were correctly diagnosed with transvaginal sonography. The most common reason of false-negative diagnoses with transvaginal sonography was the misinterpretation of adenomyosis as leiomyomas. It was concluded that MR imaging was significantly superior than transvaginal sonography in the diagnosis of adenomyosis.



Chopra S et al<sup>19</sup> conducted a study to compare imaging findings on sonography and magnetic resonance imaging (MRI) of the common and uncommon variants of adenomyosis. The MRI findings and sonograms were assessed together, and the original radiology reports were studied. Magnetic resonance imaging was taken as the reference standard for the diagnosis of adenomyosis. Adenomyosis was diagnosed in 45 of 80 women on MRI; whereas on sonography it was diagnosed in 33 (73%) of these 45 cases. In a study conducted by Jae Young Byun et al,<sup>20</sup> preoperative magnetic resonance (MR) images were retrospectively reviewed in 45 patients who underwent hysterectomy with pathologically proved adenomyosis. Diffuse adenomyosis was found in 66.7% cases and focal adenomyosis in 33.3% cases. and the study concluded that MR imaging is useful in diagnosing and differentiating adenomyosis from uterine myoma, hence in planning treatment strategy.

Kim SH et al<sup>21</sup> studied 99 cases of cervical carcinoma and compared CT and 0.5 T MRI findings using surgical-pathologic findings as gold standards. Magnetic resonance imaging was superior to CT in tumor detection (sensitivity 75 vs. 51%), in parametrial evaluation (accuracy 87 vs. 80%), in overall tumor staging (accuracy 77 vs. 69%), and in pelvic lymph node evaluation (accuracy 88 vs. 83%). The study revealed that CT was inferior to MRI to in evaluating preoperative staging of uterine cervical carcinoma and hence MRI should be used instead of CT for preoperative staging of this disease. Another similar study by Subak et al revealed same conclusions.<sup>22</sup>

Dynamic contrast enhanced MRI (DCE-MRI) has the potential to improve tumor detection and local staging, and can also provide quantitative information about uterine and cervical tumor perfusion, which may be useful for both monitoring therapeutic effects and predicting therapeutic outcome.<sup>23</sup>

## CONCLUSION

The present study concluded that 3T MRI proved to be a very useful non-invasive tool in accurately diagnosing the abnormalities of uterus. MRI with its multiplanar imaging helped in identifying various pathologies, knowing their exact location and extent with great resolution and with minimal or no artifacts. The various sequences viz. T1W, T2W, FAT SAT etc. helped in characterizing the nature of the lesions with great accuracy. Diffusion weighted images and post contrast images proved to be very useful in differentiating benign from malignant uterine pathologies. MRI also helped in staging of the gynaecological malignancies, in identifying early invasion of adjacent structures as well as lymph nodal infiltration, thus further proved useful in further management of the patient.

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