

Original Research Article

Role of Magnetic Resonance Imaging in Perimenopausal Bleeding and Its Correlation to Transvaginal Ultrasound

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Article History

Received: 13.01.2022

Accepted: 18.02.2022

Published: 24.02.2022

Journal homepage:

<https://www.easpublisher.com>

Quick Response Code



Abstract: Background and purpose: Abnormal uterine bleeding is a common presenting symptom of most of the benign and malignant uterine lesions among perimenopausal women. Although age-related, systemic, iatrogenic, and hormonal causes are more common and can be diagnosed by readily available lab tests, structural causes (either benign or malignant) are of concern to the patients in perimenopausal age women, when imaging (TVS, and MRI) comes into play. This study aims to compare the role of TVS and MRI in the characterization of uterine lesions presented as perimenopausal bleeding. **Results:** This observational prospective study was performed at a single tertiary care centre, comprising 52 consecutive patients of perimenopausal bleeding. All patients were subjected to TVS and MRI examination and correlation with histopathology was done. Most of the patients (44.2%) in our study belonged to age group of 40 to 49 years, with mean age for benign and malignant lesions was 46.81 ± 8.5 and 52.10 ± 7.05 respectively ($p = 0.025$). For evaluation of malignant lesions, sensitivity and specificity of MRI (100% and 96.87% respectively) was found to be higher than TVS (60% and 93.75% respectively with false negative rate of 40%) when both were compared with histopathology. **Conclusion:** Although TVS continues to remain the mainstay imaging modality, MRI because of excellent tissue delineation has demonstrated its superiority to TVS, for depicting and characterizing the unique features of various uterine lesions.

Keywords: Perimenopausal bleeding, Transvaginal ultrasound, Magnetic resonance imaging.

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INTRODUCTION

Abnormal uterine bleeding (AUB) is one of the most prevalent gynecologic issues, affecting up to 30% of reproductive age women and up to 50% of perimenopausal women. It is defined as "excessive bleeding that occurs outside of normal cyclic menstruation" [7]. The etiology of abnormal uterine bleeding in perimenopausal women predominantly includes physiological hormonal alterations or neoplastic tumors, which can be benign or malignant. Furthermore, one in every 40 women has a lifetime risk of acquiring uterine malignancy with > 85% cases from underdeveloped countries[3].

Management of uterine lesions is challenging and relies heavily on diagnostic modalities for early detection and accurate prognostication. Of all the various imaging modalities available, ultrasonography (TAS and TVS) continues to be the mainstay, owing to

its wide availability, patient acceptance, and low cost. But, it has shortcomings such as restricted field of view, limitation in obese patients, and its dependence on the operator's skill.

Because of its excellent soft-tissue contrast and multiplanar capabilities, MRI can more accurately show extent of the lesions. However, it is employed less often owing to its high cost, reduced availability, and prolonged acquisition time.

Efforts are being made to enhance the outcomes of cases with uterine diseases by diagnosing early-stage disease utilizing both imaging modalities in combination. More research is needed to investigate the benefits of newer imaging modalities to improve the current situation. The study is aimed to provide imaging features for early identification, characterization, and extent of uterine pathologies, as well as relevant information for clinicians to make reasonable decisions

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among competing imaging modalities. Understanding these available imaging modalities and their optimized use to diagnose the wide spectrum of uterine lesions is important to improve disease outcomes and long-term prognosis. We would like to present a research study, to compare the efficacy of TVS and MRI for the characterization of uterine lesions.

Aim

- 1) To assess the role of Transvaginal ultrasound (TVS) and Magnetic Resonance Imaging (MRI) in the characterization and to know the extent of lesions in perimenopausal bleeding.
- 2) To compare the accuracy of Transvaginal ultrasound and Magnetic resonance imaging.
- 3) To assess the diagnostic potential of Transvaginal ultrasound and Magnetic resonance imaging in terms of sensitivity and specificity by correlating the imaging finding with histopathology.

MATERIALS AND METHODS

This was a hospital-based Prospective Observational study, conducted in our institution after getting approval from the Ethics and Scientific Review Committee of M.Y hospital and MGMMC Indore. The duration of the study was from April 2020 to September 2021.

Inclusion criteria: Patients referred to the department of Radiodiagnosis MGMMC Indore for radiological evaluation of abnormal uterine bleeding.

Exclusion criteria: Females having endocrine abnormalities, bleeding disorders, pregnant women, and unmarried women were excluded. Also, patients with a pacemaker or critically located foreign body were not subjected to MRI examination. Finally, patients in whom histopathology reports couldn't be obtained as patients didn't undergo surgery were excluded from our study.

All patients were subjected to the following: Patients were selected as per the inclusion and exclusion criteria. The procedure was explained to the patients/attendants and the informed written consent was taken from all of the patients/attendants. A detailed history of the patient, physical examination findings, and radiological investigations was recorded and tabulated.

Transabdominal along with transvaginal ultrasound (Esaote Mylab machine) and MRI (3T, 97 channel) evaluations were done. The uterus was

assessed in sagittal and transverse view to record the uterus size, myometrial and endometrial characteristics including mass lesion if present, and further evaluation of lesion was done with color Doppler. Also, the adnexa and other pelvic organs were assessed for the presence of coexisting pathology.

All patients underwent MRI for further evaluation of uterine lesions. MRI was done on a 3T, 97 channel system. Following sequences had been performed in the MR evaluation of all the patients- Axial T1, axial, sagittal and coronal T2, axial Fat-saturation T1, axial oblique T2 done parallel to the short axis of the uterine corpus, axial oblique T2 parallel to the short axis of the cervix and Diffusion-weighted imaging (DWI). Additional sequences including contrast were tailored according to the provisional diagnosis of the patients.

Description of lesion on MRI was done under following points-

The location of the lesion, The size and shape of the lesion, Homogenous/heterogenous, well /ill defined, Assessment of contour & lesion margin, presence of contrast enhancement, The presence of calcification, haemorrhage, cystic/necrotic areas, presence of mass effect, involvement of adjacent structures, appearance on diffusion weighted images and in corresponding ADC maps. Results are correlated and compared with histopathological analysis.

Sample size and Statistical Analysis: A total of 65 patients who presented with perimenopausal bleeding underwent TVS, in the Department of Radiodiagnosis, M.G.M. Medical College, and M.Y. Hospital, Indore from April 2020 to September 2021 after taking written consent. Out of these, 52 patients were subjected to MRI and histopathological examination. Nine patients were lost to follow up while four got operated without prior MRI. Data were tabulated in a Microsoft Excel sheet, for the analysis of data. Further depiction of data was done in the form of various tables and charts. SPSS was used to analyze the data. The Mean, Median, and standard deviation of the quantitative variables were calculated. Cut off value was calculated by the Youden index. P value < 0.05 was considered statistically significant.

RESULTS

The mean age of the patient with benign lesions was significantly less than their malignant counterpart (46.81 ± 8.5 vs. 52.10 ± 7.05 , $P = 0.025$). The age range was 30 to 69 years.

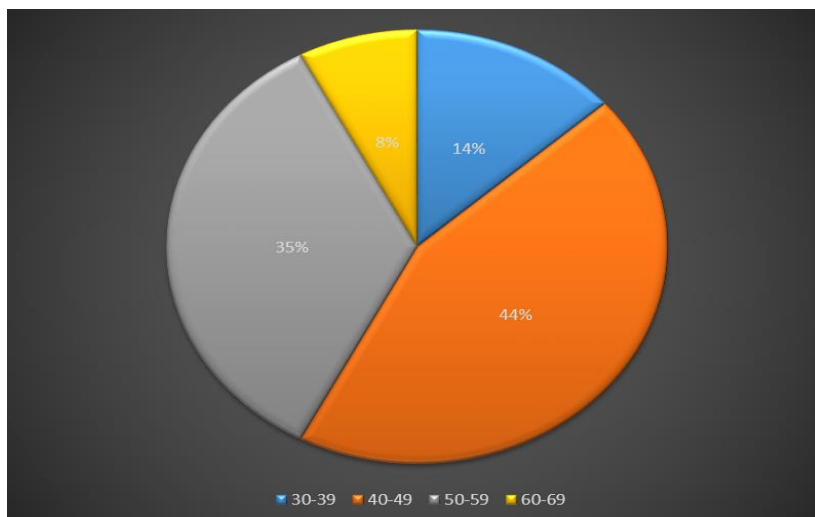


Fig-1: Age distribution of cases

All patients presented with AUB. Twenty four out of 52, (46.25%) had vaginal discharge and 16 out of 52 (30.85%) had pelvic pain.

On TVS, 60% of patients had enlarged uterus. In 10 out of 52 (19.2%) cases heterogeneous myometrium, in nine out of 52 cases myometrial mass, in 11.5% cases myometrial cysts and in 5.8% cases, echogenic nodules were observed. We observed that altered myometrial echotexture had 100% sensitivity, and myometrial cysts had 100% specificity in the identification of adenomyosis.

Ill-defined junctional zone on TVS was present in 18 out of 52 (34.6%) patients while its equivalent counterpart on MRI in the form of thickening of the junctional zone was seen in a higher percentage of cases [23 out of 52 (44.2%)]. Thickening of the junctional zone was found to be the most sensitive (100%) MR imaging criteria for diagnosing adenomyosis.

The myometrial invasion was found in 38.5% on MRI while TVS could diagnose myometrial invasion in only 17.3% of cases on TVS. On MRI, minor myometrial invasions that were overlooked by TVS could also be detected. We also provided a cut-off of 10.5 mm for endometrial thickness, below which no malignancy was found.

On TVS among a total of 52 cases, six (11.5%) had a cervical mass lesion, one had parametrial invasion, and some cases had an adnexal lesion, and three (5.7%) cases had bladder and bowel involvement while on MRI cervical involvement was present in nine (17.3%) cases (three had altered cervical signal, and six had expansile cervical mass). Furthermore, a higher percentage of patients had parametrial invasion and adnexal involvement on MRI. Hence MRI proved to be more effective than TVS in detecting local extension to the cervix and pelvic organs.

MRI detected lymph node metastases in seven cases but TVS failed to detect any of them. The majority of lesions (10 out of 15) with peripheral vascularity on color Doppler were proved as fibroid with 66% sensitivity. 25 out of 52 cases showed heterogeneous contrast enhancement on MRI which was found to be a strong predictor of malignancy/inflammatory etiology.

All of the 38.5% of which showed restricted diffusion was found to be malignant and all of the 61.5% lesions which showed facilitated diffusion was found to be benign on histopathology indicating that DWI has 100% specificity and sensitivity for differentiating between benign and malignant lesions.

The morphological characteristics (which include ill-defined endometrial margin, mass lesion, heterogeneity of lesion, myometrial invasion, and internal vascularity on color Doppler) and the ancillary characteristics (which include parametrial involvement, invasion of neighboring structure, heterogenous contrast enhancement with necrosis and hemorrhage) which usually predicts malignancy was observed in 26.9% cases only on TVS whereas on MRI 40.4% cases had such characteristics. When comparing both of these modalities with histopathology, MRI was found to be highly accurate (98.07%) as compared to TVS (80.76%) in characterizing uterine lesions.

DISCUSSION AND CONCLUSION

The majority of the patients (44.2%) in our study belonged to the age group of 40 to 49 years. The demographic findings of our study are in concordance with previous studies of Meena Jain *et al*. [4] and Pujitha *et al*. [1].

In our study, uterine fibroid and adenomyosis were the most common benign pathologies detected on TVS (19.2% each), endometrial polyps (13.46%), endometrial hyperplasia (11.5%), and endometritis

(9.6%). Among malignant uterine lesion 17.3% cases had endometrial carcinoma followed by cervical cancer (9.6%). Meena Jain *et al*. [4] found the fibroid followed by adenomyosis were the most prevalent benign lesion in their study.

Adenomyosis was diagnosed with 100% accuracy by both TVS and MRI. Pujitha *et al*. [1] also observed that TVS and MRI had 100% sensitivity and specificity for diagnosing adenomyosis. Reinhold *et al*. [5] observed nearly similar diagnostic efficiencies of TVS and MRI, with TVS having an 86% specificity in their study.

TVS diagnosed seven lesions (13.46%) as endometrial polyps due to their regular margin and vascular pedicle. Two cases that were initially misdiagnosed as an endometrial polyp by TVS were later found to be endometrial carcinoma on MRI study

and histological confirmation. Based on morphologic characteristics for diagnosing endometrial carcinomas, TVS had the same sensitivity (100% each) but less specificity (95%) as compared to MRI (100%). Although carcinomas and polyps often coexist and this precision does not appear to be enough to avoid histological testing.

One out of five endometritis diagnosed by TVS was later proved to be malignant on MRI and histological evaluation. Furthermore, two cases of fibroid which were misinterpreted as benign lesions on TVS turned out to be malignant (one cervical carcinoma and one leiomyosarcoma) on MRI and histology.

Among all 52 cases, TVS interpreted 14 patients as malignant, and the rest 38 as benign with the accuracy of 80.76% compared to histopathology.

Table-1: Comparison of benign and malignant uterine lesions diagnosed on TVS, MRI, with histopathology, demonstrating that MRI has diagnostic efficiency comparable to histopathology.

	TVS		MRI	
	Benign	Malignant	Benign	Malignant
Sensitivity	93.75%	60%	96.87%	100%
Specificity	60%	93.75%	100%	96.87%
PPV	78.94%	85.71%	100%	95.23%
NPV	85.71%	78.94%	95.23%	100%

Adenomyosis was the most common benign finding on MRI (10/52 cases), followed by fibroid (13.46%), endometrial polyps (9.6%), endometrial hyperplasia, and endometritis (7.6%). Most of these lesions were correctly diagnosed by MRI in concordance to histopathological evaluation. Pujitha *et al*. [1], in their study also observed a nearly similar spectrum of uterine lesions.

Among malignant uterine lesions, MRI correctly identified 13 out of 15 histopathological diagnosed cases of endometrial cancer, and all six cases of cervical carcinoma. Two cases of endometrial carcinoma on MRI were turned out to be endometrial hyperplasia on histology due to overlapping imaging characteristics.

For identification of endometrial hyperplasia, although TVS and MRI were equally specific (100% each) TVS was more sensitive than MRI (83% vs. 66.66%). This is, in contrast, to study done by, Mohammad Tharwat *et al*. [6], in which they found that sensitivity and specificity of MRI was 100%, and 93.4% respectively for endometrial hyperplasia, however, Ahmad *et al*. [2], observed that MRI is less sensitive (50%), with 84% specificity.

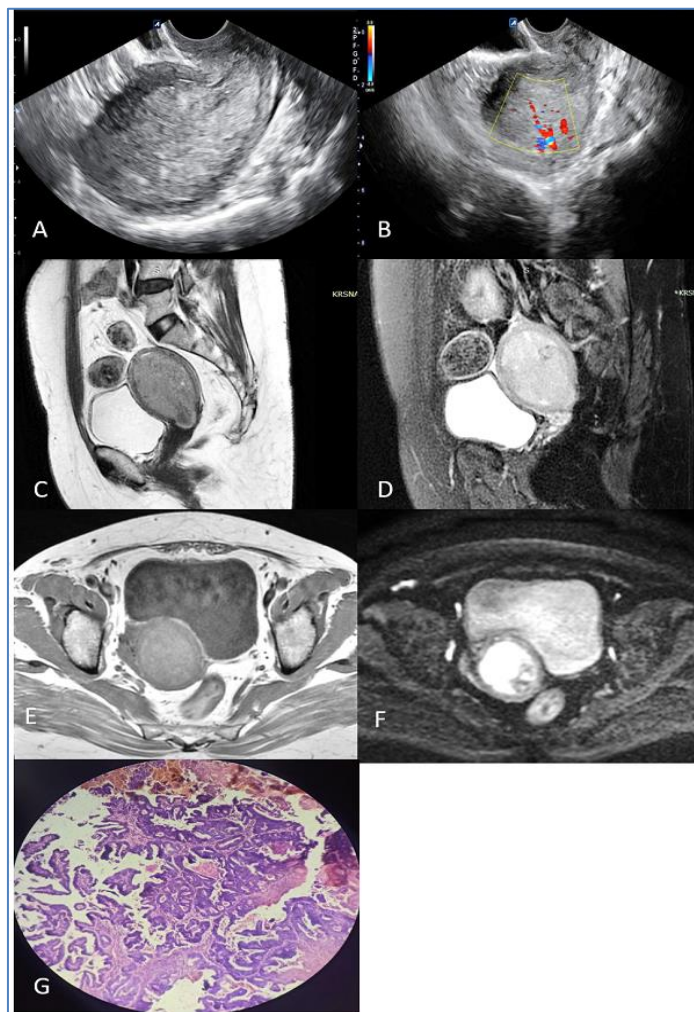
Out of a total of 52 studied patients, 21 (40.4%) were diagnosed as malignant and the rest 31 (59.6%) as benign on MRI. For MRI, our findings were comparable to a study by Yadav [8] who found that

overall sensitivity for detection of lesions by MRI was 100% and specificity was 98.41%. Mohammad Tharwat *et al*. [6] sensitivity and specificity of MRI was 100%, and 81.25% respectively. Uterine lesions display a myriad on TVS and MRI.

The study's major limitation was the small sample size; with 52 patients, we covered the complete spectrum of uterine pathology. Furthermore, the study does not reflect the true prevalence of uterine pathology because many cases undergo hysterectomy without MRI examination.

Perimenopausal bleeding is commonly encountered in day-to-day practice, and because it has such a large impact on women's health, early detection of pathology is crucial. With early detection alone, it is possible to significantly improve the survival rate in cases having uterine malignancy in perimenopausal age.

Figure 2: Endometrial carcinoma, TVS images showing diffuse, homogenous thickening of endometrium with regular margin (A), and significant internal vascularity on colour Doppler image (B). MR images depicting a well-defined slightly hyperintense mass with in endometrium (C, and D) not invading in to myometrium (E), and showing restriction on DW image (F). This was confirmed as endometrial carcinoma on histopathology (G).



With a sensitivity and specificity of 60% and 93.75% respectively for malignant uterine lesions, TVS is a good primary imaging modality. It is non-invasive, has low cost, and is a widely available dynamic imaging modality. But, TVS is not considered sufficiently versatile and also encounters inter observer variation. False positives lead to unnecessary interventions and false negatives lead to neglecting a serious disease. As there is a tremendous fall in survival rate with the advance of the malignant stage, false negative is the more dangerous aspect of an investigative modality. Hence, a high false-negative of 40.0% on evaluation with TVS is to be addressed. This warrants a better diagnostic modality for a more accurate pickup of the lesions.

With a sensitivity and specificity of 100% and 96.87% for MRI, the diagnostic performance of MRI was better than TVS. With a nil false negatives rate, MRI with DWI sequence was proven to be a better choice. The added advantages are that it is non-invasive and has no risk of radiation exposure. Also, diffusion-weighted imaging obviates the need for an intravenous contrast media, making this suitable for cases with contraindication to contrast usage. It can help to

localize the lesion, stage it, and identify recurrence, and therapeutic response. The drawbacks are the expense, limited availability, and the general contraindications to MRI.

From our study, it can be concluded that, although TVS continues to stay in the mainstay imaging modality, MRI should be considered in the evaluation plan of suspected uterine malignancy, especially in sonographically inconclusive lesions. Eventually, a shift of MRI from a problem-solving tool to a central management tool is likely.

Main points

- 1) Uterine lesions display a myriad of findings on imaging. Knowledge of such features is required to make a diagnosis or to list the differentials, to avoid unwanted invasive procedures, and to improve the outcome of a malignant lesion.
- 2) Substantial disparities were seen between TVS and MRI for diagnosis of malignancy mainly because TVS is unable to detect focal myometrial invasion, minimal endometrial irregularities and differential enhancement.
- 3) MRI due to its multi-parametric capabilities to

evaluate tissue characteristics expected to score over TVS in the evaluation of endometrial pathologies.

Abbreviations

AUB: Abnormal uterine bleeding; MRI: Magnetic resonance imaging; TVS: Transvaginal ultrasonography; T1WI: T1-weighted image; T2WI: T2-weighted image; SPSS: Statistical Package for the Social Science.

Declarations

- Ethics approval and consent to participate- The study was approved by our institutional ethical committee.
- Consent for publication- All participants in this study received a detailed explanation about the aim, objectives, and methodology of the study before enrolment. Consent to publish the data was also taken from all the participants of the study.
- Availability of data and material- The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.
- Competing interests- We declare that we have no competing interests.
- Funding- This work has not received funding.
- Authors' contributions- All authors of this research paper have directly participated in the planning, execution, or analysis of this study. All authors of this paper have read and approved the final version submitted.
- Acknowledgements- Not applicable.

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Cite This Article: Dr. Alka Agrawal, Dr. Prachi Shukla, Dr. Roshani Rathore (2022). Role of Magnetic Resonance Imaging in Perimenopausal Bleeding and Its Correlation to Transvaginal Ultrasound. *EAS J Radiol Imaging Technol*, 4(1), 4-9.