Section: Miscellaneous

Original Research Article

COMPARATIVE EVALUATION OF MRI AND ULTRASOUND IN THE CHARACTERIZATION OF UTERINE MASS LESIONS WITH HISTOPATHOLOGICAL CORRELATION

M. D. Manimozhi[1], M. D. Pradeep[2], P. Sindhu[3]

[1]Senior Resident, St. Peters Medical College Hospital and Research Institute, Hosur, Tamilnadu, India.
[2]Associate Professor, St. Peters Medical College Hospital and Research Institute, Hosur, Tamilnadu, India
[3]Assistant Professor, St. Peters Medical College Hospital and Research Institute, Hosur, Tamilnadu, India.

Received : 20/10/2025
Received in revised form : 07/12/2025
Accepted : 24/12/2025

Keywords:
Diagnostic accuracy, Histopathology, Imaging correlation, Magnetic resonance imaging, Transvaginal ultrasonography, Transabdominal ultrasonography, Uterine mass lesions.

Corresponding Author:
Dr. M. D. Pradeep,
Email: drmdpradeep@gmail.com

DOI: 10.47009/jamp.2026.8.1.147

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2026; 8 (1); 772-776

ABSTRACT

Background: Uterine mass lesions are common in women of reproductive and peri-menopausal age. Accurate preoperative characterization is essential for appropriate management. While transabdominal and transvaginal ultrasonography are widely used as first-line modalities, their diagnostic accuracy is limited in certain conditions, particularly adenomyosis and complex lesions. Magnetic Resonance Imaging (MRI) has emerged as a superior modality due to its excellent soft-tissue contrast and multiplanar capability. The objective is to evaluate the role of MRI in the characterization of uterine mass lesions and to compare its diagnostic performance with transabdominal and transvaginal ultrasonography, using histopathology as the reference standard. **Materials and Methods:** This prospective study included 52 patients with clinically suspected uterine mass lesions. All patients underwent transabdominal ultrasound, transvaginal ultrasound, and MRI prior to surgical intervention. Imaging findings were correlated with histopathological examination. Sensitivity, specificity, diagnostic accuracy, and inter-modality agreement were calculated. **Result:** Fibroids were the most common uterine mass (46.2%), followed by adenomyosis (23.1%) and cervical carcinoma (19.2%). MRI demonstrated superior diagnostic accuracy in detecting and characterizing uterine lesions, particularly adenomyosis and malignant lesions. Transvaginal ultrasound showed better agreement with MRI than transabdominal ultrasound in lesion detection. MRI showed high sensitivity and specificity for lesion localization, characterization, and staging of malignancies. **Conclusion:** MRI is a highly accurate imaging modality for the evaluation of uterine mass lesions and is superior to ultrasonography in lesion characterization and staging. MRI should be considered the imaging modality of choice in equivocal or complex uterine pathology.

INTRODUCTION

Uterine mass lesions represent a significant cause of gynaecological morbidity across women of reproductive and peri-menopausal age groups and are among the most frequent indications for gynaecological imaging and surgical intervention.[1] The spectrum of uterine masses ranges from benign entities such as leiomyomas, adenomyosis, and endometrial polyps to malignant conditions including endometrial carcinoma and carcinoma of the cervix.[2] Accurate preoperative diagnosis is essential, as treatment strategies and prognostic outcomes vary widely depending on the type, location, and extent of the lesion.[3]

Leiomyomas are the most common benign uterine tumours and may present with abnormal uterine bleeding, pelvic pain, infertility, or pressure symptoms.[4] Adenomyosis, characterized by ectopic endometrial glands within the myometrium, often presents with symptoms overlapping those of fibroids, making clinical and imaging differentiation challenging.[5] Malignant uterine lesions, particularly carcinoma cervix and endometrial carcinoma, require precise local staging for appropriate management and prognostication.[6]

Ultrasonography, including transabdominal (TAUS) and transvaginal ultrasound (TVUS), is the first-line imaging modality for evaluation of uterine pathology owing to its wide availability, non-invasiveness, and

ISSN (O): 2687-5365; ISSN (P): 2753-6556

cost-effectiveness.[7] TAUS provides a global overview of pelvic anatomy, while TVUS offers improved spatial resolution and better visualization of endometrial and myometrial structures.[8] However, ultrasound is operator-dependent and limited by factors such as obesity, bowel gas, uterine enlargement, and poor tissue contrast, particularly in differentiating adenomyosis from leiomyoma and in assessing malignant spread.[9]

Magnetic Resonance Imaging (MRI) has emerged as a superior problem-solving modality in the evaluation of uterine mass lesions due to its excellent soft-tissue contrast, multiplanar capability, and high spatial resolution.[10] MRI allows precise delineation of uterine zonal anatomy, enabling accurate differentiation between leiomyomas and adenomyosis based on junctional zone assessment.[11] Additionally, MRI plays a pivotal role in preoperative staging of gynaecological malignancies by accurately assessing myometrial invasion, cervical stromal involvement, parametrial spread, and adjacent organ infiltration.[12]

Despite the growing body of literature supporting the utility of MRI, ultrasonography continues to be the primary screening modality in routine clinical practice, particularly in resource-limited settings.[13] A systematic comparison of TAUS, TVUS, and MRI with histopathology as the reference standard is essential to define the exact diagnostic contribution of each modality and to establish evidence-based imaging algorithms for uterine mass evaluation.[14] The present study was therefore undertaken to evaluate and compare the diagnostic performance of transabdominal ultrasound, transvaginal ultrasound, and MRI in the characterization of uterine mass lesions, with histopathological examination serving as the gold standard.

Objectives

1. To evaluate the MRI characteristics of uterine mass lesions.
2. To compare the diagnostic performance of MRI, transabdominal ultrasound, and transvaginal ultrasound in characterizing uterine mass lesions.
3. To assess the accuracy of MRI in staging malignant uterine lesions.

MATERIALS AND METHODS

This prospective, observational study was conducted in the Department of Radiodiagnosis in collaboration with the Department of Obstetrics and Gynaecology at a tertiary care teaching hospital in Bangalore for a period of 9 months. Institutional Ethics Committee approval was obtained prior to study initiation, and written informed consent was taken from all participants.

A total of 52 consecutive female patients with clinical suspicion of uterine mass lesions were included in the study. Patients were referred for imaging evaluation based on symptoms such as abnormal uterine bleeding, pelvic pain, dysmenorrhoea, infertility, or clinical suspicion of uterine malignancy.

Women with clinically suspected uterine mass lesions, patients undergoing surgical intervention with availability of histopathological examination and patients willing to provide informed consent were included in the study. Pregnant women, patients with contraindications to MRI (e.g., pacemakers, ferromagnetic implants, severe claustrophobia) and patients with prior hysterectomy were excluded from the study.

Imaging Protocol: All patients underwent transabdominal ultrasound (TAUS), transvaginal ultrasound (TVUS), and MRI prior to surgical management. Imaging findings were independently recorded and later correlated with histopathological results.

Transabdominal Ultrasound (TAUS): TAUS was performed using a curvilinear transducer with a frequency of 3–5 MHz. Patients were examined with a full urinary bladder to optimize visualization of pelvic organs. Uterine size, contour, myometrial echotexture, focal lesions, and adnexal structures were evaluated.

Transvaginal Ultrasound (TVUS): TVUS was performed using a high-frequency (5–9 MHz) endovaginal probe after bladder emptying. Detailed assessment of the uterus was done, focusing on myometrial lesions, endometrial thickness, echotexture, and lesion localization. Features suggestive of fibroid, adenomyosis, and endometrial pathology were documented.

Magnetic Resonance Imaging (MRI): MRI examinations were performed using a 1.5-Tesla MRI scanner with a phased-array pelvic coil. Patients were scanned in the supine position.

The MRI protocol included: Axial, sagittal, and coronal T2-weighted fast spin-echo sequences, Axial and sagittal T1-weighted sequences, Post-contrast T1-weighted fat-suppressed sequences (where indicated)

MRI parameters assessed included uterine size, zonal anatomy, lesion signal characteristics, junctional zone thickness, lesion margins, and extent of disease. For malignant lesions, depth of myometrial invasion, cervical stromal involvement, parametrial extension, and adjacent organ invasion were evaluated.

Image Analysis: Ultrasound and MRI images were interpreted by radiologists with experience in gynaecological imaging. Imaging diagnoses were recorded prior to surgery and blinded to histopathological results. Lesions were categorized as fibroid, adenomyosis, malignant, polypoidal, or normal uterus based on established imaging criteria.

Reference Standard: Histopathological examination of surgical specimens served as the reference standard. Imaging findings from TAUS, TVUS, and MRI were correlated with histopathology for final diagnosis.

Statistical Analysis: Data were analyzed using SPSS software version 26. Sensitivity, specificity, positive predictive value, negative predictive value, and

ISSN (O): 2687-5365; ISSN (P): 2753-6556

diagnostic accuracy were calculated for each imaging modality using histopathology as the gold standard. Inter-modality agreement was assessed using Cohen's kappa (κ) coefficient. Differences in diagnostic performance between imaging modalities were analyzed using the Chi-square test, Z test, and McNemar test, as appropriate. A P-value < 0.05 was considered statistically significant.

RESULTS

The age distribution of the study population is illustrated in [Figure 1], with the majority of patients belonging to the reproductive and perimenopausal age groups i.e., 32 (61.5%) belonged to < 40 years age group.

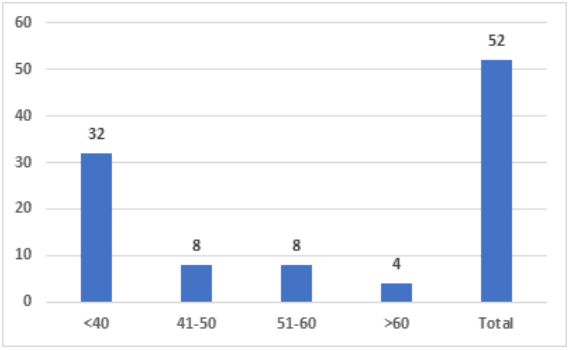

Figure 1: Age distribution

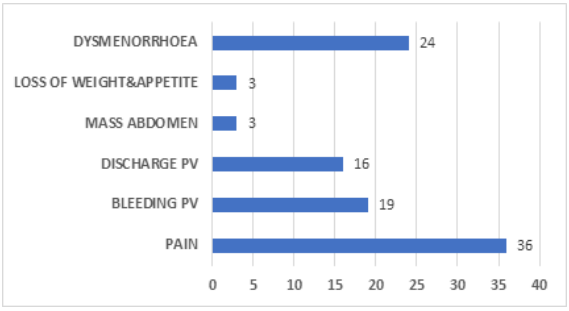

Figure 2: Presenting complaints

The common presenting complaints included abnormal uterine bleeding (19, 18.81%), pelvic pain (36, 35.64%), dysmenorrhoea (24, 23.76%) discharge PV (16, 15.84%), and other symptoms as shown in [Figure 2].

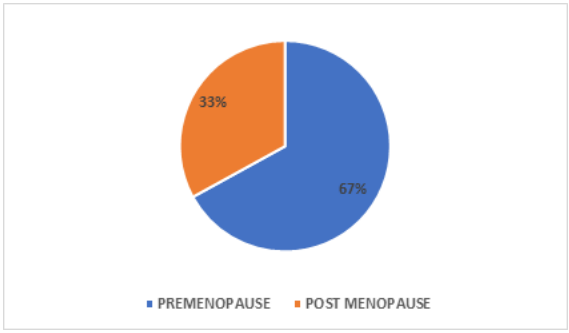

Figure 3: Menopausal status

[Figure 3] depicts the menopausal status of the study population, with a higher proportion of premenopausal women (67%).

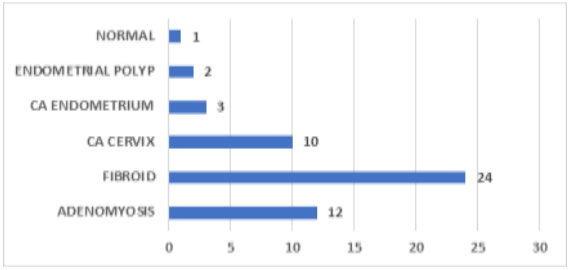

Figure 4: Final Diagnosis based on histopathology

Final diagnosis based on histopathological examination is presented in [Figure 4], with leiomyoma (24, 46.15%) being the most common uterine mass lesion, followed by adenomyosis (12, 23.08%) and malignant lesions-cancer cervix (10, 19.23%) and endometrial carcinoma (3, 5.77%).

Table 1: One-to-One Comparison of Imaging Modalities for Myometrial Mass Detection

Modality comparison	Diagonal agreement (%)	Cohen's κ	P value
TAUS vs TVUS	75%	0.60 (moderate)	< 0.01
TAUS vs MRI	71%	0.54 (moderate)	< 0.01
TVUS vs MRI	96%	0.93 (excellent)	< 0.01

Excellent agreement was observed between TVUS and MRI (diagonal agreement 96%, κ = 0.93), indicating near-equivalent detection capability. Moderate agreement was noted between TAUS and TVUS (75%, κ = 0.60) and between TAUS and MRI (71%, κ = 0.54). Agreement between all imaging modality pairs was statistically significant (Z test, P < 0.01). [Table 1].

Table 2: Diagnostic Performance of Imaging Modalities for Leiomyoma (Fibroid Uterus) and Adenomyosis in comparison to Histopathology

Uterine lesion	Modality	Sensitivity (%)	Specificity (%)	Cohen's κ	P value
Leiomyoma (Fibroid Uterus)	TAUS	79	86	0.65 (good)	< 0.01
	TVUS	100	89	0.89 (very good)	
	MRI	100	96	0.96 (excellent)	
Adenomyosis	TAUS	33	Not calculable	0.00 (poor)	< 0.05
	TVUS	58	Not calculable	0.00 (poor)	
	MRI	92	Not calculable	0.00 (poor)	

ISSN (O): 2687-5365; ISSN (P): 2753-6556

For leiomyoma detection, all modalities demonstrated statistically significant agreement with histopathology (χ^2 test, $P < 0.01$). MRI showed the highest sensitivity (100%) and specificity (96%), followed closely by TVUS (sensitivity 100%, specificity 89%). TAUS showed comparatively lower sensitivity (79%) and specificity (86%). MRI demonstrated significantly superior diagnostic performance compared to TAUS and TVUS.

For adenomyosis, MRI demonstrated markedly higher sensitivity (92%) compared to TVUS (58%) and TAUS (33%). The difference in sensitivity between MRI and ultrasound modalities was statistically significant (McNemar test, $P < 0.05$). Specificity could not be calculated, as only histopathologically proven adenomyosis cases were included.

Table 3: Differentiation Between Fibroid and Adenomyosis of each modality in comparison to Histopathology

Modality	Sensitivity (%)	Specificity (%)	Cohen's κ	P value
TAUS	33	46	0.19 (poor)	< 0.001
TVUS	58	92	0.53 (moderate)	
MRI	92	100	0.93 (excellent)	

For differentiation between fibroid and adenomyosis in comparison to histopathology, MRI demonstrated markedly higher sensitivity (92%) compared to TVUS (58%) and TAUS (33%) with excellent agreement of 0.93 with histopathology. MRI showed significantly better diagnostic performance compared to TAUS and TVUS (McNemar test, $P < 0.001$).

Table 4: Diagnostic Accuracy of TVUS and MRI together in comparison to Histopathology for Endometrial and Cervical Carcinoma

Modality	Sensitivity (%)	Specificity (%)	Cohen's κ	P value
TVUS and MRI	100	97	0.85 (very good)	<0.01
TVUS and MRI	98	100	0.91 (excellent)	<0.01

MRI and TVUS together demonstrated markedly higher sensitivity (100%) and higher specificity (97%) with very good agreement of 0.85 with histopathology for detection of endometrial carcinoma which was statistically significant ($p<0.01$). MRI and TVUS together demonstrated higher sensitivity (98%) and markedly higher specificity (100%) with excellent agreement of 0.91 with histopathology for detection of cervical carcinoma which was statistically significant ($p<0.01$).

DISCUSSION

In this prospective study, MRI demonstrated superior diagnostic performance compared to TAUS and TVUS in the evaluation of uterine mass lesions, especially for adenomyosis and malignant lesions, corroborating findings from previous research.

For leiomyoma detection in our study, MRI achieved 100% sensitivity and 96% specificity, consistent with a study by Shazia Ashraf et al,[15] where MRI showed 95% sensitivity and 90% specificity for fibroids compared with TVUS's 83% sensitivity and 75% specificity in a larger cohort of 90 women (premenopausal age group). Similarly, Hind et al,[16] reported MRI sensitivity of 100% for fibroid detection, reinforcing MRI's reliability in identifying lesion number, location, and degenerative changes. This confirms the excellent ability of MRI to delineate leiomyoma extent and characteristics.

For adenomyosis, our MRI sensitivity of 92% markedly exceeded that of TAUS (33%) and TVUS (58%), underscoring the difficulty of detecting this condition using ultrasound alone. These results align with a large cohort study that reported TVUS specificity of 91.8% but a much lower sensitivity of 36.8% for adenomyosis, emphasizing the limited role of ultrasound for initial detection despite reasonable specificity.[17] Additionally, other research has shown MRI sensitivity for adenomyosis ranging from 85–90% compared with TVUS sensitivity around 70–72.5% and MRI specificity between 72.5–87.5%, reaffirming the relative strength of MRI in tissue characterization.[11] Dueholm et al,[3] reported MRI sensitivity of 77.5% and specificity of 92.5%, while TVUS sensitivity was approximately 65%, highlighting MRI's advantage in identifying subtle junctional zone abnormalities.

The findings of our study are also consistent with previous literature reporting MRI sensitivity ranging from 85–90% and TVUS sensitivity between 65–72.5% 2,15. Ultrasound specificity for adenomyosis has been reported to be high (>90%) in some series, but poor sensitivity limits its diagnostic reliability.[9] Our results reaffirm that MRI is the most accurate modality for diagnosing adenomyosis, particularly in patients with coexisting fibroids.

In terms of differentiating fibroids from adenomyosis, MRI's sensitivity (92%) and specificity (100%) in our study were significantly higher than TAUS and TVUS. This agrees with evidence indicating MRI's high accuracy in distinguishing these pathologies based on zonal anatomy and junctional zone parameters, although older series indicated that MRI might have moderate sensitivity (38%) but high specificity (91%) for adenomyosis in certain settings.[18] Differences in reported values may reflect variations in MRI protocols, criteria for junctional zone assessment, and population characteristics. However, our study results are in concordance with prior studies demonstrating MRI's high diagnostic accuracy based

ISSN (O): 2687-5365; ISSN (P): 2753-6556

on junctional zone assessment and signal characteristics.[3,11,16]

In this study, MRI demonstrated significantly higher detection rates compared to ultrasound modalities for detection of endometrial polyps ($P < 0.05$) which was consistent with a study by Bazot et al.[11]

For malignant lesions, in this study, TVUS and MRI showed good sensitivity (100%). In a study by Sala E et al. MRI provided superior assessment of myometrial invasion and parametrial extension, highlighting MRI as the preferred modality for local staging of endometrial and cervical carcinoma due to its multiplanar capabilities and soft-tissue contrast.[12]

Our study findings are also supported by prior studies reporting MRI sensitivity of 83–90% and specificity of 95% for uterine malignancies, compared with ultrasound sensitivity of approximately 75%.[12,17]

Comparative studies of overall uterine mass diagnosis have similarly concluded that MRI outperforms ultrasound. A prospective analysis of 50 women demonstrated USG sensitivity of 75% and MRI sensitivity of 83%, with both modalities showing similar specificity (~95%) in diagnosing uterine masses, but MRI performing better in complex or malignant cases.[17] These results are in general agreement with our findings, although our study's focus on modality-specific performance across distinct lesion types provides more granularity.

Our study strengthens the evidence that ultrasound is a valuable first-line screening tool due to its accessibility and high specificity in certain contexts, but MRI should be considered when initial imaging is inconclusive or when precise lesion characterization and staging are required. The high diagnostic accuracy of MRI for both benign and malignant uterine lesions supports it's integration into clinical decision-making algorithms, particularly for preoperative planning and in cases where treatment strategy hinges on detailed anatomical delineation.

CONCLUSION

In this study, Magnetic resonance imaging (MRI) provided comprehensive characterization of uterine mass lesions with excellent correlation to histopathological findings. MRI performed detailed lesion evaluation with respect to location, signal characteristics, junctional zone involvement, and extent of disease.

When compared with transabdominal and transvaginal ultrasonography, MRI showed significantly superior diagnostic performance in the detection and characterization of uterine mass lesions. MRI demonstrated the highest sensitivity and specificity for leiomyoma detection and showed markedly higher sensitivity for adenomyosis, Transvaginal ultrasound performed better than transabdominal ultrasound but remained inferior to MRI, particularly for complex myometrial pathology.

MRI also proved to be the most reliable modality for differentiating leiomyoma from adenomyosis, with excellent diagnostic agreement with histopathology. In addition, MRI provided superior assessment of malignant uterine lesions, enabling accurate evaluation of myometrial invasion and local disease extent.

Overall, the results confirm that while ultrasonography remains an effective initial screening tool, MRI serves as the most accurate problem-solving and staging modality for uterine mass lesions. The findings support the integration of MRI into diagnostic algorithms, particularly in cases with inconclusive ultrasound findings, suspected adenomyosis, or malignancy, ensuring evidence-based and objective-aligned clinical decision-making.

REFERENCES

1. Stewart EA, Cookson CL, Gandolfo RA, Schulze-Rath R, Senapati S, McCarthy M, et al. Epidemiology of uterine fibroids: a systematic review. BJOG. 2017;124(10):1501-12.
2. Berek JS, Hacker NF, Weisenfeld A, Fu YS, Lentz GM, Monk BJ, et al. Gynecologic oncology: clinical practice and surgical principles. Gynecol Oncol. 2015;136(3):393-401.
3. Dueholm M, Lundorf E, Hansen ES, Ledertoug S, Olesen F, et al. Magnetic resonance imaging and transvaginal ultrasonography for diagnosis of adenomyosis. Fertil Steril. 2001;76(3):588-94.
4. Parker WH, Fu YS, Berek JS, et al. Uterine myomas: management. Obstet Gynecol. 2007;110(1):37-50.
5. Reinhold C, Tafazoli F, Wang L, et al. Imaging features of adenomyosis. Hum Reprod Update. 1998;4(4):337-49.
6. Pecorelli S, Benedet JL, Creasman WT, Shepherd JH, et al. FIGO staging of gynecologic cancer. Int J Gynaecol Obstet. 2009;105(2):103-4.
7. Timor-Tritsch IE, Monteagudo A, et al. Transvaginal sonography in gynecologic diagnosis. Ultrasound Obstet Gynecol. 1992;2(4):256-70.
8. Fleischer AC, Andreotti RF, Strachowski LM, et al. Sonographic evaluation of uterine pathology. Radiographics. 2012;32(5):E151-E169.
9. Kepkep K, Tuncay YA, Göynümer G, et al. Transvaginal sonography in the diagnosis of adenomyosis. Ultrasound Obstet Gynecol. 2007;30(4):535-40.
10. Szklaruk J, Tamm EP, Choi H, Varavithya V, et al. MR imaging of common and uncommon uterine tumors. Radiographics. 2003;23(2):403-24.
11. Bazot M, Cortez A, Darai E, Rouger J, Chopier J, Antoine JM, et al. Ultrasonography versus magnetic resonance imaging for diagnosing adenomyosis. Hum Reprod. 2001;16(11):2427-33.
12. Sala E, Rockall AG, Freeman SJ, Mitchell DG, Reinhold C, et al. The added role of MR imaging in treatment stratification of gynecologic malignancies. Radiology. 2013;266(3):941-55.
13. Testa AC, Di Legge A, Bonatti M, et al. Imaging techniques for evaluation of uterine pathology. Best Pract Res Clin Obstet Gynaecol. 2009;23(5):557-73.
14. Hricak H, Yu KK, et al. Radiology in gynecologic oncology. N Engl J Med. 1996;335(15):1170-80.
15. Ashraf S, Asim A, Taj A, Ashraf Y, Kumar R, Asghar S, et al. Diagnostic accuracy of pelvic MRI and transvaginal ultrasound for detecting uterine fibroids and adenomyosis: a comparative study. Pak J Med Health Sci. 2024;18(01):462.
16. Hind MA, Haider QH, Hussein HN, Abdulameer RS, Abbas MA, Jasim AM, et al. Diagnostic accuracy of MRI in evaluation of uterine mass lesions compared with ultrasound. Indian J Forensic Med Toxicol. 2021;15(3):2406–2415.
17. Elsaid AY, Youssef NA, Khater HM, Abdelrahman AE, Mahmoud AE, et al. Comparative study between MRI and ultrasound in evaluation of uterine lesions with histopathological correlation. Benha Med J. 2023;40(6):134–148.
18. Reinhold C, Tafazoli F, Wang L, Nance KV, Atri M, Bret PM, et al. Uterine adenomyosis: endovaginal US and MR imaging features with histopathologic correlation. Radiology. 1996;199(1):151–158.

ISSN (O): 2687-5365; ISSN (P): 2753-6556