Role of Magnetic Resonance Imaging (MRI) In Abnormal Uterine Bleeding

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ABSTRACT

Background: Abnormal uterine bleeding (AUB) is not always reported by women experiencing symptoms. Because of this, 3% to 35% of women worldwide may have abnormal uterine bleeding.

Objective: MRI examination of women with AUB to detect any organic cause not detected with transvaginal ultrasonographic examination and if MRI add any advantage more than transvaginal ultrasound.

Patients and methods: This study had been conducted at the department of diagnostic radiology-Sohag University Hospital at the period from September 2016 to September 2018. 50 women with abnormal uterine bleeding were referred from the Department of Obstetrics and Gynecology or from the Outpatient Clinic for this study.

Results: Our study revealed a sensitivity of transvaginal ultrasonography (TVS) was 100% and specificity was 95.56% in detecting uterine pathology. **For uterine myoma**; the current study showed that MRI had a sensitivity of 100%, specificity 100%, PPV 90.9% NPV 100% and accuracy 98%. Our MRI sensitivity and specificity for endometrial carcinoma were high may be because endometrial carcinoma was one case only and we used DW image for her diagnosis. The need for histopathological evaluation of endometrial lesion couldn't be totally excluded. In our study TVS had a sensitivity for endometrial carcinoma 100% and specificity 100%

Conclusion: Role of MRI in abnormal uterine bleeding as equal as that of (TVUS) but still TVUS has the upper hand as the first imaging choice, real time imaging.

Keywords: MRI, Abnormal Uterine Bleeding, DWI, TVUS.

INTRODUCTION

Any significant deviation from a woman's established menstrual pattern may be considered abnormal uterine bleeding, and several factors direct evaluation of a patient with such bleeding. Premenopausal disorders include endometriosis, adenomyosis, and leiomyomas. A positive pregnancy test in a woman of childbearing age prompts a search for an intrauterine pregnancy. Possible complications that may contribute to bleeding include ectopic pregnancy, placental factors including position, trauma and infection, gestational trophoblastic disease, preterm labor and postpartum complications. Atrophic changes, hormonal status and carcinoma are considerations in the postmenopausal patient with abnormal uterine bleeding [1].

The International Federation of Gynecology and Obstetrics (FIGO) has approved a new classification system (PALM-COEIN) for causes of abnormal uterine bleeding in nongravid women of reproductive age. The classification system is stratified into nine basic categories that are arranged according to the acronym PALM-COEIN: polyp, adenomyosis, leiomyoma, malignancy and hyperplasia, coagulopathy, ovulatory disorders, endometrial, iatrogenic and not classified [2].

Evaluation for structural abnormalities affecting the endometrial cavity is performed to identify pathology including endometrial or endocervical polyps and submucous leiomyomas that could contribute to AUB. Transvaginal ultrasonography (TVUS) is an appropriate and important screening tool and in most instances, should be performed early in the course of the investigation. Ideally, the ultrasonography system must be of adequate quality to clearly display both myometrial and endometrial features, and the examiner should have the ability to operate the scanning device and interpret the images displayed. Regardless, TVUS is not 100% sensitive even in ideal circumstances because polyps and other small lesions may elude detection even in the context of a normal study [2].

Diffusion-weighted MRI (DW MRI) is a non-enhanced imaging technique that facilitates the display of tissue characteristics based on the difference in diffusion motion of water molecules. Several recent studies have reported DWI to be useful to detect and differentiate endometrial cancer from normal endometrium or a benign lesion [3].

DWI is a method to visualize the three-dimensional microscopic movement of water molecules within the intra- and extracellular compartments. DWI visualizes the variability in water mobility due to changes in tissue cellularity, cell membrane integrity and fluid viscosity. The more restricted the movement of water, the higher the signal intensity generated on DWI. The apparent diffusion coefficient (ADC) can provide quantitative degree of diffusion. Restricted diffusion is displayed as low signal intensity on an ADC map. The movement of water molecules is typically restricted within the tumor microenvironment due to increased cellularity. Due to restriction in movement of water

molecules, the majority of tumors demonstrate higher DWI signal intensity and lower ADC values when compared with adjacent normal tissue as a consequence of increased conspicuity DWI can be utilized to improve tumor detection, staging and response assessment [4].

Ultrasonography is the first modality of choice for evaluation of female pelvis. However, there are some shortcomings of this modality such as limited field of view, bowel gasses obscuring the pelvic organs and body habitus of the patients. One of the most problematic diagnoses is the evaluation of large pelvic masses (>5 cm in size). These pelvic masses most commonly arise from the uterus, cervix, ovaries and fallopian tubes. In addition, pelvic masses may arise from the urinary system, gastrointestinal system, adjacent soft tissues and metastases. Thus, the differential diagnosis for female pelvic masses is extensive. The site of origin, imaging characteristics and clinical history may all help to narrow the differential diagnosis. MRI is very helpful in work up of these lesions, their location, origin and relationship to adjacent organ, peritoneal or extraperitoneal involvement, lymph nodes and lateral pelvic wall involvement [5].

AIM OF THE WORK
MRI examination of women with AUB to detect any organic cause not detected with transvaginal ultrasonographic examination and if MRI add any advantage more than transvaginal ultrasound.

PATIENTS AND METHODS

Patients:
This study was conducted at the Department of Diagnostic Radiology-Sohag University Hospital at the period from September 2016 to September 2018. 50 women with abnormal uterine bleeding (AUB) referred from the Department of Obstetrics and Gynecology or from the Outpatient Clinic.
Inclusion criteria: Any patient with abnormal uterine bleeding with no palpable pathology by thorough clinical examination done by the gynecologist. AUB includes the following: any changes in the menstrual pattern (interval between the onset of bleeding episodes is less than 21 days) or prolonged menstruation (longer than seven days) and bleeding/spotting at an abnormal time (intermenstrual bleeding). Post-menopausal bleeding is an episode of bleeding 12 months or more after the last menstrual period.

The exclusion criteria were as follows:
• Patients with systemic diseases (liver, thyroid,etc.)
• Patients with positive pregnancy test
• Patients on oral anticoagulants/ antithrombotic therapy
• Patients with hematological disorders
All the data of history and clinical examination were obtained from the patients' files of Obstetrics/Gynecology Department. Demographic characteristics (age, residency, occupation and education), medical history, history of abdominal or pelvic surgery, and current medical conditions/medications (diabetes and hypertension), including a history of cancer (history of breast cancer). Information regarding menstrual patterns, reproductive history, history of contraceptive and hormone use, and menopausal status were obtained from the patient sheet.

Ethical approval:
The study was approved by the Ethics Board of Sohag University and an informed written consent was taken from each participant in the study.

Methods:
Ultrasound:
The patients were subjected to ultrasonography. First abdominal ultrasound to exclude any hepatic, renal or other systemic diseases and to exclude any pelvic masses then TVUS was performed, independent of the phase of menstrual cycle. The patients were asked to empty the urinary bladder. Two-dimensional transvaginal ultrasound was performed by endocavitary transducer (4-11MHz ultrasound Toshiba aplio 500).

During the TVUS, endometrial thickness was measured at its thickest point from the anterior to the posterior in the sagittal plane of the uterus. Calipers were placed perpendicularly to the outer edge of the endometrium. If there was fluid in the endometrial cavity, the endometrial thickness was measured as described above, but with the inclusion of the endometrial cavity fluid and double endometrial lining, then the fluid diameter was subtracted at the same point. On TVUS the sonographic appearance of the endometrium was classified according to the following parameters: normal or abnormal thickness, homogeneous or heterogeneous echogenicity. Normal endometrium and uterine cavity were defined by an echo-dense line in the middle of the uterus with a homogenous endometrial lining with distinct margins to the myometrium. Normal myometrium was also uniform in echo pattern. Any discontinuity was noted and all other findings, such as deformations of endometrial lining, absence of the central echo-dense line, any mass lesion with or without well-defined margins or variable echo-density were cosidered abnormal.

MRI:

All cases were performed using 1.5 Tesla Philips Achieva MRI scanner (Philips Medical Systems, Best, Netherland). The bladder should be emptied at about 30 min or just before the exam.

Patient preparation:

Before MRI examination, the patients were routinely questioned about any of the conditions which might be a contraindication for MRI examination such as cardiac pace makers, metallic intracranial or thoracic surgical clips and metallic prosthetic implants. The patients were instructed to remove any metal object [e.g. jewelry, hair pins] and change into a cotton gown for examination.

T2 weighted image: high resolution sagittal (TE 120 ms, TR minimum 2000 maximum3000) slice thickness 6mm FOV 300 mm), axial (TE 120 ms, TR minimum 2000 maximum3000) slice thickness 6mm and FOV 280 mm) and coronal.

T1 weighted image: TSE axial (TE 7 ms TR shortest and FOV 290 mm. T1 fat saturation in axial and sagittal in some cases suspected to have fatty lesions.

T2 SPAIR: sagittal (TE 75 ms, TR minimum 3000 ms maximum 5000 ms, slice thickness 4.5 mm and FOV 320 mm).

Diffusion weighted image: b factors of 0, 1000 and 800/mm^2. The region of interest was defined within the tumor on T2-weighted. In this study we used a cut off ADC value = $1.2 \times 10-3$ mm^2/s. to distinguish endometrial carcinoma from benign lesions [6]. Data were transferred at a workstation (Extended Workspace Philips, Philips Medical Systems, Best, Netherland.

    The MRI features of endometrial polyps are a polypoid endometrial mass, usually with T2 hyperintense signal, containing a low T2 signal linear core (felt to represent the stroma of dense fibrous tissue) and intratumoral cysts (felt to reflect dilated endometrial glands) [7].

    Endometrial carcinoma is relative hypointense lesion at the hyperintense endometrium at T2 with relative hyperintense signal at DW image with ADC value less than 1.2×10^{-3} mm^2/s [6].

    Endometrial hyperplasia appears as endometrial homogenous T2 hyperintense signal, clear endometrial-myometrial interface, hyperintense diffusion with ACD value more than 1.2×10^{-3} mm^2/s [6].

Statistical analysis

    Data were analyzed using STATA version 14.2 (Stata Statistical Software: Release 14.2 College Station, TX: Stata Corp LP.). Quantitative data were represented as mean, standard deviation, median and range. Qualitative data were presented as number and percentage. The sensitivity, specificity, and positive and negative predictive values were calculated for MRI, and TVUS.

RESULTS

Table (1): Characteristics of studied population

Variable	Summery statistics
Age	43.72 ± 11.72 43 (23-75)
Parity	Nulliparous 8 cases (16%) Multiparous 42 cases (84%)
Residency	Rural 40 (80%) Urban 10 (20%)
Occupation	Employee 7 (14%) House-wife 43 (86%)
Menstrual status	Premenopausal 27 (54.00%) Perimenopausal 17 (34.00%) Postmenopausal 6 (12.00%)

This study included 50 women who had uterine causes of abnormal uterine bleeding. Their ages ranged from 23-75years old with median 43 years and mean ± SD (43.72 ± 11.72). 27 cases (54%) were premenopausal, the perimenopausal women were 17cases (34%) and the postmenopausal were 6 cases (12%).

Table (2): The diagnostic potential of MRI and TVS in evaluation of uterine pathology

Study	Finding	Pathological finding		Diagnostic potential (%)	
		Abnormal	Normal		
MRI	Abnormal	27	4	Sensitivity	100
				Specificity	82.60
	Normal	0	19	PPV	87.09
				NPV	100
				Accuracy	92
TVS	Abnormal	27	1	Sensitivity	100
				Specificity	95.56
	Normal	0	22	PPV	96.42
				NPV	100
				Accuracy	98

The MRI and TVS were similar in sensitivity to detect uterine pathology (sensitivity 100%). The specificity of the TVS was better than the MRI (95.56% and 82.60% respectively) (Table 2).

Table 3: The diagnostic potential of MRI and TVUS in evaluation of uterine pathology in premenopausal group

Study	Finding	Pathological finding		Diagnostic potential (%)	
		Abnormal	Normal		
MRI	Abnormal	11	3	Sensitivity	100
				Specificity	81.25
	Normal	0	13	PPV	78.57
				NPV	100
				Accuracy	88.884
TVS	Abnormal	11	2	Sensitivity	100
				Specificity	87.5
	Normal	0	14	PPV	84.61
				NPV	100
				Accuracy	92.59

Table (4): The diagnostic potential of MRI and TVS in evaluation of uterine pathology in perimenopausal group

Study	Finding	Pathological finding		Diagnostic potential (%)	
		Abnormal	Normal		
MRI	Abnormal	11	1	Sensitivity	100
				Specificity	83.33
	Normal	0	5	PPV	91.66
				NPV	100
				Accuracy	94.11
TVS	Abnormal	10	0	Sensitivity	83.33
				Specificity	100
	Normal	2	5	PPV	100
				NPV	71.42
				Accuracy	88.23

Our 27 cases of premenopausal bleeding, histopathology diagnosed 16 patients as normal uterine cavity, four cases with fibroid (one case showed submucosal fibroid), two cases with adenomyosis, two cases adenomyosis & fibroid, one case had polyp, one case hyperplasia and one case adenomyosis & polyp.

The results of MRI examination in the premenopausal women found 13 cases were normal, four cases were fibroid (one submucosal), three cases adenomyosis & fibroid, three cases had polyp & hyperplasia and four case adenomyosis & polyp. The false positive cases of MRI were 2cases that were falsely diagnosed as polyp & hyperplasia and one case falsely diagnoses as polyp & adenomyosis.

The results of TVS were 14 cases normal, four cases fibroid, five cases adenomyosis, three cases hyperplasia and one polyp. The falsely diagnosed cases were two cases of adenomyosis proved histopathologically to be normal. MRI had a sensitivity (100%) and specificity (81.25%) and the TVUS had a sensitivity of (100%) and specificity (87.5%) in the diagnosis of endometrial pathology in premenopausal women (Table 3).

Our 17 patients in the perimenopause period (45-55years), histopathology revealed 6 cases were normal, five cases had adenomyosis, three cases had fibroid, one case for polyp, one case fibroid & polyp and one case hyperplasia & polyp.

MRI results were: 5 cases as normal, five cases had adenomyosis, three cases had fibroid, one case for hyperplasia, one case polyp, one case fibroid & polyp and one case hyperplasia & polyp. The falsely positive case was the hyperplasia histopathological were proliferative disorder.

TVS results were: 7 cases normal, three cases adenomyosis, four cases fibroid, two cases hyperplasia and one case polyp. The two cases of hyperplasia histopathologically proved to be one hyperplasia & polyp and the other was proliferative disorder.

The results of MRI examination in perimenopause women in evaluation of uterine pathology showed sensitivity 100% and specificity 83.33%. The results of TVS showed 83.33% sensitivity and 100% specificity (Table 4).

Table (5): The diagnostic potential of MRI and TVS in evaluation of uterine pathology in postmenopausal group

Study	Finding	Pathological finding		Diagnostic potential (%)	
		Abnormal	Normal		
MRI	Abnormal	5	0	Sensitivity	100
				Specificity	100
	Normal	0	1	PPV	100
				NPP	100
				Accuracy	100
TVS	Abnormal	5	0	Sensitivity	100
				Specificity	100
	Normal	0	1	PPV	100
				NPP	100
				Accuracy	100

In postmenopausal patients 6 cases (>55years) histopathological results were: two cases had hyperplasia, two cases polyp, one case had atrophic endometrium and one cases with endometrial carcinoma (Table 5).
The results of MRI and TVS examination in postmenopausal women in evaluation of uterine pathology had similar sensitivity and specificity (100% sensitivity and 100% specificity).

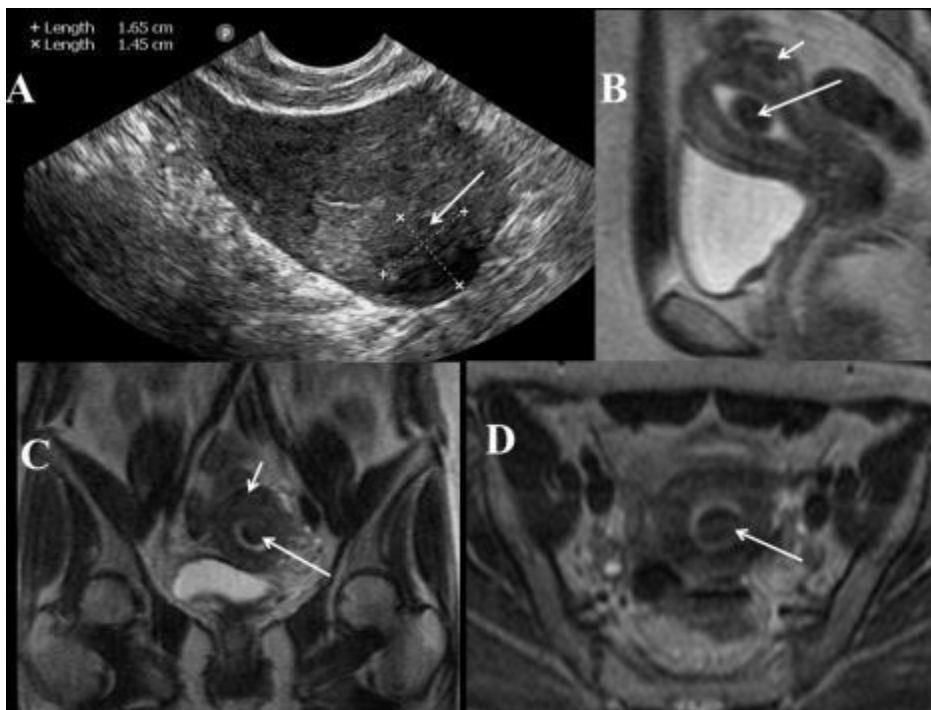**Case (1):** Female patient 39 years old presented by abnormal uterine bleeding.

Figure (1): Longitudinal TVS image revealed a well-defined posterior wall iso-hypoechoic solid lesion suggesting interstitial fibroid (white arrow). (B, C, D) - Sagittal, coronal and axial T2 revealed a posterior wall (short white arrow) and a submucosal (long white arrow) well defined hypointense lesions consistent with interstitial and submucosal fibroids.

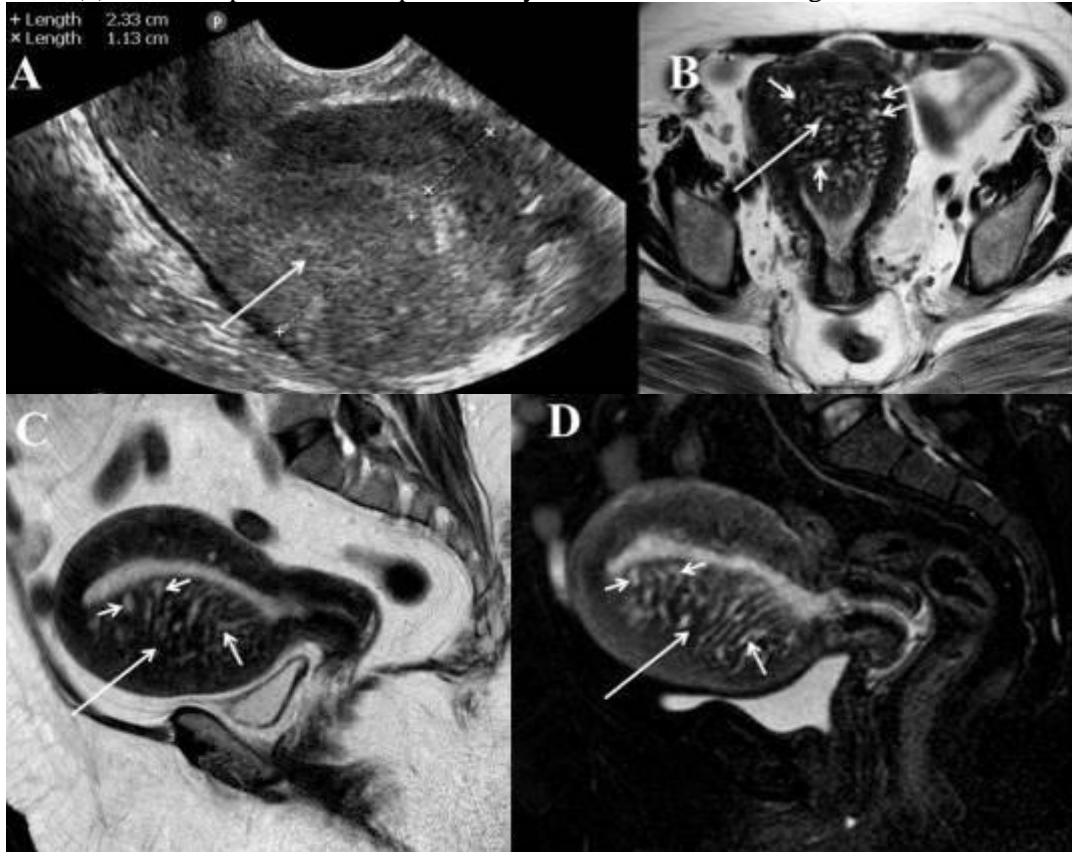**Case (2):** Premenopausal female patient 33 years old with menorrhagia.

Figure (2): Longitudinal TVS image revealed asymmetrical increased anterior myometrial wall thickness as compared to that of the posterior wall with slight hyperechoic pattern suggesting adenomyosis (white arrow). (B)- Axial T2, (C)- Sagittal T2, (D)- Sagittal T2 SPAIR images revealed increased anterior myometrial wall transitional zone thickness (long solid arrow) containing multiple tiny high signal foci (short solid arrow). Findings were correlating with focal adenomyosis.

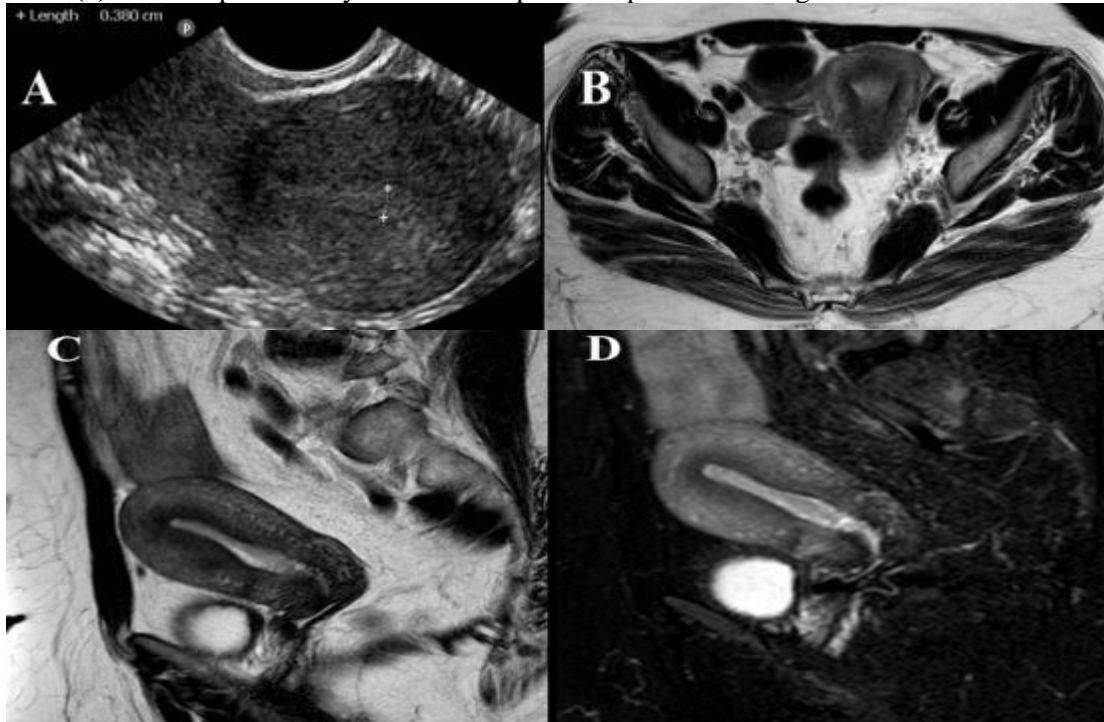**Case (3):** Female patient 55 years old with perimenopausal bleeding.

Figure (3): Longitudinal TVUS image revealed normal echogenicity of the myometrium with homogenous endometrial thickness. (B) - Axial T2, (C) - Sagittal T2, (D) - Sagittal T2 SPAIR images showed normal transitional zone, normal myometrium and normal endometrium thickness. The case was diagnosed as dysfunctional uterine bleeding.

Case (4): Female patient 69 years old with post-menopausal bleeding.
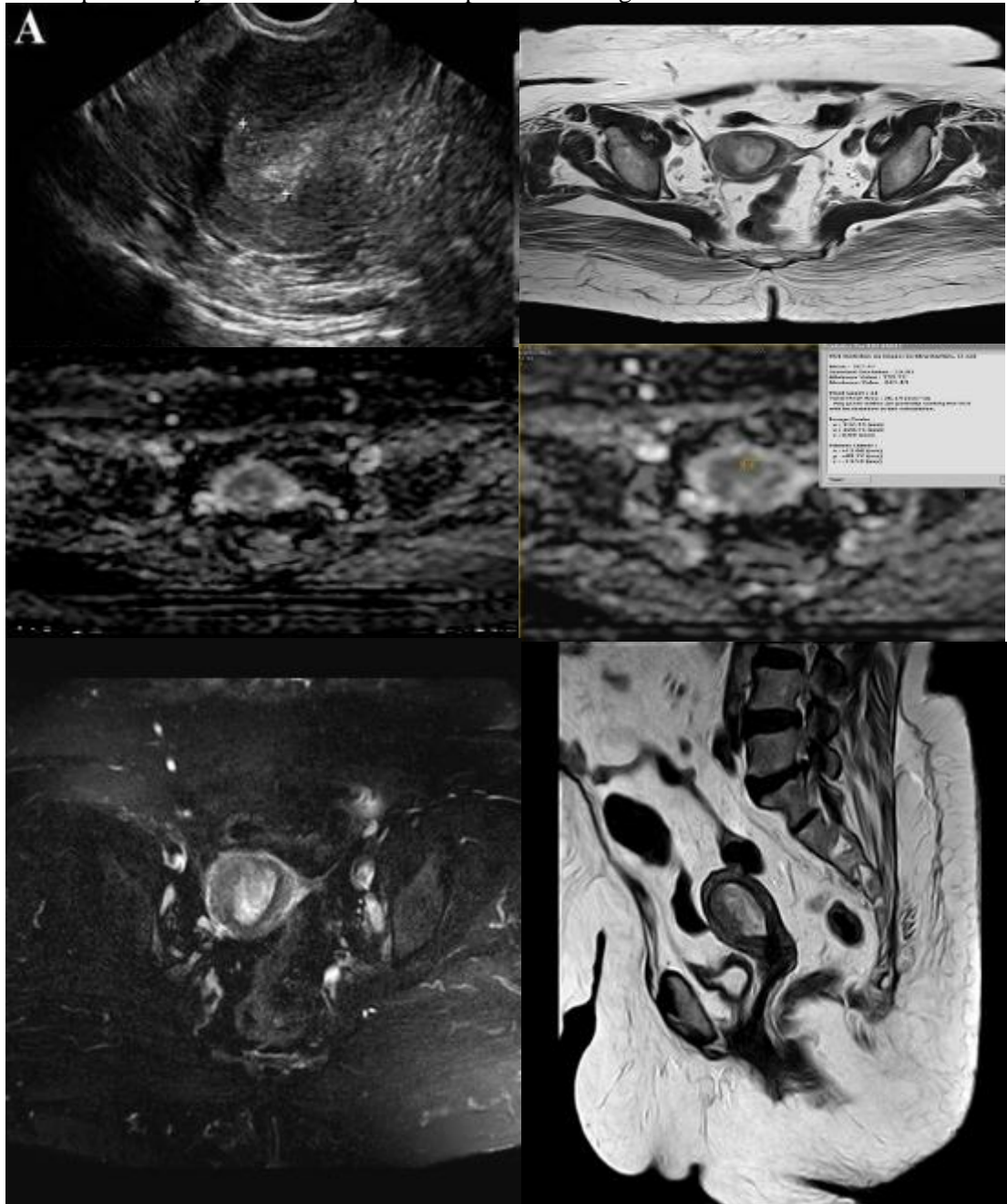

Figure (4): Longitudinal TVS image reveals thick endometrium with endometrial thickness complex measures 15.7 mm. (B) - Axial T2, (C & D) - ADC map at b-1000, (E) - Axial T2 SPAIR images show an endometrial mass lesion with a relative hypointense signal (arrow) with relative loss of the endometrial-myometrial border at anterior wall. (F) - Sagittal T2, The lesion showed restricted diffusion. MRI suggested endometrial carcinoma stage I-a whereas histopathology revealed endometrial carcinoma type II stage I-b.

DISCUSSION

In our study, the most common cause of abnormal uterine bleeding is non-organic cause (46%) followed by adenomyosis (14%), fibroid (14%), polyp (8%), hyperplasia (4%), endometrial carcinoma (2%), fibroid & adenomyosis (4%), polyp & hyperplasia (4%), adenomyosis & polyp (2%) and fibroid & polyp (2%) . Our results agrees with **Soleymani *et al.*** [8] who concluded that the proliferative endometrium and secretory endometrium were the most common

histopathological observations in AUB patients. Also, our results agrees with **Singh and Ramana** [9] where they also concluded that the commonest histopathological pattern in abnormal uterine bleeding was normal physiological phases of menstrual cycle.

In our study, abnormal uterine bleeding was more common in multipara. This agrees with **Singh and Ramana** [9]**,** they concluded that the incidence of AUB was noticed to be increasing with parity.

Our study revealed that endometrial atrophy was seen in one case 2%. This agrees with **Singh and**

Ramana [9], in their study where endometrial atrophy accounted for 3% of cases.

Our study revealed that MRI sensitivity for uterine pathology was 100% and specificity was 82.60%. This agrees with **Yadav** [5] where he concluded that overall sensitivity for detection of lesions by MRI was 100% and specificity was 98.41%. Our results disagree with **Dueholm et al.** [10] who found the MRI sensitivity was 76 % and specificity was 92% and disagree with **Ahmad et al.** [11] who found that the sensitivity was 78.75% and specificity was 63.64%.

Our study revealed a sensitivity of TVUS was 100% and specificity was 95.56% in detecting uterine pathology. Our study agrees with **Babacan et al.** [12].

For uterine myoma, the current study showed that MRI had a sensitivity of 100%, specificity of 100%, PPV of 90.9%, NPVof 100% and accuracy of 98%. Our study agrees with **Dueholm et al.** [10] where they concluded that magnetic resonance imaging sensitivity was 99 %, agrees with **Griffin et al.** [13] where they showed that MRI had a sensitivity 99%, agrees with **Jagannathan** [14] in his study he reported that MRI had a sensitivity of 100% and specificity of 96% and agrees with **Hossain et al.** [15] where MRI had a sensitivity of 97.1%. Our study disagrees with **Moghadam et al.** [16] where they reported that MRI specificity was 33%. They explained this low specificity to be because his study was influenced by selection bias as that study was performed on a diseased population with a previous diagnosis of myoma where ultrasound alone was thought by the physician to be inadequate.

Regarding diagnosis of uterine fibroid, sensitivity of TVUS was 80%, specificity was 100%, PPV was 100%, NPV was 95.23% and accuracy was 96%. This agrees with **Mise et al.** [17] and **Shiva et al.** [18], but disagrees with **Levens et al.** [19] where they studied small population (eighteen).

For assessment of endometrial polyp, MRI in the present series had a sensitivity of 100% and specificity was 90.4%, which agrees with **Ahmed et al.** [11] and Balcacer et al. [20].

Our study revealed that TVUS sensitivity for endometrial polyp was 50%, and specificity was100%, which agrees with **Zhu et al.** [21] and agrees with **Shiva et al.** [18], disagrees with **Sarala and Misra** [22] where the sensitivity of TVUS for polyp which was 92.41%, their study done for 100 female and all patients underwent TVUS during the late follicular phase of the cycle but our study done TVS regardless the phase of the menstrual cycle.

Study for endometrial hyperplasia, MRI sensitivity was 100%, specificity was 93.4% and accuracy was 96%. This agrees with **Ahmed et al.** [23] and disagrees with **Ahmad et al.** [11] study in which MRI sensitivity was 50%, specificity was 84% and

accuracy was 78.33%. This discrepancy may be related to less sensitive MRI system used in his study (0.3 Tesla).

The current study revealed that the TVUS sensitivity for endometrial hyperplasia was 75%, specificity was 91.3%, PPV was 42.8%, NPV was 97.67% and accuracy was 90%. This agrees with **Choudhary et al.** [24] and disagrees with **Nazim et al.** [25], **Wanderley et al.** [26] and Sarala and Misra [22].

For study of endometrial carcinoma, MRI had a sensitivity and specificity of 100% this agrees with **Inada et al.** [27] who concluded that the fused DW images/T2-weighted images demonstrated an endometrial cancer had sensitivity of 96%, **Bharwani et al.** [28] reported that specificity of DW image for endometrial carcinoma was 100% and agrees with **Jagannathan** [14] who concluded that MRI in detecting endometrial carcinoma had a sensitivity of 100% and specificity of 97%.

Our MRI sensitivity and specificity for endometrial carcinoma was high may be because endometrial carcinoma was one case only and we used DW image for her diagnosis. The need for histopathological evaluation of endometrial lesion couldn't be totally excluded.

In our study, TVUS had a sensitivity for endometrial carcinoma of 100% and specificity of 100%. This agrees with **Showkat et al.** [29] **and Mayuri et al.** [30]. The current study for TVUS evaluation for endometrial carcinoma disagrees with **Steiner et al.** [31] and with **Maiti et al.** [32].

CONCLUSION

Role of MRI in abnormal uterine bleeding was equal to that of TVUS but still TVUS has the upper hand as the first imaging choice and real time imaging. Patients also preferred TVUS than MRI. MRI diffusion sequence for female pelvis should be added to the routine protocol for female pelvis for the differentiation of benign and malignant endometrial lesions.

REFERENCES

1. **Williams PL, Laifer-Narin SL, Ragavendra N (2003):** US of abnormal uterine bleeding. Radiographics, 23 (3): 703-18.
2. **Munro MG, Critchley HO, Broder MS et al. (2011):** FIGO classification system (PALM- COEIN) for causes of abnormal uterine bleeding in nongravid women of reproductive age. International Journal of Gynecology and Obstetrics, 113: 3-13.
3. **Çavuşoğlu M, Ciliz DS, Ozsoy A et al. (2016):** Diffusion-Weighted Mri of Postmenopausal Women with Vaginal Bleeding and Endometrial Thickening: Differentiation of Benign and Malignant Lesions. Journal of the Belgian Society of Radiology, 100 (1): 70-5.
4. **Addley HC, Vargas HA, Moyle PL et al. (2010):** Pelvic imaging following chemotherapy and radiation therapy

for gynecologic malignancies. Radiographics, 30: 1843-56.

5. **Yadav P (2016):** Magnetic resonance imaging in the evaluation of female pelvis. Med J DY Patil Univ., 9: 627-634.

6. **Habib LA, Alhawary M, Abd Alghany A *et al.* (2018):** Role of MRI in Diagnosis of Endometrial Cancer. The Egyptian Journal of Hospital Medicine, 72 (10): 5505-5512.

7. **Hase S, Mitsumori A, Inai R *et al.* (2012):** Endometrial polyps: MR imaging features. Acta Med Okayama, 66 (6): 475-85.

8. **Soleymani E, Ziari K, Rahmani O *et al.* (2014):** Histopathological findings of endometrial specimens in abnormal uterine bleeding. Archives of Gynecology and Obstetrics, 289: 845-849.

9. **Singh A, Ramana BPV (2016):** Study of histopathological pattern of endometrium in abnormal uterine bleeding and its management. https://www.ijrcog.org/index.php/ijrcog/article/view/599

10. **Dueholm M, Lundorf E, Hansen ES *et al.* (2001):** Evaluation of the uterine cavity with magnetic resonance imaging, transvaginal sonography, hysterosonographic examination, and diagnostic hysteroscopy. Fertility and Sterility, 76 (2): 350-357.

11. **Ahmad RA, Sadek SM, Ragheb AS (2015):** Evaluation of the uterine cavity by magnetic resonance imaging, three dimensional hysterosonography and diagnostic hysteroscopy in women with pre- and post-menopausal bleeding. Middle East Fertility Society Journal, 20: 70-78.

12. **Babacan A, Gun I, Kizilaslan C *et al.* (2014):** Comparison of transvaginal ultrasonography and hysteroscopy in the diagnosis of uterine pathologies. International Journal of Clinical and Experimental Medicine, 7: 764-769.

13. **Griffin N, Grant LA, Sala E (2008):** Magnetic resonance imaging of vaginal and vulval pathology. Eur Radiol., 18: 1269-80.

14. **Jagannathan D (2017):** Comparison of The Diagnostic Accuracy of Magnetic Resonance Imaging (MRI), Transabdominal Ultrasound (TAS), Transvaginal Ultrasound (TVS) In Characterizing The Uterine Mass Lesions. IOSR Journal of Dental and Medical Sciences, 16 (2): 65-74.

15. **Hossain MZ, Rahman MM, Ullah MM *et al.* (2017):** A Comparative Study of Magnetic Resonance Imaging and Transabdominal Ultrasonography for the Diagnosis and Evaluation of Uterine Fibroids. Mymensingh Med J., 26: 821-827.

16. **Moghadam R, Lathi RB, Shahmohamady B *et al.* (2006):** Predictive value of magnetic resonance imaging in differentiating between leiomyoma and adenomyosis. JSLS: Journal of the Society of Laparoendoscopic Surgeons, 10 (2): 216.

17. **Mise J, Mise P, Mise S *et al.* (2017):** Role of transvaginal sonography in various gynecological disorders. Int J Reprod Contracept Obstet Gynecol., 6 (7): 3138-3142.

18. **Shiva M, Ahmadi F, Arabipoor A *et al.* (2018):** Accuracy of Two-Dimensional Transvaginal Sonography and Office Hysteroscopy for Detection of Uterine Abnormalities in Patients with Repeated Implantation Failures or Recurrent Pregnancy Loss. Int J Fertil Steril., 11 (4): 287-292.

19. **Levens ED, Wesley R, Premkumar A *et al.* (2009):** Magnetic resonance imaging and transvaginal ultrasound for determining fibroid burden: implications for research and clinical care. Am J Obstet Gynecol., 200(5):1-7.

20. **Balcacer P, Cooper KA, Huber S *et al.* (2018):** Magnetic Resonance Imaging Features of Endometrial Polyps: Frequency of Occurrence and Interobserver Reliability. J Comput Assist Tomogr., 42: 721-726.

21. **Zhu H, Fu J, Lei H *et al.* (2016):** Evaluation of transvaginal sonography in detecting endometrial polyps and the pregnancy outcome following hysteroscopic polypectomy in infertile women. Exp Ther Med., 12 (2): 1196–1200.

22. **Sarala K, Misra K (2018):** Role of Transvaginal Sonography and Diagnostic Hysteroscopy in Evaluation of Endometrial Cavity in Infertile Women. International Journal of Contemporary Medical Research, 5 (3): 1-3.

23. **Ahmed SA, El Taieb HA, Abotaleb H (2018):** Diagnostic performance of sonohysterography and MRI diffusion in benign endometrial lesion characterization. The Egyptian Journal of Radiology and Nuclear Medicine, 49: 579-589.

24. **Choudhary J, Acharya V, Jain M (2017):** Evaluation of abnormal uterine bleeding with transvaginal sonography and hysteroscopy in perimenopausal women. International Journal of Reproduction, Contraception, Obstetrics and Gynecology, 6(8): 3607-3613.

25. **Nazim F, Hayat Z, Hannan A *et al.* (2013):** Role of transvaginal ultrasound in identifying endometrial hyperplasia. J Ayub Med Coll Abbottabad, 25: 100-2.

26. **Wanderley MDS, Álvares MM, Vogt MDFB *et al.* (2016):** Accuracy of Transvaginal Ultrasonography, Hysteroscopy and Uterine Curettage in Evaluating Endometrial Pathologies. J Revista Brasileira de Ginecologia e Obstetrícia , 38: 506-511.

27. **Inada Y, Matsuki M, Nakai G *et al.* (2009):** Body diffusion-weighted MR imaging of uterine endometrial cancer: is it helpful in the detection of cancer in nonenhanced MR imaging? Eur J Radiol., 70: 122-7.

28. **Bharwani N, Miquel ME, Sahdev A *et al.* (2011):** Diffusion-weighted imaging in the assessment of tumour grade in endometrial cancer. Br J Radiol., 84 (1007): 997–1004.

29. **Showkat MS, Nabi S, Khondker L *et al.* (2013):** Role of transvaginal sonography in the detection of endometrial carcinoma. Bangladesh Med Res Counc Bull., 39: 80-5.

30. **Mayuri M, Abha S, Narula MK (2014):** Role of transvaginal sonography, power doppler and hysteroscopy in women with abnormal uterine bleeding: a comparative study. IOSR-JDMS., 11: 82-89.

31. **Steiner E, Juhasz-Bösz I, Emons G *et al.* (2012):** Transvaginal Ultrasound for Endometrial Carcinoma Screening - Current Evidence-based Data. Geburtshilfe und Frauenheilkunde, 72: 1088-1091

32. **Maiti G, Lele P, Borse D (2018):** Comparison of transvaginal sonography with hysteroscopy and correlation with histopathological report in case of abnormal uterine bleeding. International Journal of Reproduction, Contraception, Obstetrics and Gynecology, 7 (2): 711-6.