Article

Role of transvaginal ultrasound of endometrium in females with abnormal uterine bleeding

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Abstract: This prospective observational study aimed to assess the role of transvaginal ultrasound (TVS) in diagnosing the cause of abnormal uterine bleeding (AUB) and characterizing benign and malignant lesions. 130 patients were included and underwent TVS and histopathological examination. TVS showed sensitivity of 59%, specificity of 93%, positive predictive value of 81%, negative predictive value of 82%, and accuracy of 58% for diagnosing malignant lesions. The study provided TVS imaging features for early identification, characterization, and extent of uterine pathologies, as well as relevant information for clinicians to make reasonable decisions. TVS is a good primary imaging modality due to its non-invasiveness, low cost, and wide availability.

Keywords: Abnormal Uterine Bleeding, Transvaginal Ultrasound.

1. Introduction

A Abnormal uterine bleeding (AUB) is a common gynecological complaint affecting up to one-third of women. It is characterized by irregularities in the menstrual cycle involving frequency, regularity, duration, and volume of flow outside of pregnancy. AUB can lead to anemia and a decrease in the quality of life of affected women. Therefore, determining the most likely etiology of AUB is essential for appropriate management and effective treatment [1,2].

The aim of this prospective observational study was to assess the role of transvaginal ultrasound (TVS) in diagnosing the cause of abnormal uterine bleeding. The study was conducted at the Department of Radiodiagnosis of Mahatma Gandhi Memorial Medical College, M. Y. Hospital and associated hospitals in Indore, (M.P.) from April 2021 to September 2022. The study included 130 patients who were referred to the department for TVS examination. The goal was to identify, characterize, and evaluate the extent of uterine pathologies, and provide clinicians with relevant information to make reasonable decisions for early diagnosis, management, and improved quality of care [3].

The results showed that TVS is a reliable primary imaging modality for the early identification of uterine pathologies, including benign and malignant lesions. In our study, 52% of the cases had heterogenous echotexture, while 48% had homogenous echotexture. Most cases had endometrial thickness (ET) between 6 to 10 mm. The study also identified TVS imaging features that could help in the characterization of the various causes of AUB. Sensitivity of TVS for diagnosing malignant lesions was 59%, specificity was 93%, positive predictive value was 81%, negative predictive value was 82%, and accuracy was 58%. In conclusion, TVS is a non-invasive, cost-effective, and widely available imaging modality that can provide reliable and reproducible information for the early diagnosis and management of AUB [4,5].

Overall, the study provides valuable insight into the use of TVS in diagnosing the cause of AUB and its potential to reduce the necessity for invasive operational procedures. The findings of the study have implications for clinicians in improving the quality of care for women with AUB. Further studies are recommended to evaluate the long-term effectiveness of TVS in the management of AUB and its impact on the quality of life of women.

2. Methods

This study was conducted in the Department of Radiodiagnosis at a tertiary care hospital in Indore, Madhya Pradesh, India, after obtaining approval from the Institutional Scientific and Ethical Committee. The study was conducted from April 2021 to September 2022, and was designed as a time-bound, hospital-based, and prospective study.

2.1. Inclusion Criteria

The study included patients who were referred to the Department of Radiodiagnosis at the hospital for radiological evaluation of abnormal uterine bleeding.

2.2. Exclusion Criteria

The following criteria were used to exclude potential participants from the study:

- Pregnant women
- Unmarried women
- Women with endocrine abnormalities and bleeding disorders
- Women with an intrauterine device in situ
- Subjects who did not provide consent to participate in the study

By using these inclusion and exclusion criteria, the study aimed to ensure that the results were representative of a specific population of patients with abnormal uterine bleeding. This approach allowed for a more focused investigation of the underlying causes and the extent of uterine pathologies, which could provide clinicians with relevant information for making informed decisions about patient management and treatment.

3. Results

The study aimed to assess the accuracy of transvaginal ultrasound (TVS) in diagnosing various uterine pathologies and to compare the TVS findings with histopathology examination (HPE). A total of 140 patients with abnormal uterine bleeding who were referred to the Department of Radiodiagnosis, Tertiary care hospital, Indore, Madhya Pradesh, India, were included in this prospective, hospital-based study conducted from April 2021 to September 2022.

Out of 44 malignant lesions confirmed on histopathology, only 32 cases were diagnosed by TVS. On the other hand, 34 cases of adenomyosis were diagnosed on TVS, and 28 were confirmed on histopathology. Similarly, 38 submucosal fibroids and 12 endometrial polyps were diagnosed on TVS, and 30 and 8 cases, respectively, were confirmed on histopathology. The detailed comparison of TVS and HPE findings is provided in Table 1 and Figure 1.

The distribution of patients based on endometrial thickness is presented in Table 2 and Figure 2. It was observed that 43% of cases had an endometrial thickness ranging from 6 to 10 mm, while 28% of cases had an endometrial thickness between 11 to 15 mm. The distribution of patients according to age is shown in Table 3, and the distribution of endometrial thickness is depicted in Figure 3. The most common age group for endometrial thickness >11mm was found to be 50-59 (24.6%) years followed by 60-69 (15.3%) years.

Furthermore, the study presents two case examples of women with abnormal uterine bleeding. In one case, a 39-year-old woman had a well-defined homogenous hyperechoic lesion in the endometrial cavity, which was found to be an endometrial polyp on further evaluation as shown in Figure 4. In the second case, a 55-year-old woman had a well-defined heterogenous hypoechoic lesion in the posterior wall of the uterus, which was diagnosed as a leiomyoma (submucosal fibroid) on TVS. The lesion showed peripheral vascularity and minimal surrounding fluid, as shown in Figure 5.

Table 1. TVS Vs HPE

Modality/Diagnosis	TVS	HPE
Polyp	12	8
Endometrial hyperplasia	14	12
Malignant	32	44
Fibroid	38	30
Adenomyosis	34	28
Total	130	130
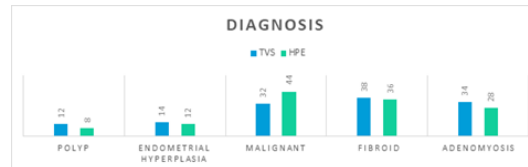
Figure 1. TVS Vs HPE

Table 2. Distribution of patients on the basis of Endometrial thickness

Endometrial thickness (in mm)	Number of cases	Percentage (%)
1 TO 5 mm	14	11 %
6 TO 10 mm	56	43 %
11 TO 15 mm	36	28 %
16 TO 20 mm	16	12 %
More than 20 mm	8	7 %
Total	130	100 %
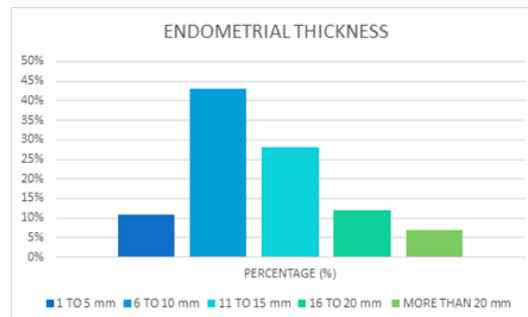
Figure 2. Endometrial thickness

Table 3. Distribution of patients according to age wise

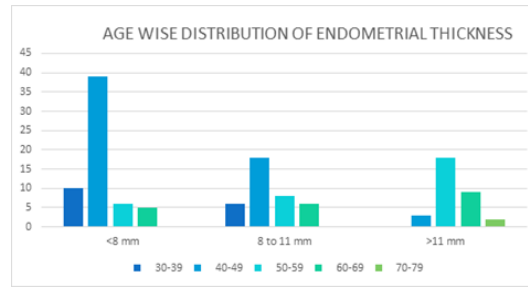| Age (y)	<8 mm	8 to 11 mm	>11 mm	Total
30-39	10	6	00	16
40-49	39	18	3	60
50-59	6	8	18	32
60-69	5	6	9	20
70-79	00	00	2	2
Total	60 (46.1%)	38(29.2%)	32(24.6%)	130(100%)

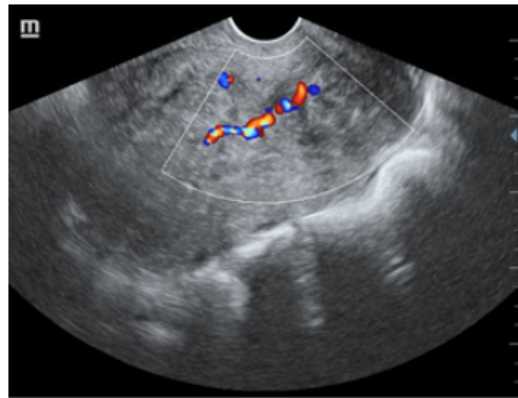**Figure 3.** Distribution of endometrial thickness

Figure 4. 39 years old women presented with abnormal uterine bleeding. A well-defined homogenous hyperechoic lesion seen in endometrial cavity, feeding vessel on doppler it was found to be Endometrial polyp

Figure 5. 55 years old women presented with abnormal uterine bleeding. TVS images depicting a well-defined heterogenous hypoechoic lesion in posterior wall of uterus, showing peripheral vascularity and with minimal fluid surrounding it found to be Leiomyoma (submucosal fibroid)

4. Discussion

Majority of the patients (46%) in our study belonged to age group of 40 to 49 years, with the mean age of 43.8±8.5 years and range of 30 to 79 years. This can be because forties are often a time of hormonal turbulence in a woman's life which can be explained by fluctuating sex-hormone levels and anovulatory cycles. This is in accordance with the study conducted by Wankhede *et al.,* (2019) [6] who also found that the mean age to be 41.7±7.82 years, with maximum population i.e. 45% belonging to the age group of 41-50 years.

In our study, the most common presenting complaint of the patients was abnormal uterine bleeding present in 130 (100%) patients followed by discharge PV in 64 (49%) patients, pelvic pain in 44 (34%) patients. This may be explained by one of three hormonal-imbalance conditions: estrogen breakthrough bleeding,

estrogen withdrawal bleeding and progesterone breakthrough bleeding. Estrogen breakthrough bleeding occurs when excess estrogen stimulates the endometrium to proliferate in an undifferentiated manner. With insufficient progesterone to provide structural support, portions of the endometrial lining slough at irregular intervals. The usual progesterone-guided vasoconstriction and platelet plugging do not take place, often resulting in profuse bleeding. Manjit Singh Bal *et al.,* 2012 [7] also found most common presenting complaint was discharge per vaginum present in 177 (59%) patients, pelvic pain in the lower abdomen was present in 58 (19.3%).

In our study, we found that 59 cases (46%) of our population was anemic. This could be explained by the excessive bleeding and high prevalence of iron deficiency anemia. While the study conducted by Dr. Meena Jain *et al.*, (2019) [8], who found anemia in 63.36% patients in their study which is more as compared to our study.

Hypertension was found in 18 cases (14%), followed diabetes mellitus in 16 cases (12%), by obesity in 20 cases (15%). Several biological pathways, including renin-angiotensin-aldosterone system dysfunction, endothelial dysfunction, chronic inflammation, and also emotional distress, are thought to link menstrual symptoms to hypertension. Study by Alexander sabre *et al.,* (2021) [9] found hypertension in 36.4% patients and diabetes in 15.6%. Kumarasamy Akalyaa *et al.*, (2020) [10] found increased BMI to be an important independent risk factor for the development of endometrial hyperplasia with atypia which is a precursor to endometrial carcinoma in premenopausal women with AUB.

In our study, 52 cases (40.4%) had an enlarged uterus, while 78 (59.6%) had a normal sized uterus. Bulkiness of uterus can be explained by the fact that hyperplasia of uterine wall leads to structural pathology i.e. fibroids and adenomyosis. Singh *et al.*, (2019) [11] found bulky uterus in 25% patients.

In our study, 68 cases (52%) had heterogenous echotexture and 62 cases (48%) had homogenous echotexture. The normal appearance of the endometrium is smooth and regular versus a disrupted appearance i.e. homogenous. Lesions with heterogenous echotexture were suspicious for most of the non-benign and inflammatory causes. Heterogenicity of endometrium maybe explained by imbalance of estrogen and progesterone production i.e. excessive estrogen production and not enough progesterone while study conducted by E. Epstein and L Valentin (2006) [12] found heterogeneous endometrium in 73% of the patients.

Out of 130 patients, majority of 56 cases (43%) had endometrial thickness between 6 to 10 mm followed by 36 cases (28%) had endometrial thickness between 11 to 15 mm, 16 patients (12 %) had endometrial thickness between 16 to 20 mm, 14 cases (11%) had endometrial thickness between 1 to 5 mm and 8 patients (7%) cases had ET above 20 mm. Endometrial hyperplasia is the result of chronic exposure to estrogen along with relative deficiency of progesterone. The study conducted by Kaur M *et al.*, (2010) (38) also found ET between 5.1 and 10 mm in the majority of the patients. No malignant cases were found in patients having ET less than 11 mm.

Most common age group for endometrial thickness >11mm was found to be 50-59 years. The progesterone drop triggers the uterus to shed its lining as a menstrual period. Women who have endometrial hyperplasia make little, if any, progesterone. As a result, the uterus doesn't shed the endometrial lining. Instead, the lining continues to grow and thickens. Schulze *et al.*, (2015) [13] found normal ET (up to 8 mm) was seen in 37 patients (61.6%), mild to moderate ET(8.1 to 11 mm) was seen in 14 patients (23.4%) and severe increase in thickness (>than 11 mm) was seen in 9 patients (15%).

Focal endometrial thickening was found in 44 cases (34%), diffuse endometrial thickening was found in 76 cases (58%), atrophic endometrium was found in 10 cases (8%) cases. Diffuse thickening of endometrium was due to hyperplasia and endometrial carcinoma. Focal endometrial thickening was a marker of lesions like endometrial polyp, submucous fibroid and focal endometrial hyperplasia. In our study, diffuse thickening of endometrium was found as a common feature of both benign (endometrial hyperplasia) and malignant etiology (endometrial carcinoma). Most of the cases having focally thickened endometrium were suspected as a polyp and focal endometrial hyperplasia in our study.

Out of 130 cases, 24 (18%) had distended endometrial cavity, 12 (9%) had obliterated, and the rest 94 (72%) had a normal endometrial cavity. Almost all cases with distended endometrial cavity were associated with cervical and endometrial malignancy in our study. This could be because of accumulation of fluid in endometrial cavity in malignancies. Yin *et al.*, (2011) also found collection in uterine cavity mainly attributed due to malignancy [14].

In our study, the endo-myometrial junctional zone was ill-defined in 42 (32%) patients and was maintained in 88 patients (68%). The lesion which had ill-defined irregular inhomogeneous junctional zone

involvement were suspicious for malignancy and were diagnosed as neoplastic and widening of junctional zone with indistinct endo-myometrial interface with cystic changes and heterogeneity of myometrium were diagnosed as adenomyosis. The presence of endometrial glands and stroma inside the myometrium due to excess estrogen can be a cause of adenomyosis.

In our study, 28 cases (22%) cases appeared as mass lesions and 102 cases (78%) cases were non-mass lesions. Out of mass lesions 12 cases (43%) had a well-defined peduncle and 16 (57%) cases did not show presence of peduncle. Lesions with peduncle were identified as endometrial polyps. Well defined homogenously hyperechoic lesions and presence of peduncle and a vascular pedicle was found to be specific for endometrial polyp.

In our study, cystic changes were the most common (26%) ancillary findings in endometrium. The presence of an intralesional cyst in endometrial pathology suggests the benign nature of lesions particularly endometrial hyperplasia, and polyp. Existence of cystic changes favors a benign state, although malignancy cannot be safely excluded. Calcification was second most common ancillary finding (15%). Calcification were observed to be associated with both benign and malignant lesions. Myometrial arterial calcification are thought to increase with advancing age and may represent calcification of radial or arcuate arteries of the uterus. They may have an increased association with atherosclerosis elsewhere. Metastatic calcification may occur in normal tissues whenever there is hypercalcemia, which may be possibly related to localised high pH and deposition of basic calcium salts.

In our study, on evaluation with colour doppler, internal vascularity was visualized in 51 (39.2%) of the lesions, while peripheral vascularity was seen in 39 (29%) cases. In 14 (11.5%) of the cases, vascular pedicles were picked up by identification of colour doppler signals. Vascularity can be explained by the fact that neovascularization where new blood vessels are formed from existing ones following endothelial cell proliferation and migration in neoplastic etiology. Majority of the cases (57%) with vascular pedicles turned out to be endometrial polyps. increased vascularity can suggest increased risk of malignancy, especially when correlated with other suspicious findings.

In present study, on colour doppler, 60% lesions had increased vascularity, 30% had decreased vascularity and 10 % had normal vascularity. Resistive index was found to be less than 0.7 in 40 (30%) cases and more than 0.7 in 90 (70%) cases. This RI value corresponds to angiogenesis and neovascularization in case of malignant lesions. In malignancy, angiogenesis and neovascularization occurs and this newly formed vessels will show increased vascularity and decreased resistive index.

In our study, total number of 26 (20%) patients showed myometrial invasion and 104 (80%) patients showed no myometrial invasion. Inhomogeneous irregular myometrium with extension of the endometrial lesion and increased vascularity were found in these lesions. In the early stage of illness it is essential to determine factors which imply to high risk a myometrium invasion more than 50% and associated changes.

Cases with myometrial invasion were suspicious along with heterogenous myometrium found in 12 cases (9.2%) echogenic nodules found in 6 cases (4.6%) and hypoechoic mass found in 14 cases (10.7%) and cystic changes found in 4 cases (3%). Heterogenous myometrium, mass and cystic changes imply to a high risk of malignancy.

Total number of benign cases were 98 (75.4%), total number of malignant cases were 32 (24.6%). Age related imbalance of estrogen and progesterone production i.e., excessive estrogen production and not enough progesterone can explain the incidence of benign lesions.

In our study, 29% were diagnosed as submucosal fibroid,26% were diagnosed as adenomyosis,11% cases were diagnosed as endometrial hyperplasia and 9% polyp. In our study, 30 cases (88%) were diagnosed as endometrial carcinoma while 4 (12%) cases were identified as cervical carcinoma.

Age related imbalance of estrogen and progesterone production i.e. excessive estrogen production and not enough progesterone can explain high incidence of fibroids.

In our study, 38 submucosal fibroids were diagnosed on TVS, 30 were confirmed on histopathology. Out of 34 cases of adenomyosis diagnosed on TVS, 28 were confirmed on histopathology. Out of the 44 malignant lesions diagnosed on histopathology only 32 cases could be picked by TVS. 14 cases diagnosed on TVS as endometrial hyperplasia only 12 were confirmed on histopathology.12 endometrial polyps were diagnosed on TVS, 8 were confirmed on histopathology.

A total of 98 Benign lesions were identified on TVS, 86 were confirmed on histopathology. Among 44 lesions which came out to be malignant only 32 were picked on TVS.

For diagnosing benign lesions, TVS showed sensitivity of 93%, specificity of 59%, positive predictive value of 82%, Negative predictive value of 81% accuracy of 82%.

TVS proved to be an excellent modality for diagnosing endometrial lesions. While histopathology is considered to be the gold standard, yet, histopathology, being an invasive procedure is often avoided and moreover, the localization of site for histopathological specimen also remains questionable until a proper prior imaging assessment. TVS has emerged as a useful modality for localization and detection of underlying structural abnormalities.

TVS showed a good sensitivity for diagnosing benign lesions which was found to be 93% and for diagnosis of malignant lesions the sensitivity came out to be appropriate 59% and specificity 93.75%. It can be used as a tool of interest for diagnosing life threatening malignant lesions early.

5. Conclusion

With a sensitivity and specificity of 59 % 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. Transvaginal probes provide high-resolution images of the pelvic organs, providing reliable and reproducible information. The study provided TVS imaging features for early identification, characterization, and extent of uterine pathologies, as well as relevant information for clinicians to make reasonable decisions. TVS showed a good sensitivity for diagnosing benign lesions which was found to be 93% and for diagnosis of malignant lesions the sensitivity came out to be appropriate 59% and specificity 93.75%. It can be used as a tool of interest for diagnosing life threatening malignant lesions early.

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