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# Evaluation of the Accuracy of Transvaginal Colour Doppler Sonography and Its Correlation with Histopathology in Abnormal Uterine Bleeding - An Observational Study

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**Abstract:** ***Introduction: Abnormal uterine bleeding is one of the most common condition for which women of any reproductive age consult their gynaecologists.[1] Virtually every woman will, at some point in her life, experience episodes of bleeding that can be perceived as abnormal. Transvaginal ultrasound with colour doppler is a simple, feasible, minimally invasive, cost effective method which can be used as the first step in evaluation of AUB. Material and Method: It was an observational type of study in which 70 patients of 40yrs of age or above with abnormal uterine bleeding attending Gynaecology OPD in obstetrics and gynaecology dept. at SMS Medical college, Jaipur from April 2016 till July 2017 were included. TVS-Colour Doppler was done in the selected women and data were correlated with final histological diagnosis. Result: By adding Doppler to Transvaginal sonograghic study, the diagnostic performance was improved to sensitivity of 92.84% and specificity of 96.13% in benign condition and sensivity and specificity of 100% in malignant conditions. Color Doppler was able to differentiate between hyperplasia with or without atypia seen in 7 and 14 women respectively. Color Doppler was also helpful in blood flow mapping of different intrauterine lesions. Conclusion: In order to reduce invasive procedures and increase the efficacy of Transvaginal sonography, color Doppler of the genital vessels i.e. uterine atery and endometrial spiral arteries with vascular impedence improves the sensitivity and specificity of TVS for the prediction of endometrial pathologies.***

**Keywords:** TVS colour doppler, histopathology

## 1. Introduction

Abnormal uterine bleeding is one of the most common condition for which women of any reproductive age consult their gynaecologists.[1] Virtually every woman will, at some point in her life, experience episodes of bleeding that can be perceived as abnormal. As it is well known that Indian culture tend to “medicalize” menstruation so, a correct diagnosis is essential because of the consequences of abnormal bleeding and the implications of its treatment.

AUB is an overarching term used to describe any departure from normal menstruation or from a normal menstrual cycle pattern (FIGO2011).[2] It is further divided based on volume of menstruation, frequency, regularity, duration, chronicity and timing related to reproductive status. Perimenopausal period in a woman’s lifetime marks a transition from reproductive phase to that of menopause. It includes the period immediate prior to menopause and the first year after menopause. The physiological and endocrinological changes that occur during this period makes the menstrual cycles more and more anovulatory.

As a consequence, abnormal uterine bleeding (AUB) is a common complaint in this age group accounting for 33% of patients attending gynecologic outpatient departments. These complaints may significantly affect quality of life result in time off work, lead to surgical intervention and ultimately have significant impact on the health care system[3].

With the marked increase in obesity, diabetes mellitus and metabolic syndrome, the incidence of endometrial carcinoma is increasing. Today endometrial carcinoma is the most common gynecologic malignancy in the United States and the incidence is expected to rises worldwide[4]. Hence the need for prompt diagnosis is only reaffirmed.

Although several invasive and non-invasive methods like dilatation and curettage, hysteroscopy, transvaginal sonography (TVS) and colour Doppler have been proved to be clinically useful for early detection of endometrial abnormality in women with AUB[5,6], still there is insufficient data for the diagnostic accuracies of all modalities.

Transvaginal ultrasound with colour doppler is a simple, feasible, minimally invasive, cost effective method which can be used as the first step in evaluation of AUB. Transvaginal route has greatly improved image resolution due to the proximity of probe to the endometrium. It effectively allows detection of abnormal endometrium as well as intracavitory lesions.

## 2. Aim and Objective

To evaluate the diagnostic accuracy of transvaginal colour doppler sonography in patients with abnormal uterine bleeding and to correlate with histopathological findings.

## 3. Material and Method

It was an observational type of study in which all patients of 40yrs of age or above with abnormal uterine bleeding attending Gynaecology OPD in obstetrics and gynaecology dept. at SMS Medical college, Jaipur from April 2016 till July 2017 were included. Selection of 70 women was done according to inclusion and exclusion criteria after informed and written consent.

**Selection Criteria**

Inclusion Criteria:Women of 40years and more presenting with abnormal uterine bleeding after informed and written consent. Exclusion Criteria:Women on hormone replacement therapy, Women with breast cancer on tamoxifen, Pregnancy and pregnancy related diseases, Visible cervical or vaginal growth, Atrophic vaginitis, Pelvic inflammatory diseases.

Detailed history, general and systematic examination, routine blood investigations was done. All eligible patients were subjected to transvaginal sonography (tvs) equipped with colour doppler. All women were examined transvaginally with 5 MHz transvaginal transducer. Transverse and longitudinal sections were obtained and maximal endometrial thickness in sagittal plane was measured (double layer). After completion of grey-scale USG, COLOR DOPPLER USG was carried out in same seating. The endometrial and subendometrial areas were seen and blood vessels were observed. Only blood vessels that were within 5mm from endometrial edge were included. And the spiral arteries blood flow resistance index (RI) and pulsitility index (PI) were measured. The bilateral ascending uterine artery was then examined in cervico-corporal section of the uterus, laterally from cervix and RI, PI were measured by one observer to eliminate inter-observer variation. Colour visualization of angiogenesis at endometrial level will also be preformed. The ratios (indices) of the resistance of blood flow (impedance) were calculated.

The ultrasound data were correlated with final histological diagnosis which was obtained by dilatation and curettage (D&C) or office aspiration biopsy or by hysterectomy.

## 4. Results

Data was calculated as Mean ± SD. Categorical data was compared using the chi-square test and student t- test. Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were calculated for Transvaginal Colour Doppler.

**Table 1:** Demographic characteristics of the study population

| | Perimenopausal (n = 58) | Postmenopausal (n = 7) |
|---|---|---|
| Mean Age (years) | 47.16±4.364 | 64.50±7.268 |
| Range (years) | 40 - 55 | 40 - 78 |
| Parity | 3.5 ± 1.5 | 3.5 ± 1.76 |
| Mean BMI (kg/m²) | 24.65±4.709 | 25.39±5.330 |

Demographic characteristics of the study population are shown in the table above. The mean age of premenopausal women presenting with AUB was 47.16±4.364 years & of post-menopausal women was 64.50±7.268 years. The mean age for women with benign and malignant changes of the endometrium was 49.94±8.438 years and 54.54±8.024years respectively (p value <0.1016). The above table depicts that the obese patients was more common in pre-menopausal & post-menopausal women as compare to normal BMI. The multiparous women were more common in both group as compare to primiparous women in both group.

**Feldman S. et al** (1995) reported that the median age at diagnosis of cancer is the sixth decade, although 20 to 25 percent of cases will be diagnosed premenopausally.[7] A study done by **Astrup K et al**[8] found that the proportion of women with irregular cycles increased from 58.3% at age 45-46 years to 100% at age 53-54 years (P < 0.001).**Pascual A. et al**[9] showed that mean age of the patients with abnormal uterine bleeding was 44+10.6 year (23–73).

**Ferrazzi et al.**[10] reported that the risk of endometrial cancer increased with increasing body mass index.

**Table 2:** Endometrial thickness in TVS- Color Doppler Findings

| **Endomet--rial Thickness** | **normal** | **polyp** | **fibroid** | **Adenom--osis** | **Hyperplasia** | | **cancer** | **total** |
|---|---|---|---|---|---|---|---|---|
| | | | | | Without atypia | With atypia | | |
| | | benign | | | | Malignant | | |
| Premenopausal | 7.09±5.722 | 8.01±3209 | 7.60±5.68 | 9.33±9.23 | 11.54±7.07 | 12.87±8.48 | 18.50±6.36 | 58 |
| Postmenopausal | 4.833±4.365 | 5.60 | 0 | 0 | 9.54±4.90 | 12 | 13.00±16.46 | 12 |
| overall | | | | | | | | 70 |

The above table depicts that the abnormal endometrial thickness was seen in 39 cases in pre-menopausal and 5 cases in post menopausal women. The mean endometrial thickness in premenopausal age group and postmenopausal age group was 7.09±5.722 and 4.833±4.365 respectively. The mean endometrial thickness in benign conditions in premenopausal women and postmenopausal women came out to be 7.120±4.239 and 4.383±3.434. In malignant conditions it came out to be 14.11±8.268 in premenopausal women and 12.75±13.45 in postmenopausal women.

**Goldstein et al**[11] showed high incidence of abnormalities of the endometrium at a thickness of ≥8 mm in perimenopausal and ≥5 mm in postmenopausal women whereas no pathology is underdiagnosed when a cut off limit of 5 mm is used[14] **Dragojevic S et al** (2005)[12] found Significant statistical difference in the endometrial thickness was established between groups I and II, and endometrial cancer was not found in less than 8 mm thick endometrium. **Karlsson B et al**[13] showed the mean endometrial thickness of malignant lesions was significantly higher than that of benign lesions

**Table 3:** Diagnosis in TVS- Color Doppler Findings

| Diagnosis | pre-menopausal (N=58) | post-menopausal (N=12) |
|---|---|---|
| Normal | 24 (41.37%) | 2 (16.66%) |
| Adenomyosis | 3 (5.17%) | 0 (0%) |
| Fibroid | 5 (8.62%) | 0 (0%) |
| Endometrial polyp | 5 (8.62%) | 1 (8.33%) |
| Atropic | 1 (1.72%) | 3 (25%) |
| Hyperplasia with atypia | 7 (12%) | 1 (8.33%) |
| Hyperplasia without atypia | 11 (18.96%) | 2 (16.66%) |
| Endometrial cancer | 2 (3.44%) | 3 (25%) |

The above table depicts that the hyperplasia without atypia most commonly occurred in both group, followed by hyperplasia with atypia, fibroid & endometrial polyp (7 & 5 cases each respectively) in pre-menopausal group and 3 cases of endometrial cancer was seen in postmenopausal women.

**Table 4:** Velocimetric parameters in uterine artery according to histology

| Pathology | Pulsatility index (mean± SD) | Resistance index (mean± SD) |
|---|---|---|
| Benign | | |
| Adenomyosis | 1.067± 0.030 | 0.9233± 0.0152 |
| Fibroid | 0.9240± 0.019 | 0.6360± 0.040 |
| Endometrial polyp | 0.9917± 0.070 | 0.6933± 0.021 |
| Hyperplasia without atypia | 1.271 ± 0.055 | 0.7869±0.063 |
| Overall | 1.186 ± 0.012 | 0.8743 ± 0.012 |
| Malignant | | |
| Hyperplasia with atypia | 0.8210 ± 0.029 | 0.5410 ± 0.076 |
| Endometrial cancer | 0.4062±0.2080 | 0.3308±0.1109 |
| Overall | 0.5868±0.2629 | 0.4311±0.1716 |

The mean value of pulsatility index was higher (1.271 ±0.055) in hyperplasia without atypia followed by adenomyosis (1.067± 0.030) & endometrial polyp (0.9917± 0.070) and in endometrial cancer was 0.4062±0.2080 in uterine artery.The mean value of resistance index was more in adenomyosis (0.9233± 0.0152) followed by hyperplasia without atypia (0.7869±0.063) and in endometrial cancer was 0.3308±0.1109 in uterine artery.

**Velocimetric parameters in spiral artery according to histology (table no.5)**

The mean value of pulsatility index was higher (0.9754±0.0925) in hyperplasia without atypia followed by adenomyosis (0.87± 0.010) & endometrial polyp (0.8533± 0.026) and in endometrial cancer was 0.5162±0.056 in spiral artery.The mean value of resistance index was more in hyperplasia without atypia (0.6769±0.0184) followed by adenomyosis (0.6300± 0.010) and in endometrial cancer was 0.3585±0.1072 in spiral artery.

**Table 5**

| Pathology | Pulsatility index (mean± SD) | Resistance index (mean± SD) |
|---|---|---|
| Benign | | |
| Adenomyosis | 0.87± 0.010 | 0.6300± 0.010 |
| Fibroid | 0.7960± 0.024 | 0.5780± 0.014 |
| Endometrial polyp | 0.8533± 0.026 | 0.6083± 0.023 |
| Hyperplasia without atypia | 0.9754±0.0925 | 0.6769±0.0184 |
| Overall | 0.8607 ± 0.67 | 0.6498 ± 0.078 |
| Carcinoma | | |
| Hyperplasia with atypia | 0.6231 ± 0.012 | 0.5427 ± 0.098 |
| Endometrial cancer | 0.5162±0.056 | 0.3585±0.1072 |
| Overall | 0.5603±0.1735 | 0.4830±0.1064 |

**Bourne and colleagues**[14] published a study in which color and pulsed Doppler modalities were used to detect endometrial cancer in postmenopausal women. **Kupesic et al**[15] found that the blood flow analysis showed significantly lower ($p<0.05$) resistance (RI=0.37) in the cases of endometrial cancer than in patients with benign uterine cavity lesions (RI=0.54). **Aleem et al**[16] concluded that color Doppler technique can be used for accurate differentiation between benign and possibly malignant endometrial findings.

**Blood Flow Pattern of Endometrial Vessels on TVS-CD**

In our study, different vascular patterns were seen according to the color Doppler flow mapping:

FIG1.Single vessel pattern was seen in all cases of endometrial polyp

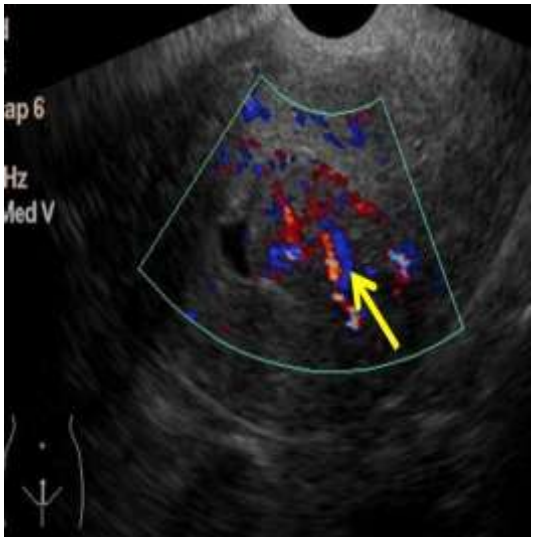

**Figure 1**

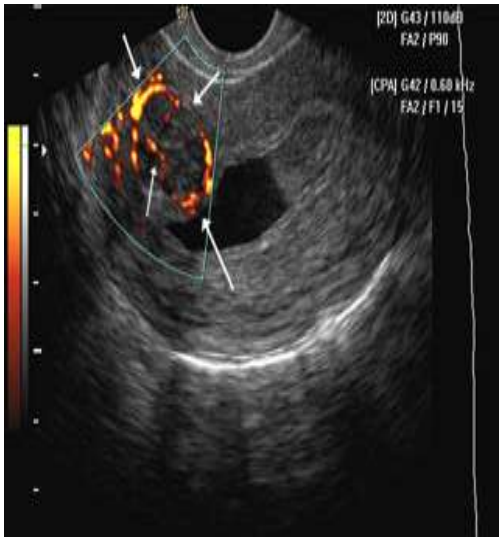

**Figure 2:** Peripheral vascular Rim was seen in 3 out of 4 cases of uterine fibroid. (75%).

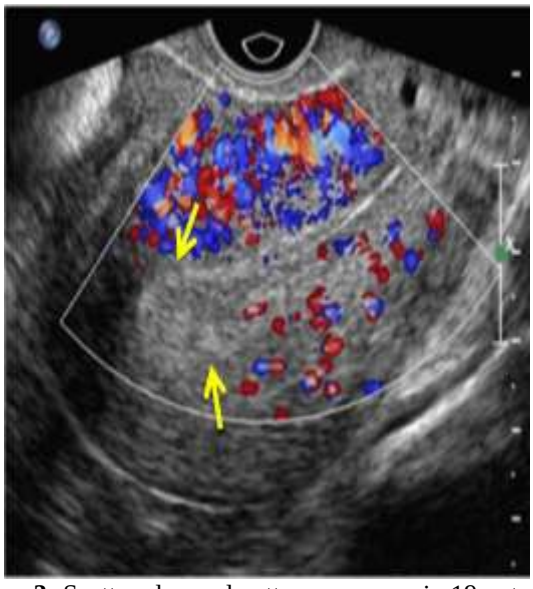

**Figure 3:** Scattered vessel pattern was seen in 19 out of 22 cases of hyperplasia (86.36%)

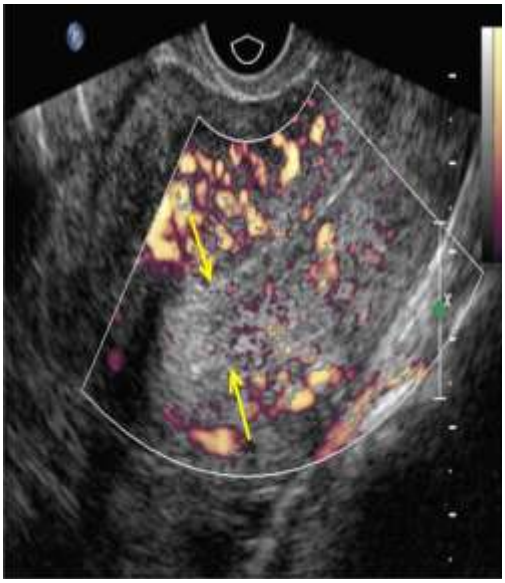

**Figure 4:** Multiple-vessel pattern was seen in all cases of endometrial cancer.

Blood flow mapping on power Doppler is a valuable tool in the diagnosis of focal endometrial pathology and is useful in distinguishing submucosal fibroids from endometrial polyps and can also be used to discriminate endometrial carcinoma from other benign pathological processes.

**Table 6:** Diagnostic performance of TVS-Colour Doppler findings

| Diagnosis on Histopathology | TVS- Colour Doppler Findings | | | |
|---|---|---|---|---|
| | Sensitivity | Specificity | PPV | NPV |
| Hyperplasia with atypia | 95.83% | 54.34% | 52.27% | 96.15% |
| Hyperplasia without atypia | 81.25% | 74.19% | 61.90% | 88.46% |
| Endometrial polyp | 71.42% | 96% | 83.33% | 92.30% |
| Fibroid | 66.66% | 96% | 80% | 92.30% |
| Atropic | 60% | 96% | 75% | 92.30% |
| Adenomyosis | 33.33% | 92.30% | 33.33% | 92.30% |
| Endometrial cancer | 100% | 100% | 100% | 100% |

The diagnostic performance of TVS-color Doppler was as follows: Sensitivity, specificity in hyperplasia with atypia was 95.83%, 54.34% respectively, in hyperplasia without atypia was 81.25%, 74.19% respectively, in endometrial polyp was 71.42% & 96% respectively, in fibroid was 66.66% & 96% respectively, in atropic was 60% & 96% respectively, in adenomyosis was 33.33% & 92.30% respectively and endometrial cancer was 100% & 100% respectively.

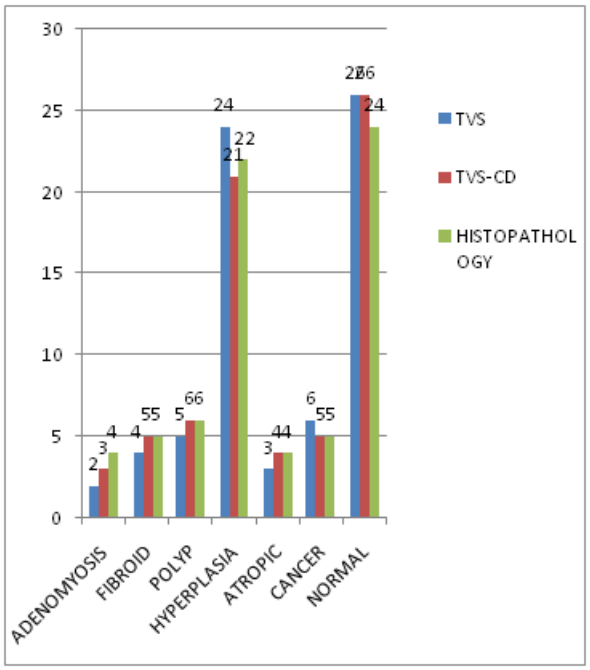


**Figure 5:** Correlation of findings of TVS, TVCD and HISTOPATHOLOGY

On TVS, normal endometrium was seen in 26 women, hyperplasia in 24, endometrial polyp in five, uterine fibroid in four, adenomyosis in two, atropy in 3 and endometrial carcinoma in 6 women. By adding Doppler study the diagnostic performance was improved as fibroid were seen in five women, polyp in six women, adenomyosis in three women, cancer in five women. Color Doppler was able to differentiate between hyperplasia with or without atypia seen in 7 and 14 women respectively.

**Conoscenti G et al**[17] showed in his study that TVS-CD showed sensitivity, specificity, PPV and NPV of 69.3%, 82.7%, 74.1% and 72.1% respectively. **Smith P et al**[18] reported a good agreement between histology and Doppler ultrasound at endometrial thickness ≥8 mm where sensitivity, specificity, PPV and NPV were 67%, 75%, 14% and 97% respectively. **Fedele et al**[19] demonstrated the sensitivity and specificity of TVS-CD for the diagnosis of submucosal fibroids to be 100% and 94%, respectively. **S.Q. Rashid et al**[20] observed that in Doppler studies a high vascularity score yielded high sensitivity (100%) but a low positive predictive value (PPV; 19%). Considering only the presence of marked central vascularity achieved a sensitivity of 88% and a specificity of 96% with a 44% PPV.

## 5. Conclusion

Differentiating benign endometrial pathologies from carcinoma is a very important subject in cases of abnormal uterine bleeding as it is crucial in changing the management plan. Previously diagnosis of uterine bleeding directly depended on the histopathological examination of the bioptic sample. But it involved invasive techniques and discomfort to the diseased. Therefore, need of the hour is to find a modality which is highly efficient in differentiating benign from malignant condition and limiting the need of invasive diagnostic procedures. The first intention screening method for endometrial alterations in perimenopausal women with AUB is Transvaginal sonography. Still, TVS alone is not a reliable method for making a diagnosis.

In order to reduce invasive procedures and increase the efficacy of Transvaginal sonography, color Doppler of the genital vessels i.e. uterine atery and endometrial spiral arteries with vascular impedence improves the sensitivity and specificity of TVS for the prediction of endometrial pathologies.Since there is no added expense to the procedure, can be done in same sitting and is more accurate than TVS, the algorithmic approach for managing women with AUB should be changed by including TVS-Color Doppler as first line diagnostic method.

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