

Transvaginal Colour Doppler Ultrasound Study of Uterine Tumours with Histopathological Correlation

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Abstract

A cross-sectional study was conducted in the Department of Radiology & Imaging, in collaboration with the Department of Obstetrics & Gynaecology, in Dhaka Medical College Hospital and Bangabandhu Sheikh Mujib Medical University Hospital, Dhaka, Bangladesh, between July 2010 and March 2012, to evaluate the diagnostic usefulness of transvaginal color doppler ultrasonography (TVCDU) in differentiating benign and malignant uterine tumours. A total of fifty women, diagnosed as having uterine tumours both clinically and using ultrasound, participated in the study. They were evaluated preoperatively using TVCDU. All the study participants underwent surgical operation and resected specimens were sent for histopathological examination. Histopathology reports were correlated with the of colour Doppler findings. The mean age of the patients was 47.72±8.79 years. Major complaints were menorrhagia (58%), dysmenorrhoea (50%) and lump in the lower abdomen (48%). Neovascularization was found in 16(32%) cases. The mean resistance index and pulsatility index were much lower in malignant tumours than that of the benign counterpart (0.35±0.03 vs. 0.67±0.01 and 0.65±0.14 vs. 1.35±0.11 respectively); the difference was statistically significant (P<0.001). The sensitivity, specificity, positive and negative predictive values of TVCDU were found 86.7%, 97.14%, 92.85% and 94.4% respectively. Overall diagnostic accuracy was 94%. To summarize, blood flow characteristics of benign and malignant uterine tumours, as evident on color Doppler imaging, have distinct diagnostic value. Hence, transvaginal colour Doppler ultrasound examination can be used as an easily available, efficient, and non-invasive diagnostic modality in differentiation of uterine tumours, which can be histologically confirmed later.

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Introduction

With the advent of transvaginal ultrasonography, a new dimension has been added to the diagnostic modalities of many gynecological disorders and their treatment. Due to near proximity of the vaginal probe to the genital organs and using high frequencies, it is now possible to study the detail of anatomy of the uterus.¹⁻³ Transvaginal sonography can identify and characterize the uterine tumours; however, benign, and malignant lesions cannot be well differentiated by the technique.³ Superimposing color and pulsed Doppler ultrasound might be an alternative safe diagnostic method. Application of color Doppler ultrasound in addition to gray-scale imaging helps physicians differentiate benign from malignant uterine masses.³⁻⁶

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Properly conducted transvaginal ultrasonography with color Doppler allow physicians to survey the body and the cervix and evaluate both any structural distortion as well as blood flow related events.⁶⁻⁸ Over years, this technique has become quick, simple, painless and less expensive method of investigation. It is also easy for the patients who are obese or cannot fill the bladder well.⁹

However, to our knowledge, the importance of transvaginal colour and pulsed Doppler sonogram as a non-invasive diagnostic tool for differentiation of uterine tumours has not been studied in our country to date. Moreover, the reliability of this imaging technique for risk estimation of uterine malignancy remains to be determined. Hence, we proposed this study to evaluate the diagnostic usefulness of transvaginal color Doppler ultrasonography (TVCDU) in differentiating benign and malignant uterine tumours, which may help to reduce invasive procedures such as dilation and curettage (D&C) or hysteroscopy with considerable reduction of both the morbidity of patients and economic costs.

Methods

This cross-sectional study was conducted in the Department of Radiology & Imaging, in collaboration with the Department of Obstetrics & Gynaecology, in Dhaka Medical College Hospital and Bangabandhu Sheikh Mujib Medical University Hospital, Dhaka, Bangladesh, between July 2010 and March 2012. After meeting all inclusion and exclusion criteria, a total of fifty women participated in the study.

Inclusion Criteria:

- 1) Patients between 30 and 70 years, who were clinically suspected cases of uterine tumours;
- 2) Diagnosed uterine tumours using per abdominal ultrasound procedure; and
- 3) Patients who agreed to undergo further evaluation using transvaginal color Doppler ultrasonography (TVCDU) and surgical operation.

Exclusion criteria:

- 1) Unmarried;
- 2) Age below 30 and above 70 years;
- 3) Inoperable uterine tumours;
- 4) Patient who refused to perform TVCDU; and
- 5) Obstetric cause of vaginal bleeding or any history of bleeding other than uterine cause.

Then, they were evaluated preoperatively using transvaginal colour Doppler ultrasonography (TVCDU). We used Siemens Sonoline (3-10MHz), gray scale and color doppler (with power) sonography at 7.5 MHz frequency, curvilinear transvaginal transducers of 7.5 MHz frequencies. We observed meticulously for any neovascularization; the newly formed capillary blood vessels from pre-existing microvessels are obligatory event of malignant tumours.¹⁰ (Fig. 1) However, vascularization of benign uterine tumours is supported by normal existing vessels.^{10,11}

Besides, two indices of waveform analysis were done. They are the resistance index (RI) (also known as the Porcelot index) and the pulsatility index (PI) (also known as the Gosling index).¹¹ They are independent of the beam/vessel angle (although obtaining a good quality doppler trace from which to make the measurement does require a beam/vessel angle of <60°). Any uterine tumour was considered malignant if RI value was

<0.4, and PI value was <1.0.^{12,13} (Fig. 2). All the study participants underwent surgical operation and resected specimens were sent for histopathological examination. Histopathology reports were correlated with the of color doppler findings.

Data of quantitative variables were expressed as Mean±SD and qualitative variables as percentage. Data were analyzed using SPSS (Statistical Package for Social Science) version 13.0. Comparison was done by unpaired Student t-test. P value <0.05 was considered as statistically significant. The study was approved by the Ethics Review Committee of Bangladesh College of Physicians and Surgeons (BCPS), Dhaka, Bangladesh.

Results

The mean age of the patients was 47.72±8.79 years; all were between 36 and 50 years. Major complaints were menorrhagia (58%), dysmenorrhoea (50%) and lump in the lower abdomen (48%) (Table-I). Transvaginal color Doppler ultrasound (TVCDU) demonstrated neovascularization in 16(32%) women (Table-II, Fig 1). The mean resistance index was much lower in malignant tumours than that of the benign group (0.35±0.03 vs. 0.67±0.01), where the difference was statistically significant (P<0.001). Similarly, pulsatility index was also found lower much lower in malignant tumours than that of the benign counterpart (0.65±0.14 vs. 1.35±0.11), and the difference was statistically significant (P<0.001) (Table-III, Fig. 2). Out of those 50 cases, 36(72%) were found benign, while 14(28%) were diagnosed as malignant, by using transvaginal colour doppler ultrasonography. However, later 35(70%) were found benign and 15(30%) came out malignant

on histopathological examination (Table-IV). The sensitivity, specificity, positive and negative predictive values of the transvaginal colour Doppler ultrasonography were found 86.7%, 97.14%, 92.85% and 94.4% respectively. Overall diagnostic accuracy was found 94% (Table-V).

Table-I: Distribution of patients according to clinical features (n=50*)

Clinical Presentation	Frequency	Percentage
Menorrhagia	29	58
Dysmenorrhoea	25	50
Lump in the lower abdomen	24	48
Urinary Symptoms	23	46
Pain in the lower abdomen	20	40
Irregular per vaginal bleeding	19	38
Anorexia	7	14
Weight loss	6	12

*Total will not correspond to 100% as symptoms vary in individual patients.

Table-II: Detection of neovascularization by colour Doppler study (n=50)

Neovascularization	Type of uterine tumour		Total
	Benign	Malignant	
Present	03	13	16 (32%)
Absent	33	01	34 (68%)
Total	36	14	50 (100%)

Figures in the parentheses indicate percentage.

Table-III: Comparison between mean Resistance Index (RI) and Pulsatility Index (PI) in patients diagnosed as benign and malignant by TVCDU

Variables	Benign (n=36)	Malignant (n=14)	P value
Resistance Index	0.67±0.01 (0.65-0.70)	0.35±0.03 (0.29-0.39)	<0.001 ^S
Pulsatility Index	1.35±0.11 (1.15-1.55)	0.65±0.14 (0.46-0.89)	<0.001 ^S

Data expressed as Mean±SD, figures in the parentheses indicate range; P value reached from unpaired Student t-test, S=significant.

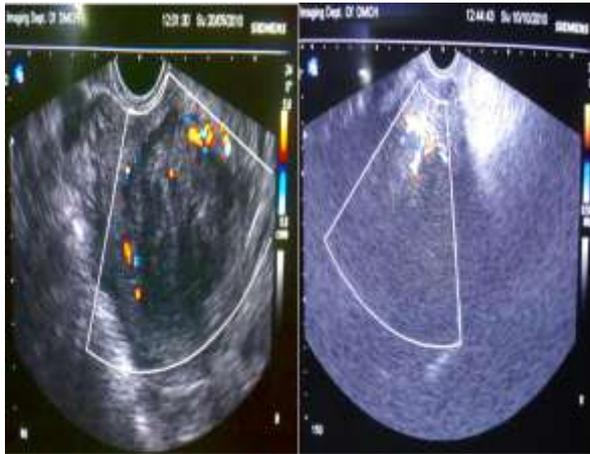


Fig.1: From left: TVCDU showing (a) benign uterine tumour where neovascularization is peripheral, and (b) malignant uterine tumour with neovascularization.



Fig. 2: TVCDU showing malignant uterine tumour with RI value 0.36 and PI value 0.46.

Table-IV: Comparison of uterine tumours by TVCDU

Diagnosis by transvaginal colour doppler ultrasonography	Histopathological diagnosis		Total
	Positive for malignancy	Negative for malignancy	
Positive for malignancy	13 (True positive)	01 (False positive)	14
Negative for malignancy	2 (False negative)	34 (True negative)	36
Total	15	35	50

Table-V: Sensitivity, Specificity, Accuracy, Positive and Negative Predictive Values of TVCDU

Validity Test	Percentage
Sensitivity	86.7
Specificity	97.14
Accuracy	94
Positive predictive value	92.85
Negative predictive value	94.44

Discussion

In the present study, the most common presenting symptoms were menorrhagia (58%), dysmenorrhea (50%) and lump in the lower abdomen (48%). Similar observations regarding clinical presentations of uterine tumours were described by Kumar & Malhotra and Weston.^{14,15}

Blood flow studies help radiologists distinguish between benign and malignant uterine lesions^{10,11} Kurjak *et al.*¹² used TVCUD and spectral analysis to differentiate between malignant and benign uterine tumours. Abnormal blood flow patterns were noted in almost all cases of endometrial adenocarcinoma (RI=0.34±0.05) and uterine sarcoma (RI=0.31±0.03). The typical finding was the presence of irregular, thin, randomly dispersed vessels, while the vascularization of benign uterine masses was supported by normal existing vessels, i.e. in uterine myomas (RI=0.58±0.12) and adenomyosis (RI=0.67±0.14). Hata *et al.*¹⁰ discriminated cervical carcinoma and endometrial carcinoma from uterine myoma; out of 7 patients with cervical carcinoma, neovascularization was found in 6 patients, which were found adjacent to and/or within the endometrium. However, those findings were absent in normal women and in patients with myoma. Similarly, Kupesic-Urek *et al.*² also found neovascularization in all patients with endometrial cancer. The blood flow analysis showed a significantly lower resistance

index (RI=0.37±0.07) in the cases of endometrial cancer than in patients with benign uterine lesions (RI=0.54±0.09). Sawicki *et al.*¹⁶ determined the location and intensity of angiogenesis as well as selected blood flow parameters by transvaginal color doppler in endometrial cancer. Low impedance (RI=0.38) and high velocity flow (20.45±9.6 cm/sec) were found in 88.9% cases.

Carter *et al.*¹⁷ showed that transvaginal color doppler sonography offers 83% sensitivity, 100% specificity, 100% positive predictive value (PPV) and 89% negative predictive value (NPV) in prediction of malignant uterine tumours, while Kurjak *et al.*¹⁸ reported 90.91% sensitivity, 99.82% specificity, 71.43% PPV, 99.96% NPV. In another study, Ruangvutilert *et al.*¹⁹ evaluated the accuracy of transvaginal ultrasound which yielded a sensitivity of 69.4%, specificity of 70.6%, PPV of 53.2%, NPV of 82.8%, with an accuracy of 70.3%. The results of the present study are in concordance with that of the previous studies.

Conclusion

To summarize, transvaginal colour doppler ultrasound (TVCDU) examination is an easily available, efficient, and non-invasive diagnostic modality for pre-operative differentiation of malignant and non-malignant uterine tumours. Hence, it is expected that using this method beside clinical examination will be helpful to diagnose a uterine malignancy and facilitate in decision making in gynaecological surgery and thereby, decreasing morbidity and mortality.

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