Original Article

Diagnostic Accuracy of Color and Spectral Doppler in Identifying Endometrial Cancer in Post-Menopausal Menometrorrhagial Patients with Histopathology as Gold Standard

Muhammad Ahmad Raza[1]*, Sana Habib[2], Bushra Akmal Khan[3], Laamia Altuf[4], Saima Arshad[5], Iqra Mussarat[1], Sidra Ghazanfar[6]

[1]MSDU- University Institute of Radiological Science & MIT, University of Lahore-Lahore, Pakistan.
[2]Sonographer- Al-Hadi Medical Complex Bhakkar, Pakistan.
[3]Department- Hayatabad Medical Complex Peshawar, Pakistan.
[4]Department of Radiological Science & MIT, Superior University Lahore, Pakistan.
[5]Lecturer-Radiology- National Conservation Strategy Institute of Sciences Islamabad, Pakistan.
[6]BSMUT- University Institute of Radiological Science & MIT, University of Lahore-Lahore, Pakistan.
Corresponding Author: Muhammad Ahmad Raza; Email: dr.ahmad663@gmail.com
Note: Muhammad Ahmad Raza & Sana Habib both have equal contribution.
Conflict of Interest: None.

ABSTRACT

Background: Endometrial cancer is the most common gynecological malignancy in postmenopausal women, often presenting with postmenopausal hemorrhage. Traditional diagnostic methods are invasive, prompting the need for less intrusive, accurate alternatives.

Objective: To evaluate the efficacy of Doppler ultrasonography in diagnosing endometrial cancer in postmenopausal women presenting with hemorrhage, using histopathology as the gold standard.

Methods: This cross-sectional study was conducted at the University of Lahore Teaching Hospital from September 2023 to March 2024, involving 140 postmenopausal women. Participants underwent transvaginal and transabdominal ultrasonography, including color and spectral Doppler assessments. Doppler findings were compared with histopathological outcomes following biopsy.

Results: Doppler ultrasonography demonstrated a sensitivity of 78.63%, specificity of 65.22%, positive predictive value of 92.00%, negative predictive value of 37.50%, and overall diagnostic accuracy of 76.43%. Stratification analysis further indicated that the accuracy exceeded 90% in detecting endometrial cancer.

Conclusion: Doppler ultrasonography is a valuable non-invasive diagnostic tool for detecting endometrial cancer in postmenopausal women with hemorrhage. It offers high sensitivity and specificity, reducing the necessity for invasive diagnostic procedures.

Keywords: Doppler Ultrasonography, Endometrial Cancer, Non-invasive Diagnosis, Postmenopausal Hemorrhage, Sensitivity, Specificity, Ultrasonography.

INTRODUCTION

Endometrial cancer is the most prevalent gynecologic malignancy in the Western world. Although the majority of patients are diagnosed at an early stage, leading to favorable prognoses, approximately 20% of cases involve high-grade carcinoma, characterized by a prolonged disease course and poor outcomes (1). The predominant symptom in these cases is irregular vaginal bleeding, a condition that significantly impacts postmenopausal women. While 90% of women with endometrial cancer initially present with postmenopausal bleeding, only 5% to 10% of women experiencing such bleeding are ultimately diagnosed with endometrial cancer (2). Additionally, endometrial cancer can occasionally be diagnosed incidentally during the evaluation of a thickened endometrial line found in hysterectomy specimens intended for benign conditions or via imaging studies conducted for other purposes. Postmenopausal bleeding, defined as vaginal bleeding that occurs twelve months after cessation of the menstrual cycle, is a common clinical presentation, accounting for about 10% of all gynecological complaints. Of these cases, 10% are diagnosed as cancerous (3, 4). The differential diagnosis for postmenopausal bleeding is extensive, including endometrial cancer, cervical inflammation, cervical

cancer, vaginal atrophy, vaginal cancer, foreign bodies, radiation-induced vaginal inflammation, estrogen-secreting ovarian tumors, use of antiplatelet medications, high blood pressure, and bleeding from the urethra or gastrointestinal tract due to various etiologies (5). Hormone replacement therapy, using medications like progesterone and estrogen, may also induce postmenopausal bleeding. Atrophic vaginitis and atrophic endometritis are among the most common causes of bleeding post-menopause, but endometrial cancer remains a primary concern and must be thoroughly investigated (6). Of patients presenting with postmenopausal bleeding, 36% are found to have some form of cancer, with endometrial cancer making up about 28% of these cases (7).

Histopathology remains the gold standard for the definitive diagnosis of endometrial cancer, typically requiring invasive procedures such as dilatation and curettage. However, these procedures are not without risk and can be distressing for the patient. Therefore, less invasive methods are desirable for raising the suspicion of cancer or, at minimum, stratifying the risk of malignancy in symptomatic individuals. Doppler ultrasonography has been explored as such an alternative. Studies have shown that cancerous tissues in the uterus are often associated with increased blood flow and decreased resistance in the organ's blood vessels, such as a spiral artery resistive index (RI) less than 0.7 indicating a high suspicion of malignancy (8). One local study reported that Doppler ultrasonography had a sensitivity of 86.96% and a specificity of 90.7% in detecting endometrial abnormalities (8). Other research has demonstrated varied degrees of sensitivity, specificity, and predictive values, indicating a potential role for this technology in clinical practice (9, 10).

The objective of this study is to evaluate the diagnostic accuracy of Color and Spectral Doppler ultrasonography in identifying endometrial cancer among postmenopausal women presenting with menometrorrhagia, using histopathology as the reference standard. This noninvasive approach could potentially spare many patients from the discomfort and risks associated with more invasive diagnostic procedures.

METHODS

Between September 2023 and March 2024, a cross-sectional study was conducted at the radiology departments of the University of Lahore Teaching Hospital, Lahore, to evaluate the diagnostic accuracy of transvaginal and transabdominal ultrasonography in detecting endometrial cancer among postmenopausal women presenting with hemorrhage. A total of 140 women referred to the Radiology department were enrolled in the study after obtaining informed consent.

Each participant underwent a comprehensive pelvic ultrasound examination, which included capturing images of a full bladder along with spectral and color Doppler data. The ultrasound examinations were performed using a Logic P/6 3D machine by a qualified radiologist who assessed the blood flow in the spiral artery, recording the resistive index (RI) values. For comparative purposes, a typical waveform for a normal spiral and iliac artery, indicating an RI value over 0.7, was documented and is displayed in Figure 1.

Following the ultrasound examination, women who met the study criteria underwent biopsy procedures, and the obtained tissues were sent for histopathological analysis. The inclusion criteria ensured that participants did not use hormone replacement therapy, intrauterine contraceptives, and did not have a history of bleeding disorders, chronic liver disease, or significant vaginal trauma.

Data collection was systematic, with each patient's profile including age, duration of menopause, marital status, parity, and initial ultrasonographic findings regarding uterine anomalies being recorded on a structured proforma. The statistical analysis was performed using SPSS version 17. Key statistical measures such as sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy of Doppler ultrasonography were calculated using a contingency table, with histopathology serving as the gold standard for confirming the presence of endometrial cancer. This methodological approach allowed for a thorough evaluation of the non-invasive diagnostic tool in comparison to the definitive histopathological findings.
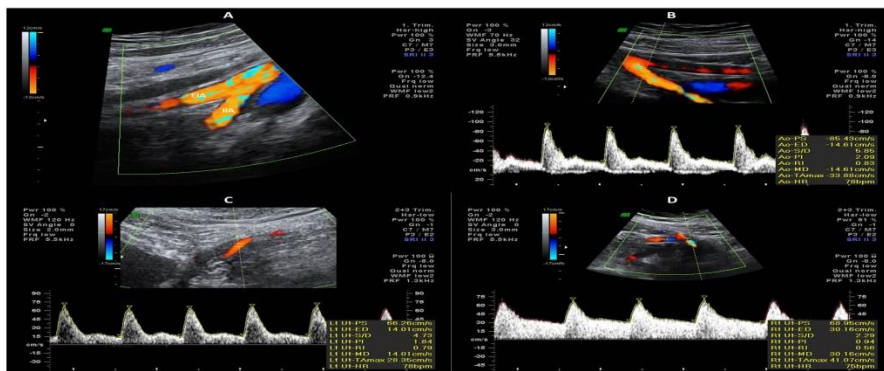

Figure 1 Normal waveform of Spiral and iliac artery

RESULTS

The study included 140 women who had experienced postmenopausal hemorrhage. The age distribution of the participants is detailed in Table 1, with an average age of 51.68 years and a standard deviation of 9.38 years. The average duration of symptoms reported was 2.13 years with a standard deviation of 0.98 years, as shown in Table 2. The marital status of the participants revealed

that 27 (19.29%) were single and 113 (80.71%) were married, as depicted in Figure 2.

In terms of parity, the majority of married women had between one and two children (Table 4). The diagnostic capabilities of Doppler ultrasonography in detecting endometrial carcinoma were assessed, with results detailed in Table 5 and illustrated in Figure 3. Color and spectral Doppler ultrasonography demonstrated a sensitivity of 78.63%, a specificity of 65.22%, a positive predictive value of 92.00%, a negative predictive value of 37.50%, and an overall accuracy of 76.43% in predicting endometrial cancer in women with postmenopausal hemorrhage. Stratification analysis further revealed that, in individuals with postmenopausal bleeding, the accuracy of color and spectral Doppler ultrasonography in identifying endometrial cancer exceeded 90%.

Post-stratification, a contingency table was utilized to calculate the sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy of color Doppler ultrasonography in the detection of endometrial carcinoma.

Figure 4 showcases a significant lesion within the endometrial canal of a woman who presented with postmenopausal bleeding. The corresponding spiral artery Doppler for the same patient is displayed in Figure 5, where RI values below 0.7 suggested a high likelihood of malignancy. Subsequent histopathological examination confirmed the presence of endometrial cancer in this patient.

Table 1: Age distribution of patients

Age Distribution	<50 years old	90 (64.28%)
	>50 years old	50 (35.71%)

Table 2: Descriptive statistics of patients

Statistics	Age (years)	Symptoms duration
Mean	51.68	2.13
St.Deviation	9.38	0.98
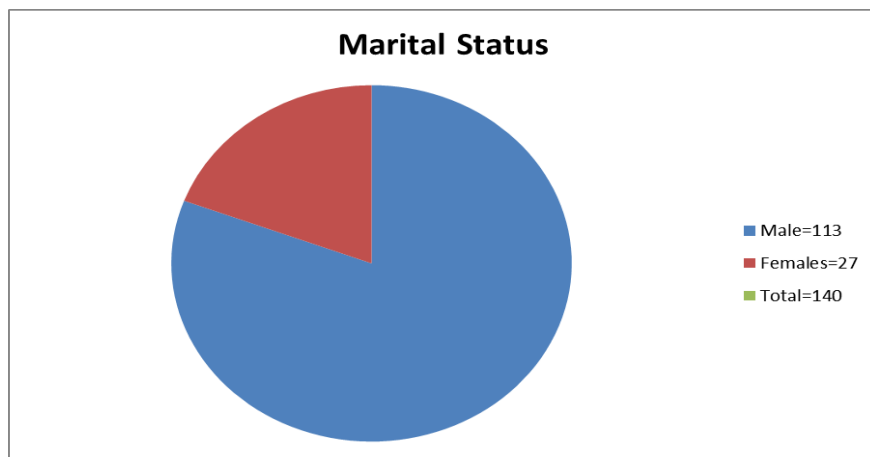
Figure 2 Marital Status Chart

Table 4: Parity status of the patients n=140

Parity Status	No Parity	31 (22.14%)
	1-2	85 (60.71%)
	>2	24 (17.14%)

Table 5: USG prediction with statistical values

Color Doppler USG	Endometrial cancer on Histopathology		Total
	Positive	Negative	
Positive	92 (TP)	8 (FP)	100
Negative	25 (FN)	15 (TN)	40

Total	117	23	140
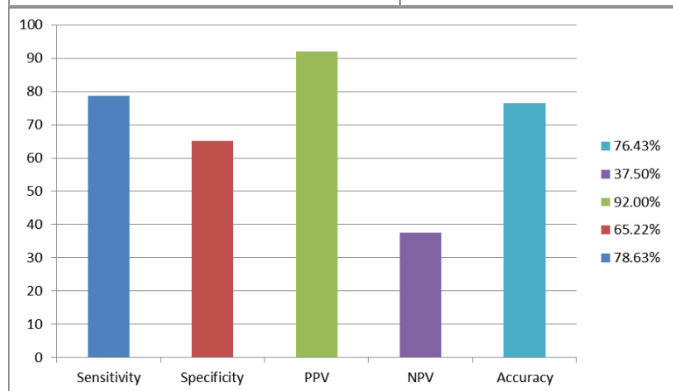
Figure 3 Statistical Measurements of Diagnostic Accuracy

Legend: 76.43%, 37.50%, 92.00%, 65.22%, 78.63%

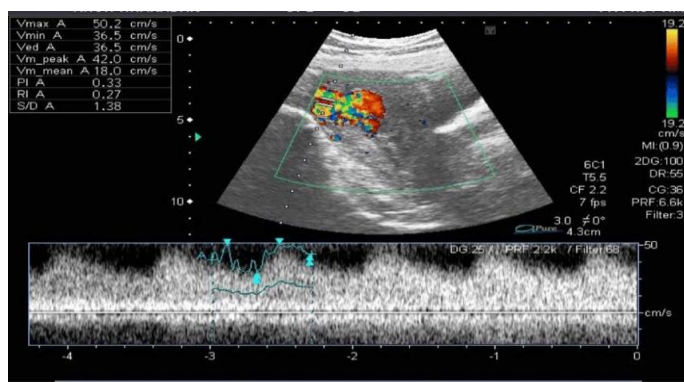Figure 4 USG pelvis with lesion within uterine canal

Figure 5 Doppler of spiral arteries obtained from the same patient as shown in figure 4

DISCUSSION

Endometrial carcinoma remains the most common cancer affecting the female pelvis. According to the Surveillance Epidemiology and End Results database, the incidence of this cancer increases significantly with age, from 2.3 per 100,000 among women aged 30 to 34, to 36.2 per 100,000 among those aged 40 to 49 (11, 12). Given the high stakes, any postmenopausal bleeding in women not on hormone replacement therapy is considered indicative of cancer until proven otherwise. Historically, endometrial curettage has been a common intervention since its inception in 1843, used widely for diagnosing uterine conditions. Despite its prevalence, limitations were evident as early as the 1950s when an analysis of 6907 curettage surgeries showed a 10% miss rate for detecting endometrial lesions, primarily polyps (13-15).

In the 1970s, the introduction of vacuum-suction curettage devices, such as the Vabra aspirator from Berkeley Medical, significantly improved the patient experience by eliminating the need for anesthesia (16). More recently, devices like the Pipelle have become popular due to their minimal discomfort and lower costs, showing comparable effectiveness to the Vabra aspirator in diagnosing endometrial conditions (16). Transvaginal sonography has since emerged as a first-line investigative tool for women with postmenopausal bleeding, given its cost-effectiveness and ability to assess endometrial carcinoma reliably when the endometrial thickness is above 5mm (17). However, the nonspecific nature of a thickened endometrium often necessitates further testing through methods like sonohysterography or endometrial office biopsy (17).

Research comparing diagnostic tools has highlighted that postmenopausal women have higher detection rates for endometrial cancer compared to premenopausal women, with the Pipelle device showing the highest sensitivity (18). This study's findings resonate with those of Shazia Batool from CMH Lahore, demonstrating a sensitivity, specificity, positive predictive value, and negative predictive value that align closely with previous studies (9). Similarly, Mahmoud El-Morsi Aboul-Fotouh's study supports the utility of transvaginal power Doppler sonography in distinguishing benign from malignant endometrial conditions in women experiencing postmenopausal hemorrhage, with significant predictive values (22).

The current study corroborates findings from Alcazar et al., who reported high diagnostic values for the power Doppler vascular pattern in detecting endometrial cancer (17). Variability in results across studies can be attributed to differences in ultrasonography equipment, settings, and operator experience, underscoring the need for standardized diagnostic criteria and technology in ultrasonographic evaluations.

While Doppler ultrasonography presents a non-invasive and effective alternative for diagnosing endometrial conditions, its use is not without limitations. The modality relies heavily on the operator's skill and the quality of the equipment, which can lead to variability in diagnostic accuracy. Moreover, while the method is less invasive than traditional surgical approaches, it cannot definitively diagnose all types of endometrial pathology, necessitating follow-up procedures in ambiguous cases.

The strengths of the study include the use of a well-defined, homogeneous study population and standardized imaging protocols which enhance the reliability of the findings. However, the study is limited by its single-center design, which may not fully represent

broader demographic variations. Additionally, the interpretation of Doppler ultrasonography is subjective and depends heavily on the technician's expertise, which could influence the study's reproducibility in different settings.

In conclusion, while Doppler ultrasonography has shown promising results in the identification of endometrial cancer in women with postmenopausal bleeding, it should be viewed as part of a comprehensive diagnostic strategy. Continued advancements in imaging technology and techniques, coupled with standardized training for operators, are crucial for improving the diagnostic accuracy and reliability of this method.

CONCLUSION

Doppler ultrasonography demonstrates high sensitivity, specificity, positive predictive value, and negative predictive value, making it a reliable diagnostic tool for identifying endometrial cancer in women presenting with postmenopausal hemorrhage. This non-invasive method can effectively distinguish between benign and malignant endometrial conditions, thereby reducing the need for more invasive procedures. By integrating Doppler ultrasonography into the diagnostic pathway, healthcare providers can offer a safer and more comfortable experience for patients, potentially leading to earlier and more accurate detection of endometrial cancer, which is crucial for effective treatment and improved patient outcomes.

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Raza MA., et al. (2024). 4(2): DOI: https://doi.org/10.61919/jhrr.v4i2.930

Journal of Health
and Rehabilitation
Research 2791-156X
JHRR

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