The Journal of Obstetrics and Gynecology of India (March–April 2025) 75 (Suppl 1):S62–S69
https://doi.org/10.1007/s13224-024-01993-7

ORIGINAL ARTICLE

Optimal Timing of Transvaginal Ultrasound to Diagnose Endometrial Polyps in Women with Abnormal Uterine Bleeding

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Received: 21 January 2024 / Accepted: 29 April 2024 / Published online: 14 June 2024

Abstract

Introduction Abnormal uterine bleeding (AUB) is the most common symptom of the endometrial polyps in fertile and postmenopausal women. This study aimed to determine the optimal time to perform a transvaginal ultrasound to diagnose endometrial polyps in the women with abnormal uterine bleeding (AUB).

Method This descriptive study from the category of a follow-up study was conducted on 350 a group of fertile women with AUB that referred to a women's clinic in Jahrom, Southern Iran. The women with abnormal uterine bleeding at the women's clinic underwent transvaginal sonography. The research included patients who had endometrial polyps discovered during the sonography. Transvaginal sonography was performed on each patient once in the luteal and once in the follicular phases. A hysteroscopy was then conducted in order to get an accurate diagnosis. The collected data were analyzed using SPSS software version 18. The receiver operating characteristic (ROC) curve was used to determine the optimal time to perform the ultrasound to diagnose endometrial polyps.

Results Among the women in the study, 88.8% (310 participants) were multiparous, and endometrial polyps were detected in 47.4% (166 patients) with the transvaginal sonography of the women. Finally, endometrial polyps were confirmed for 107 patients (64.45%) with hysteroscopy. ROC curve analysis showed that the optimal time to diagnose the endometrial polyps with transvaginal ultrasound was on days 11–13 of the menstrual cycle during the follicular phase, with a sensitivity of 82.5% and a specificity of 73%.

Conclusions By designating days 11–13 of the follicular phase of the menstrual cycle as the ideal time to utilize transvaginal ultrasound for the purpose of diagnosing endometrial lesions, it is possible to reduce errors and enhance the accessibility of treatment and diagnosis. This study provides essential information for clinicians to identify the endometrial polyps in the women with AUB.

Keywords Endometrial polyps · Transvaginal ultrasound · Fertile women · Timing · Diagnosis

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Abbreviations

AUB	Abnormal uterine bleeding
SPSS	Statistical Package for the Social Sciences
ROC curve	Receiver operating characteristic curve
TVS	Transvaginal ultrasound
PPV	Positive predictive value
NPV	Negative predictive value
AUC	Area under the curve
D&C	Dilatation and curettage
SIS	Saline infusion sonography

Introduction

Endometrial polyps are a common issue among women, characterized by the excessive growth of endometrial glands and stroma [1]. While they typically occur in the premenopausal, lifestyle changes and poor dietary habits have led to their occurrence in young women, causing significant problems. Although these polyps are often asymptomatic, they can cause complications, such as bleeding among the menstrual cycles, bleeding after menopause, infertility, and abortion in approximately a quarter of women [2].

Abnormal uterine bleeding (AUB) is the most common symptom of endometrial polyps in the fertile and postmenopausal women [1, 3]. The prevalence of endometrial polyps varies depending on the population studied [4, 5]. They are diagnosed in 24–41% of women with AUB and 10% asymptomatic women [6]. The prevalence of endometrial polyps is higher in infertile women, with the studies reporting rates as high as 40–50% [7]. However, it is relatively rare in women under 20 [6].

Although endometrial polyps are usually benign, they can rarely become cancerous, with the prevalence of malignancy caused by endometrial polyps ranging from 0.8 to 8%, depending on the size of examined sample, and the resection method used [8–10].

While the precise cause of endometrial polyps remains unknown, it is hypothesized that an estrogen hormone imbalance within the body contributes to their development and proliferation. The infrequent identification of endometrial lesions prior to menarche suggests that estrogenic stimulation of the endometrium is a significant contributor to their development [11, 12]. Several risk factors were identified for the development of endometrial polyps, including age, high blood pressure, obesity, and using the tamoxifen [11]. Among these risk factors, age is the most well-known and established risk factor for developing endometrial polyps [12].

There are different ways to diagnose the endometrial polyps. Hysteroscopy, diagnostic curettage, transvaginal ultrasound, ultrasound with saline injection, and hysterosalpingography are among these methods [1]. One of the test for diagnosing endometrial polyps is the diagnostic hysteroscopy, compared to non-invasive techniques. It has the maximum sensitivity and specificity [13–15]; other method is transvaginal ultrasound as a primary diagnostic method in terms of the invasive nature, and cost is associated with hysteroscopy [16].

Polypectomy can be an effective treatment option to improve the fertility in infertile women with endometrial polyps, with success rates ranging from 40 to 80% [7]. Different studies have reported various recurrence rates of endometrial polyps, ranging from 2.5 to 43.6% in premenopausal women and lower rates in postmenopausal women [17–19].

The increasing utilization of transvaginal ultrasound has facilitated the diagnosis of endometrial polyps [20]. However, the timing of transvaginal ultrasound within the menstrual cycle is crucial for optimal detection. Studies comparing transvaginal ultrasound to hysteroscopy have reported varying levels of sensitivity, specificity, positive predictive value, and negative predictive value, underscoring the importance of timing [21, 22].

In the proliferative phase, the endometrium also grows and its thickness increases simultaneously with the growth of the ovarian follicle. It starts from the 6th day of menstruation and continues until the 14th day of menstruation. So that on day 7–8 of the menstrual cycle, the thickness of the endometrium reaches a significant level. The cause of this stage is the effect of estrogen on the glands and cells of the endometrium and the increase in the blood flow of the functional layer. In the late proliferative phase around ovulation, the endometrium develops three layers (a trilaminar or striated appearance) measuring 6–10 mm and measuring 10–13 mm at the time of ovulation: an outer echogenic basal layer, a Median hypoechoic function, and an internal echogenic band in the central interface, possibly caused by edema and the activity of the secretory glands of this face. Therefore, considering the three layers and the transparency of the endometrial layers, endometrial polyps and any other lesion can be seen clearly [23].

The rationale for timing transvaginal ultrasound (TVS) during the follicular phase is crucial for enhancing the detection of endometrial polyps. By aligning TVS with the physiological changes of the menstrual cycle, particularly during the proliferative phase, clinicians can optimize diagnostic sensitivity, accuracy, and patient outcomes when evaluating abnormal uterine bleeding and endometrial pathology. This strategic timing allows for improved visualization and detection of endometrial polyps, emphasizing the importance of early and precise identification of these lesions to enhance clinical management and patient care [24, 25].

This study aims to elucidate the rationale behind the timing of transvaginal ultrasound for endometrial polyp diagnosis, providing valuable insights for clinicians and researchers in the field.

Materials and Method

Study Design

This descriptive study from the category of a follow-up study was conducted on 350 fertile women with AUB (at the time of the study) referred to a women's clinic in Jahrom, Southern Iran. Moreover, the menstrual cycle characteristics of these women were regular before the occurrence of AUB, and they did not show any symptoms of irregular bleeding or spotting. After the event of polyps, they experienced regular bleeding, raising suspicion of endometrial polyps.

The sample size was calculated based on $P = 0.5$, alpha $= 0.05$, and margin of error $= 0.052$. The participants were selected using a convenience sampling method.

Women with abnormal uterine bleeding (AUB) underwent transvaginal sonography at the Women's Clinic. The research included patients who were diagnosed with endometrial polyps during the sonography. Every patient received transvaginal sonography once during the follicular phase and once during the luteal phase. Following that, a hysteroscopy was conducted to get an accurate diagnosis. The justification for repeating sonography in the proliferative and secretory phases after the suspicion of endometrial polyps in the initial sonography is as follows: Before 11th and after the 13th day of the menstrual cycle, specifically during the initial proliferative phase (early), and the luteal phase, whenever a hyper-echoic pattern was observed, the suspicion of endometrial polyps arose. Patients were advised to return for their next cycle between days 11 and 13 of the menstrual cycle.

At that time, sonography was performed, and when the diagnosis of endometrial polyps was confirmed, the patient underwent hysteroscopic surgery.

Sonographic Evaluation Process for Endometrial Polyps

To ascertain the presence of endometrial lesions, the subsequent procedures were executed utilizing transvaginal ultrasonography (TVS). By utilizing a methodical approach, the critical significance of sonographic indicators was underscored. To ensure a thorough evaluation, a comprehensive checklist was recommended for each patient, encompassing the assessment of following sonographic signs:

The visualization of an echogenic lesion within the endometrial cavity.

The identification of interrupted mucosa sign.

The evaluation of focal endometrial thickening.

The recognition of bright edge sign.

The visualization of a peduncle.

The assessment of the presence of endometrial fluid surrounding the polyp.

The identification of a feeding vessel, characterized as a vascular signal renowned for its high specificity in diagnosing the endometrial polyps.

Subsequently, an exhaustive checklist was meticulously compiled for each patient, documenting the presence or absence of each aforementioned sign. The frequency of these sonographic signs across all TVS examinations conducted in the study was quantified. The next study focused on figuring out each sign's sensitivity and specificity while taking the ultrasound operations' timing into account. Additionally, the focus was on determining which indication became more noticeable on the particular day that the article indicated as the best day to find endometrial polyps. The optimal time for the imaging to reduce the false positive and false negative results is on the 10th day of the menstrual cycle when the endometrium is at its thinnest. When it comes to diagnosing endometrial polyps, TVUS was shown to have a sensitivity of 19–96%, specificity of 53–100%, positive predictive value (PPV) of 75–100%, and negative predictive value (NPV) of 87–97% [26].

Participants

The inclusion criteria for the study required that the participants of reproductive age with AUB were diagnosed with endometrial polyps via TVS and expressed personal consent to participate. Furthermore, the participants were required to be Iranian, native, and residing in Jahrom to facilitate follow-up. Exclusion criteria included incomplete questionnaires, dissatisfaction with participating in the research, myoma, pregnancy, polycystic ovary syndrome, adenomyosis, and other causes of AUB.

Data Collection

Women presenting to the women's clinic with anomalous uterine hemorrhage were examined via transvaginal sonography. The study enrolled patients who had been sonographically diagnosed with endometrial lesions, contingent upon the acquisition of informed consent, and strict adherence to ethical principles to safeguard the confidentiality of their information. Each patient underwent transvaginal sonography once during the follicular phase, and once during the luteal phase, with both sets of results being accurately recorded in the corresponding medical form.

In transvaginal sonography, endometrial polyps may appear as hyper-echoic lesions or a focal mass surrounded by hyper-echoic halos. However, they may sometimes be identified as localized thickening in the endometrial canal.

Subsequently, a hysteroscopy was performed to attain a precise diagnosis. In post-hysteroscopy, the patients were regularly monitored via the transvaginal sonography to track polyp recurrence and determine the initial polyp diagnosis's specific phase (follicular or luteal) based on the sonography results conducted before the hysteroscopy. We conducted recurrence assessments for every 6 months up to 18 months.

Statistical Analysis

Descriptive statistics were used to summarize the data and calculate measures of central tendency, such as the mean, and measures of dispersion, such as the standard deviation. Frequency indices were calculated to determine the distribution of various variables among the study participants. Furthermore, the receiver operating characteristic (ROC) curve was used to determine the optimal time to perform an ultrasound to diagnose endometrial polyps. To ascertain the test's overall accuracy, this required plotting the sensitivity against the 1-specificity of the test results at various thresholds and calculating the area under the curve (AUC). ROC curve analysis helped identify the best time to perform an ultrasound, which can aid in the timely diagnosis, and treatment of endometrial polyps. All statistical analyses were performed using SPSS version 18 software, and a significance level of 0.05 was considered for all tests.

Table 1 Description of demographic variables in participating women

Variable	Mean	Standard deviation
Age (years)	40.03	5.9
Height (cm)	158.83	69.5
Weight (kg)	66.40	61.9
Body mass index	26.36	85.3
Endometrial thickness	9.3	5.9
Endometrial polyp size	8.4	4.8

Results

The participants' mean age and body mass index (BMI) were 40.03 ± 5.9 years and 26.36 ± 3.85. The average polyp thickness and size were 5.9 ± 9.3 and 12.48 ± 4.86, respectively (Table 1). Of the women in the study, 88.8% (310 participants) were multiparous, and endometrial polyps were detected in 47.4% (166 participants) of the women, and frequency symptoms included spotting (19.1%) and abnormal vaginal bleeding (10.6%). Finally, among 166 patients referred for hysteroscopy, endometrial polyps were confirmed for 107 patients (64.45%) (Table 2).

In order to ascertain the most effective time for transvaginal sonography (TVS) to identify clear endometrial lesions with three layers, the receiver operating characteristic (ROC) curve was utilized to examine TVS timing in conjunction with triple-layered endometrium visualization. ROC analysis identified the 11–13th day of the menstrual cycle as the best time for detecting polyps, with a sensitivity of 82.5% and specificity of 73%. An area under the curve (AUC) value of 0.841 highlighted the test's efficacy in identifying health status (Fig. 1a).

Optimal thresholds to detect the clear triple-layered endometrium were established regarding endometrial parameters. An endometrial thickness over 8 mm showed a sensitivity of 63.6% and specificity of 44.6%, with an AUC of 0.561, indicating moderate proficiency to distinguish healthy and

Table 2 Description of background variables in participating women

Variable		Frequency	Percentage (%)
Symptoms	Vaginal bleeding	37	10.6
	Spotting	67	19.1
	Menstrual pain	30	8.6
	Infection	7	2.0
	Oligomenorrhea	9	2.6
	Polymenorrhea	6	1.7
	Hypermenorrhea	8	2.3
	Menstrual Irregularity	8	2.3
	Abdominal pain	9	2.6
	Lower back pain	14	4.0
	Diabetes	4	1.1
	Heart problems	5	1.4
	Rheumatism	2	0.6
Pregnancy characteristics	1	40	11.2
	2	182	52.0
	3	105	30.33
	4	23	6.47
Polyp count	Single	327	93.4
	Multiple	23	6.6
Endometrial Observation	Yes	166	47.0
	No	18	5.2

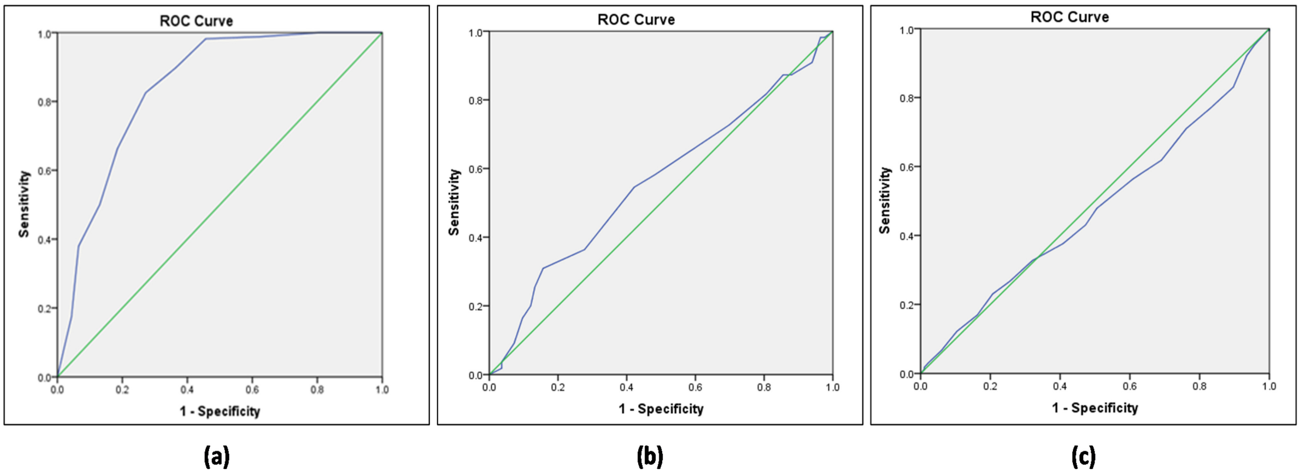

Fig. 1 ROC curves illustrating the optimal parameters for detecting the clear triple-layered endometrial polyps: **a** timing of transvaginal sonography, **b** endometrial thickness, and **c** polyp size. ROC analysis reveals the sensitivities and specificities associated with each parameter's ability to detect endometrial polyps accurately

affected subjects (Fig. 1b). Similarly, concerning endometrial polyp size, a size greater than 9 mm yielded a sensitivity of 61.8% and specificity of 31.0%, supported by an AUC of 0.476 (Fig. 1c).

Pre-treatment endometrial thickness measured 8 mm in all women, increasing to 9-mm post-treatment. Vaginal bleeding frequency associated with the endometrial polyps significantly shifted post-treatment, with an improvement rate of 97.9% (Fig. 2). The clinic provided information regarding the recurrence rates of polyps subsequent to polypectomy, in addition to drug-related and post-treatment surgical complications, among fertile women who visited.

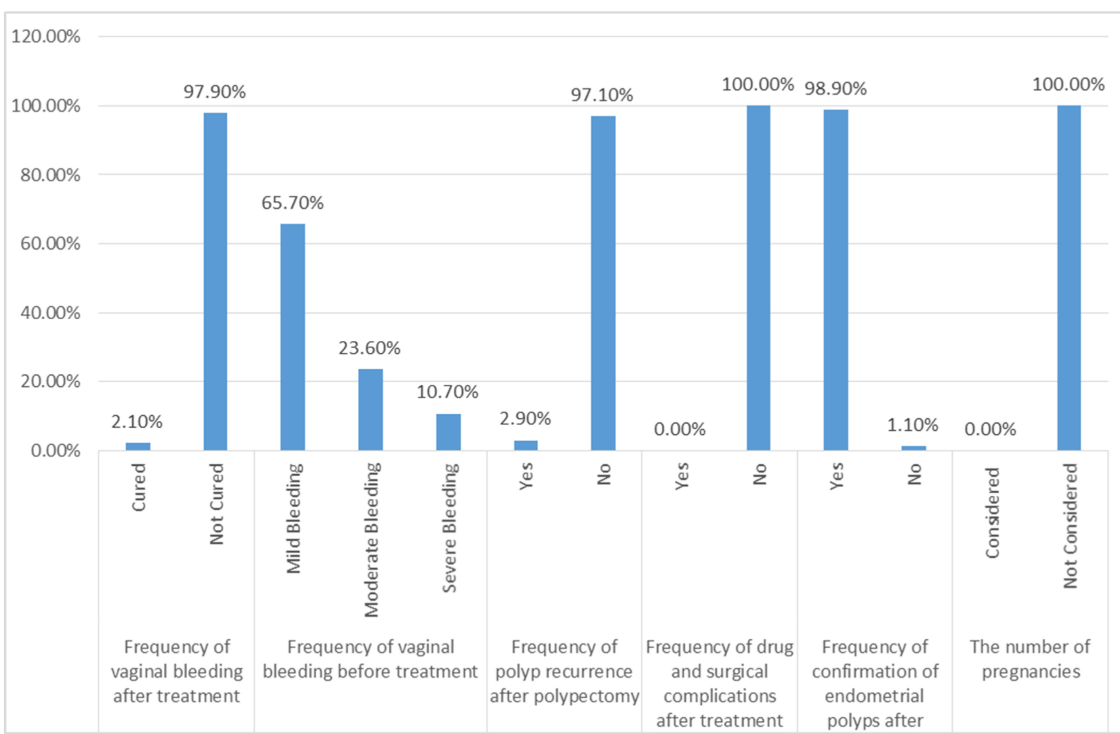

Fig. 2 Comprehensive insights into endometrial polyp characteristics and treatment outcomes in the fertile women: frequency of vaginal bleeding before and after treatment, polyp recurrence, treatment complications, confirmation rate after hysteroscopy, and pregnancy incidences at the women's clinic in Jahrom city

A recurrence of polyps was identified in 2.9% of reproductive women subsequent to polypectomy; however, no complications were reported in relation to drug-related or surgical interventions (Fig. 2). A recurrence took place 1 year later. Hysteroscopy confirmed endometrial polyps in 98.9% of fertile women attending the clinic (Fig. 2).

Discussion

This study showed that endometrial polyps are a common finding in the women with abnormal vaginal bleeding, and transvaginal ultrasound is an effective method for their diagnosis. Our research indicates that the optimal timing for conducting a transvaginal ultrasound to identify a three-layer and transparent endometrium, which is a sign of endometrial polyps, is between day 11 and 13 of the menstrual cycle, specifically during the follicular phase. This method has a sensitivity of 82.5% and a specificity of 73%. AUC value of 0.841 indicates that the test correctly identifies healthy and sick people. During this period, in terms of the peak estrogen levels, the endometrium is three-layered and transparent, providing a reliable indication of the presence of endometrial polyps.

During the menstrual and early proliferative phase, the endometrium undergoes characteristic changes in appearance and thickness. A thin, bright echogenic band forms from the basal layer, typically measuring 1–4 mm thick. Minimal fluid may be present in the endometrial cavity during the menstrual phase, making it challenging to identify endometrial polyps clearly [23].

In the proliferative phase, stimulated by estrogen, the endometrium thickens, reaching a significant level around days 7–8 of the menstrual cycle. This growth corresponds with the increase in ovarian follicle size. As ovulation approaches, typically around day 14, the endometrium develops a trilaminar appearance, with distinct layers visible on TVS. This trilaminar pattern facilitates clear visualization of endometrial polyps and other lesions. During the secretory phase, following ovulation, the endometrium becomes uniformly echogenic due to edema and increased vascularity of the functional layer. This phase, which lasts from approximately day 14 until the end of the cycle, poses challenges in distinguishing endometrial polyps from normal endometrial changes [24, 25].

Based on results of this study, we recommend performing TVS for diagnosing endometrial polyps between days 11 and 13 of the menstrual cycle. During this window, the endometrium exhibits optimal characteristics for clear visualization of polyps while minimizing the potential for misinterpretation due to cyclical changes.

Our findings suggest that the optimal thickness of the endometrium for diagnosing polyps is above 8 mm, while the optimal size of the polyp is above 9 mm.

This study's findings are consistent with those of previous research. For example, Mirzaeian et al. found that combining D&C and transvaginal ultrasound is necessary to accurately diagnose endometrial polyps with thicknesses less than 8 mm [20]. Similarly, the study by Zhu et al. highlighted the high sensitivity and specificity of transvaginal ultrasound for diagnosing endometrial polyps, suggesting it as an initial diagnostic method to select patients for hysteroscopy [16].

In general, these studies provide further evidence of the effectiveness of transvaginal ultrasound and other related diagnostic methods in accurately diagnosing endometrial polyps and other gynecological conditions.

The study by Niknejadi et al. [27] supports the findings of this study, as it highlights the cost-effectiveness and the accuracy of transvaginal ultrasound in diagnosing intrauterine lesions, such as polyps, submucosal, and septal fibroids. Researchers found that transvaginal ultrasonography improved surgical planning and execution by accurately identifying and describing intrauterine anomalies, making it a useful adjunct to hysteroscopy. The usefulness of transvaginal ultrasonography in detecting uterine anomalies is a common thread across these research. While previous studies showed the effectiveness of transvaginal ultrasound as a diagnostic method [28], the present study is unique in its focus on determining the optimal timing of transvaginal ultrasound for the diagnosis of endometrial polyps. By identifying the most effective timing for ultrasound during the menstrual cycle, this study provides important insights that can help to further optimize the accuracy of diagnosis and the treatment for women with endometrial polyps.

Limitations and Strengths of the Study

While the present study provides valuable insights into diagnosing endometrial polyps, it is essential to acknowledge its limitations. Firstly, the study only included women with a history of abnormal vaginal bleeding, which may limit the generalizability of the findings to the broader population. Furthermore, the study did not evaluate the accuracy of other diagnostic methods, such as hysteroscopy or endometrial biopsy, which could limit the comparison of different diagnostic techniques' relative strengths and weaknesses. Furthermore, the study did not account for the factors, such as age, hormonal status, or use of hormonal medications, which could affect the appearance of the endometrium and the accuracy of transvaginal ultrasound to diagnose endometrial polyps.

However, the study had several notable strengths. It is used a standardized diagnostic method (transvaginal ultrasound) and evaluated the accuracy of this method at different times in the menstrual cycle and for different endometrial thicknesses and polyp sizes. The research gave precise suggestions for the ideal time of transvaginal ultrasonography for identifying endometrial polyps, which doctors may find useful in their practice.

Conclusion

Based on the findings of this study, conducting the transvaginal ultrasound to detect endometrial polyps between 11 and 13th days of the menstrual cycle in the follicular phase is likely the most effective approach. During this period, in terms of the peak estrogen levels, the endometrium is three-layered and transparent, providing a reliable indication of the presence of endometrial polyps. Our results also show that the ideal size of the polyp is above 9 mm, and the ideal thickness of the endometrium is above 8 mm for polyp diagnosis. When patients have atypical vaginal bleeding, these findings may aid doctors in determining the best time to perform transvaginal ultrasounds and in interpreting the data to diagnose endometrial polyps.

Acknowledgements The present study was conducted as part of a Medical Doctor thesis at Jahrom University of Medical Sciences, which studied the optimal timing of transvaginal ultrasound to diagnose endometrial polyps. We want to express our gratitude to all the participants who participated in the study, and the Vice President of Health at Jahrom University of Medical Sciences for their valuable support and assistance in conducting the research. Their contributions were greatly appreciated and instrumental in completing this study.

Author Contributions AR and TKH were involved in the study design and planning. MA and MJ conducted the literature search and screening. AR and TKH were responsible for data collection, while VR participated in the statistical analysis. AR, TKH, and MA contributed to data interpretation. The manuscript was drafted by VR, MJ, and AR, with VR critically revising the manuscript. All authors have read and approved the final manuscript for publication. VR had full access to all data in this study and took complete responsibility for the integrity, and accuracy of the data analysis.

Funding We acknowledge that the Research Deputy of Jahrom University of Medical Sciences, Iran, funded this study. The Research Deputy's financial assistance did not, it is imperative to stress, have any impact on the study's design, data collection, analysis, or interpretation. The study Deputy provided just financial assistance and was not involved in any part of the study process. The study findings and results were solely based on the data collected and analyzed by the research team and were not influenced by external factors.

Data Availability The authors recognize that the article contains the necessary data to support the findings presented in this research.

Declarations

Conflict of interest The authors declare that they have no competing interests.

Ethical Approval Before the start of the study, all participants were fully informed about the aim of the research, and the details of their involvement were explained to them. Participants were assured that the researcher would keep their personal information confidential. The study was conducted with the approval of the Vice Chancellor for Research of Jahrom University of Medical Sciences (Ethical Code IR.JUMS.REC.1396.077), and written informed consent was obtained from all participants.

Consent for Publication Not applicable.

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