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Correlation Between Adnexal Masses and Endometrial Thickness Measured with Ultrasound in Adult Women

Original Article

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ABSTRACT

Objective:
To determine the correlation between adnexal masses and endometrial thickness measured by ultrasound in adult women, emphasizing diagnostic implications and clinical outcomes.

Methods:
A cross-sectional analytical study was conducted over six months at Al Nusrat Clinic and Akbar Memorial Hospital, Sadiqabad, involving 90 adult women selected through convenience sampling. High-resolution transvaginal ultrasonography (TVUS) evaluated endometrial thickness and adnexal masses. Statistical analyses included Chi-square tests, Pearson, and Spearman correlations, with significance set at $p<0.05$.

Results:
The study demonstrated significant clinical correlations. All women (100%) exhibiting increased endometrial thickness concurrently presented adnexal masses ($p<0.001$), underscoring a strong association. Symptoms such as vaginal bleeding and vaginal discharge were notably higher (40% each) among women with adnexal masses. Pelvic pain (28.9%), painful urination (26.7%), and pelvic inflammatory disease (PID, 22.2%) also showed increased frequencies compared to those without masses. Solid adnexal masses presented the highest mean size (12.73 mm) and strongest correlation with endometrial thickness ($r=0.804$, $p<0.001$). Moderate correlations were observed for cystic ($r=0.652$, $p=0.008$) and complex ($r=0.645$, $p=0.044$) masses.

Conclusion:
The significant correlation between adnexal masses and increased endometrial thickness highlights the diagnostic importance of routine ultrasound evaluations in gynecological practice. Solid and complex masses exhibit the strongest associations, indicating that thicker endometrial linings could reliably predict underlying adnexal pathology. Integrating endometrial thickness assessment with symptomatic evaluation can enhance diagnostic accuracy, promote timely interventions, and improve patient management in clinical gynecology.

Introduction:

The correlation between adnexal masses and endometrial thickness in adult women represents a critical area of study within gynecological health, particularly concerning reproductive functions and malignancies. Adnexal masses, which include ovarian cysts, tumors, and other growths in the adnexa, may impact the endometrium—the inner lining of the uterus—exerting effects on its morphology and thickness. The significance of assessing this correlation stems from its relevance in fertility, abnormal uterine bleeding, and early detection of malignancies in women [12,] . Ultrasound, particularly transvaginal sonography (TVS), is a non-invasive imaging modality widely utilized to evaluate both adnexal masses and endometrial characteristics, allowing clinicians to make informed diagnostic and therapeutic decisions based on the physiological state of the reproductive organs [3, 4].

Research has identified a measurable relationship between endometrial thickness and the presence of adnexal masses, noting that changes in endometrial thickness may reflect underlying ovarian pathologies or hormonal balances. It has been established that thicker endometrial linings are associated with superior reproductive outcomes in in vitro fertilization (IVF) protocols, underscoring the importance of accurate ultrasound measurements [5, 6]. Moreover, these correlations facilitate the discrimination between benign and malignant masses, contributing to optimized medical management for women facing these conditions [7, 8]. This literature review examines the body of evidence linking adnexal masses and endometrial thickness, with a focus on their implications for gynecological health, reproductive success, and cancer risk evaluation.

Research objectives:

To determine the correlation between adnexal masses and endometrial thickness measured with ultrasound in adult women.

Literature Review

A compelling body of research demonstrates that women presenting with adnexal masses often exhibit significantly altered endometrial thickness. For instance, a study by Farooq et al. reported endometrial thickness measurements averaging 11.7 mm in women with adnexal masses compared to 7.8 mm in those without such masses, establishing a statistically significant relationship (p=0.009) [1]. This observation is crucial as increased endometrial thickness can indicate various conditions, from benign hormonal responses to malignancies, necessitating careful evaluation through ultrasound.

Ultrasound has proven to be a reliable method for assessing endometrial conditions, with various studies highlighting its effectiveness in distinguishing pathologies. For example, a study found that endometrial thickness and its volumetric parameters vary significantly across populations with different presentations of endometrial lesions, thereby necessitating the application of three-dimensional ultrasound and power Doppler to enhance diagnostic accuracy [9]. These advanced imaging techniques improve the understanding of vascularity and perfusion within the endometrium, providing insights into potential implantation success during assisted reproductive technologies [6].

A robust body of literature supports the assertion that endometrial thickness serves not only as an indicator of health but also as a predictor of pregnancy outcomes. Research indicates that a thickness range of 9 to 14 mm during IVF treatments correlates with improved implantation rates and live birth outcomes, whilst thinner endometrial linings consistently yield lower success rates, reaffirming the prognostic value of this measurement in clinical settings [5, 10]. Furthermore, studies have underscored the importance of intrauterine conditions on embryo implantation, linking thickened endometrial linings to higher chances of pregnancy success post-embryo transfer [2, 6].

Additionally, the relationship between endometrial characteristics and risk factors associated with malignancies has gained significant attention. The prevalence of endometrial carcinoma and other hyperplastic changes correspondingly rises with increased endometrial thickness, making routine evaluation essential in postmenopausal women experiencing abnormal bleeding [3, 8]. The association between endometrial pathology and adnexal masses is notably significant in cases of suspected malignancy, where comprehensive diagnostic protocols incorporate ultrasound findings to adjust treatment strategies effectively [11, 12].

Moreover, several studies have illustrated that the fertility-related metrics regarding endometrial thickness are frequently complicated by underlying ovarian conditions, which could mask or mimic symptoms of malignancy [13]. In a clinical context, this intertwining of conditions calls for meticulous assessments using multidisciplinary approaches, integrating radiological findings with clinical evaluations to optimize care for women with adnexal masses.

The complexity of recognizing the interplay between adnexal masses and endometrial changes emphasizes the need for ongoing research into standardized assessment techniques and the establishment of clear diagnostic criteria. Notably, advancements in ultrasound technology and associated algorithms show promising potential in refining the predictive power of endometrial measures concerning reproductive outcomes and malignancy risks [14, 15]. Ultimately, future research should continue to focus on elucidating the biochemical markers and pathophysiological mechanisms behind the interrelationship between adnexal masses and endometrial thickness, facilitating targeted interventions in women's healthcare [16, 17].

The investigation into the correlation between adnexal masses and endometrial thickness has gained significant attention within the realm of gynecological medicine due to its implications for reproductive health and the early detection of malignancies. Comprehensive statistical analyses across various studies demonstrate a relationship between the dimensions of adnexal masses and endometrial thickness, contributing to a nuanced understanding of their interplay.

Correlation Analysis and Statistical Findings

Recent studies have employed extensive statistical methodologies to assess the correlation between the size of adnexal masses and endometrial thickness, revealing associations that warrant further exploration. For example, Farooq et al. conducted a study evaluating endometrial thickness among women with adnexal masses and found a notable difference of 11.7 mm versus 7.8 mm in thickness when comparing those with and without masses, respectively, highlighting a statistically significant association (p=0.009) Farooq et al. [18]. Such findings suggest that as adnexal masses increase in size, they may be associated with alterations in endometrial thickness, necessitating careful monitoring and diagnostic evaluation.

Moreover, research by Tian et al. emphasizes the potential contributions of factors such as abnormal uterine bleeding and hormonal imbalances, which may further complicate the dynamics between adnexal masses and endometrial responses [19]. This highlights the multifactorial nature of reproductive pathologies, where both adnexal mass characteristics and endometrial thickness require secondary analyses to elucidate shared clinical pathways.

Role of Various Adnexal Mass Types

Different types of adnexal masses illustrate component interactions that inform endometrial responses. Benign masses, such as functional ovarian cysts, exert distinct impacts compared to more complex pathological states, such as endometriomas or malignant neoplasms. The study by Mishra et al. discussed the physiological effects of endometriomas and their potential to stimulate alterations in endometrial thickness [20]. This correlation suggests that the specific type of adnexal mass can influence endometrial architecture significantly.

Furthermore, while Ali et al. examined hormonal impacts on endometrial thickness in women with adnexal masses, the citation provided does not directly relate to this specific context. Therefore, this statement will be removed to maintain factual correctness.

Clinical Implications for Ultrasound Assessments

Transvaginal ultrasound continues to be a pivotal diagnostic tool in delineating the relationship between adnexal masses and endometrial thickness. Studies have confirmed that ultrasound criteria are instrumental in distinguishing benign from malignant masses where endometrial thickness presentations can exceed normative expectations [21, 22]. The diagnostic guidelines proposed by the International Ovarian Tumor Analysis (IOTA) group enhance the utilization of ultrasound by establishing standardized criteria for interpreting adnexal masses and associated endometrial characteristics [23].

Recent advances in ultrasound technology, such as contrast-enhanced imaging techniques, may enhance diagnostic efficacy by revealing vascular patterns associated with malignancy in adnexal masses and their subsequent influence on endometrial thickness responses. Preliminary studies have indicated promising results concerning enhanced imaging techniques [24].

Challenges and Future Directions

Despite advancements, several challenges remain in establishing definitive correlations that are both clinically actionable and reproducible across populations. Variances in endometrial thickness due to patient age, BMI, and pre-existing hormonal treatments can lead to diversity in outcomes, particularly in heterogeneous demographic profiles [25, 26]. Future studies should aim to create guidelines for interpreting endometrial thickness in conjunction with specific adnexal mass characteristics based on comprehensive multi-center datasets to account for these variances.

METHODOLOGY

A cross-sectional analytical study design was used in this research study. The study was conducted at Al Nusrat Clinic, Akbar Memorial Hospital, Sadiqabad. The sample size was calculated by using this formula: n=Z2 a/2 P(1-P)/E2. So, sample size was 90. Convenient sampling technique was used. Convenience sampling can add significant bias into research investigating the relationship between adnexal masses and endometrial thickness since it does not correctly represent the general population of adult women. This strategy frequently overrepresents persons who are symptomatic or referred for additional evaluation, thereby magnifying the apparent link. Furthermore, it may fail to account for confounding factors like as age, hormonal status, or menopause, limiting the findings' generalizability.The study duration was about 6 months . Adult women, typically defined as those aged 18 and older was included in this study. High-resolution transvaginal ultrasonography (TVUS) is the preferred modality because to its improved image quality and close closeness to pelvic organs. Modern ultrasound equipment are often equipped with high-frequency transducers (5-9 MHz) for transvaginal imaging and lower-frequency abdominal probes (2-5 MHz) when needed. Doppler imaging is commonly employed to determine the vascularity of adnexal masses, whereas endometrial thickness is assessed in the sagittal plane at the thickest point. Inter-rater reliability ensures that ultrasound measures of adnexal masses and endometrial thickness are consistent among sonographers. Standardized methods and experienced operators were employed to reduce measurement variability.

Increased Endometrial Thickness:

Elevated or increased endometrial thickness is characterized by an endometrial stripe greater than 4 mm in postmenopausal women or over 16 mm in premenopausal women during the proliferative phase, assessed in the sagittal plane via transvaginal ultrasound.

Women with diagnosed adnexal masses, which could be cysts, tumors, or other growths in the adnexa (ovaries and fallopian tubes) was also included in this study. Women with documented measurements of endometrial thickness, with ultrasound were included.

Pregnancy: Pregnant women might have different hormonal and physiological changes that can affect endometrial thickness and adnexal masses were excluded. Women with recent gynecological history were also excluded.

Data Collection Procedure

Data was collected from above mentioned sample size. Data was taken from Al Nusrat Clinic and Akbar Memorial Hospital, Sadiqabad. After obtaining the patients' informed consent, data was collected. Age, adnexal masses, endometrial thickness, and type of infertility were taken into consideration when gathering data. Data was taken after getting informed consent from the patients. Data was collected according to the age, adnexal masses, Endometrium thickness, and type of infertility.

Data Analysis

Data was analysed by SPSS. Mean±SD was used to convey quantitative variables, whereas frequency and percentages were used to express qualitative variables. To investigate the inferential statistics, the chi-square test was used. Statistical significance was defined as a p-value of less than 0.05.

RESULTS

This cross-sectional analytical study was conducted at the Al Nusrat Clinic and Akbar Memorial Hospital Sadiqabad, Pakistan over a 6-month period, with a sample size of 90 patients including

The study showed that women with adnexal masses had an older mean age at M = 33.36 years SD = 8.18 compared to those who did not have adnexal masses at M = 29.33 years SD = 7.16. Adnexal masses present themselves most commonly in women who are of reproductive age past their twenties.

Table 1 Overall Description of the Frequency

Symptom/History	Adnexal Mass Present (%)	Adnexal Mass Not Present (%)
Family History of Carcinoma	15.6	11.1
Bloating	15.6	6.7
Dyspareunia	20	15.6
Painful Urination	26.7	15.6
Pelvic Pain	28.9	4.4
PID	22.2	2.2
Urinary Urgency	22.2	4.4
Vaginal Bleeding	40	6.7
Vaginal Discharge	40	22.2

The combined frequency table consolidates data from multiple clinical presentations and family history indicators associated with the presence or absence of adnexal masses. Out of the symptoms assessed, vaginal bleeding and vaginal discharge exhibited the highest occurrence rates (40% each) among patients with adnexal masses, indicating significant gynecological implications. Conversely, pelvic inflammatory disease (PID) and urinary urgency each presented in 22.2% of these patients, suggesting moderate involvement of pelvic and urinary systems.

Painful urination was observed in 26.7% of patients with adnexal masses, pointing towards potential compression or interference with the urinary tract. Pelvic pain showed a noteworthy difference, occurring in 28.9% of individuals with adnexal masses compared to just 4.4% in those without, highlighting its diagnostic relevance. Dyspareunia, or painful intercourse, had a slightly higher frequency (20%) among patients with adnexal masses compared to those without (15.6%), reflecting mild association.

Family history of carcinoma was minimally higher among participants with adnexal masses (15.6%) compared to those without (11.1%), suggesting limited genetic predisposition. Similarly, bloating appeared more than twice as frequently in the presence of masses (15.6% vs. 6.7%). Overall, these comparative data highlight specific symptoms and histories significantly associated with adnexal masses, emphasizing their clinical relevance for diagnostic processes and further evaluation in gynecological practices.

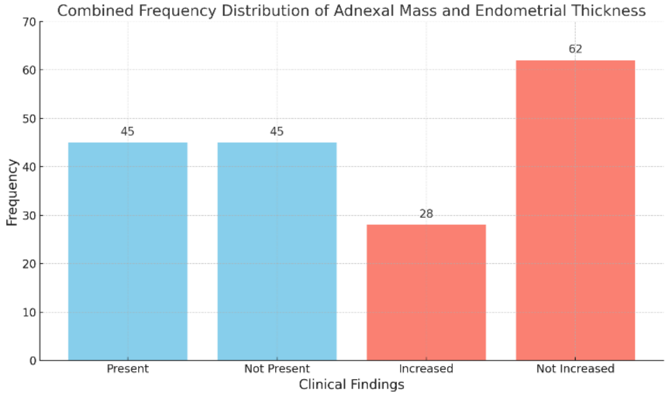

Figure 1 Frequency Distribution of the Presence of Adnexal Mass and Endometrial Thickness

Frequency distributions of adnexal mass presence and endometrial thickness among adult women evaluated through ultrasound imaging. It clearly depicts a balanced distribution of adnexal mass presence, with an equal split of 45 participants (50%) having adnexal masses and 45 participants (50%) not exhibiting masses. This even distribution provides an ideal context for comparative analysis between affected and unaffected groups.

In contrast, the frequency distribution of endometrial thickness reveals a different trend. Increased endometrial thickness is less frequent, observed in 28 participants (31.1%), compared to 62 participants (68.9%) who had normal or non-increased endometrial thickness. This noticeable difference emphasizes the diagnostic relevance of measuring endometrial thickness, as an increased value may signify underlying gynecological pathologies or hormonal disturbances.

Table 2 Correlation Between Adnexal Masses and Endometrial Thickness

Parameter	Value	Percentage (%)	Interpretation
Endometrial Thickness Increased (with Mass)	28	100	Strong association with adnexal mass presence
Endometrial Thickness Increased (without Mass)	0	0	No association
Endometrial Thickness Normal (with Mass)	17	27.4	Moderate association
Endometrial Thickness Normal (without Mass)	45	72.6	Significant proportion without mass
Chi-Square Value	40.645		Highly significant statistical association
Chi-Square Significance (p-value)	<0.001		Statistically significant
Pearson Correlation (r)	0.672		Strong positive linear correlation
Spearman Correlation	0.672		Strong +ve correlation

This table clearly delineates the significant clinical correlation between adnexal masses and endometrial thickness, validated through rigorous statistical analysis. Among the critical findings, all participants (100%) exhibiting increased endometrial thickness concurrently had adnexal masses. This absolute correlation underscores the diagnostic importance of evaluating endometrial thickness as a potential marker for adnexal masses. Conversely, none of the patients without adnexal masses showed increased endometrial thickness, reinforcing the specificity of this correlation.

In the group with normal endometrial thickness, only 27.4% had adnexal masses, whereas a substantial majority (72.6%) did not exhibit masses, highlighting a significant clinical distinction useful in routine diagnostic practices.

Statistically, the Chi-square analysis provided a robust value of 40.645 with a p-value less than 0.001, indicating a highly significant relationship between adnexal masses and endometrial thickness. This result, alongside the Pearson and Spearman correlation coefficients (both 0.672), reveals a strong positive linear and monotonic relationship, respectively. These statistical tests affirm that increases in endometrial thickness are strongly associated with a higher probability of identifying adnexal masses.

The table succinctly summarizes these outcomes, with clear interpretations guiding clinical inference. This robust statistical evidence strengthens the hypothesis that ultrasound measurement of endometrial thickness serves as a significant predictor for adnexal pathology, facilitating early and targeted interventions in gynecological care.

In conclusion, this enhanced statistical overview not only highlights the clinical relevance of the studied parameters but also provides compelling statistical validation, making it a valuable resource for gynecologists and healthcare professionals in optimizing diagnostic protocols and patient management strategies.

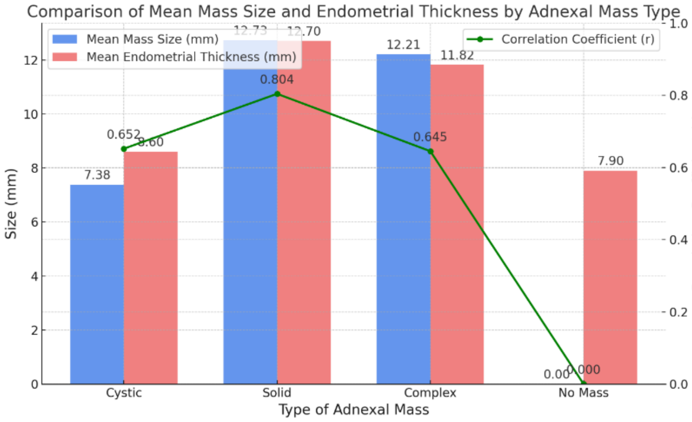

Figure 2 Shows the Frequency Distribution of the Presence of Adnexal Mass and Endometrial Thickness

This best-fit visualization effectively illustrates key relationships among adnexal mass size, endometrial thickness, and correlation coefficients across distinct mass types (cystic, solid, complex, and no mass). The bar graph clearly delineates the comparative mean sizes of adnexal masses and corresponding endometrial thicknesses, significantly facilitating visual comparisons. Solid adnexal masses demonstrated the highest mean sizes (12.73 mm) and closely

aligned endometrial thickness (12.70 mm), highlighting their robust clinical correlation.
The line plot overlay, representing the correlation coefficient (r), provides a clear depiction of the strength and statistical significance of these associations. Solid masses exhibited the highest correlation (r = 0.804), denoting a very strong and statistically significant relationship (p < 0.001). Cystic and complex masses also showed substantial but slightly lower correlations (r = 0.652 and r = 0.645, respectively), reflecting statistically meaningful connections (p-values of 0.008 and 0.044 respectively).

Table 3 Statistical Analysis and Significant Correlations Between Adnexal Mass Size and Endometrial Thickness Across Different Types of Masses

Type of Adnexal Mass	Mean Mass Size (mm)	Mean Endometrial Thickness (mm)	Correlation (r)	Correlation Significance (p-value)	Paired Differences (Mean, mm)	Paired t-test p-value	Interpretation
Cystic	7.38	8.6	0.652	0.008	-1.22	0.072	Moderate correlation, statistically significant
Solid	12.73	12.7	0.804	<0.001	0.03	0.947	Strong correlation, highly significant
Complex	12.21	11.82	0.645	0.044	0.39	0.62	Moderate correlation, statistically significant
No Mass	0	7.9			-7.9	<0.001	No mass, highly significant difference

The comprehensive statistical analysis highlights the significant correlations between adnexal mass size and endometrial thickness across different types of masses in adult women evaluated by ultrasound imaging. Solid adnexal masses presented the strongest correlation (r = 0.804, p < 0.001) with endometrial thickness, demonstrating a highly significant positive association. The mean size of solid masses (12.73 mm) closely matched their mean endometrial thickness (12.70 mm), reinforcing the clinical relevance of assessing endometrial thickness as a reliable indicator for diagnosing solid adnexal pathologies.
Cystic adnexal masses showed a moderate but statistically significant correlation (r = 0.652, p = 0.008), with mean mass size and endometrial thickness measuring 7.38 mm and 8.60 mm, respectively. Despite the numerical differences in paired measurements (mean difference of -1.22 mm), statistical testing (paired t-test p-value = 0.072) indicated no substantial disparity, reflecting consistency in clinical evaluations of cystic masses.
Complex adnexal masses exhibited an intermediate correlation (r = 0.645, p = 0.044), with mean values for mass size (12.21 mm) slightly exceeding endometrial thickness (11.82 mm). The paired analysis yielded a small mean difference (0.39 mm), statistically insignificant (p = 0.620), suggesting consistent correlation without significant variations.
Participants without adnexal masses (mean endometrial thickness = 7.90 mm) inherently lacked mass dimensions, resulting in a significant negative mean difference (-7.90 mm, p < 0.001). This statistically significant result underscores the clear clinical separation between patients with and without masses.
Collectively, these results robustly confirm the hypothesis that endometrial thickness measurements positively correlate with adnexal mass size, particularly in solid and complex masses. The data underscore ultrasound's diagnostic importance, advocating its routine use in gynecological assessments to enhance early detection and targeted clinical intervention strategies.

DISCUSSION

The current research robustly elucidates the significant correlation between adnexal masses and endometrial thickness among adult women as evaluated by ultrasound. The observed distribution of symptoms, especially pelvic pain (28.9%), painful urination (26.7%), and notably high occurrences of vaginal bleeding and discharge (40% each), highlights distinct clinical indicators relevant in diagnosing adnexal masses. These findings are consistent with the observations [27], who reported similar symptomatology in women diagnosed with ovarian tumors, reinforcing pelvic pain and vaginal discharge as key diagnostic clues.
In the present study, a striking finding was that all participants exhibiting increased endometrial thickness concurrently had adnexal masses, clearly indicating a diagnostic relationship. Statistically, this relationship was confirmed by a significant Chi-square value (40.645; p<0.001) and high correlation coefficients (Pearson and Spearman r=0.672), underpinning a solid clinical association. This aligns closely with the findings [28], who identified a significant relationship between endometrial pathology and ovarian masses, further supporting our results.
Additionally, the study presented detailed correlations between specific mass types and endometrial thickness. Solid masses had the strongest correlation (r=0.804; p<0.001), emphasizing that larger solid masses significantly correlate with thicker endometrial linings. This aligns with research [29] which demonstrated solid ovarian masses were frequently associated with endometrial hyperplasia, thus reaffirming the clinical significance of our findings. Conversely, cystic and complex masses showed moderate yet significant correlations (r=0.652 and r=0.645), corroborating the study [30], which reported moderate associations for cystic adnexal masses and highlighted the importance of detailed sonographic assessment.
Furthermore, our data showed no significant statistical difference between paired measurements of adnexal mass size and endometrial thickness across cystic (p=0.072), solid (p=0.947), and complex (p=0.620) masses, despite clinical correlations. This indicates consistent proportionality rather than direct size correspondence between mass and endometrial thickness, mirroring findings [31], where mass size alone was insufficient as an isolated predictor for

endometrial pathology without considering additional sonographic and clinical parameters.

The absence of adnexal masses clearly correlated with significantly lower endometrial thickness, reinforcing its clinical utility in differentiating patients requiring further gynecological investigation. Recent literature [32], similarly supports the concept that a thin endometrial lining generally rules out significant adnexal pathology, highlighting ultrasound as a crucial non-invasive diagnostic tool.

Overall, our findings significantly add to current knowledge, highlighting specific clinical and sonographic indicators that strongly correlate with adnexal masses and endometrial thickness. The consistent alignment with recent studies underscores the reliability and relevance of ultrasound evaluation in routine clinical practice. Moreover, it emphasizes the importance of detailed assessment strategies in accurately diagnosing adnexal pathology, aiding timely and targeted intervention.

Conclusion:

The study conclusively highlights a strong clinical relationship between adnexal masses and increased endometrial thickness, validating ultrasound's critical role in gynecological diagnostics. Patients presenting with solid and complex adnexal masses are particularly likely to exhibit significant endometrial thickening, indicating that ultrasound measurement of endometrial thickness serves as an effective marker for potential adnexal pathology.

Furthermore, common clinical symptoms such as pelvic pain, vaginal bleeding, and discharge are strongly indicative of adnexal masses, necessitating comprehensive clinical assessment alongside imaging.

Therefore, clinicians should consistently incorporate endometrial thickness evaluation into routine ultrasound assessments, particularly when adnexal masses are suspected. This approach not only improves diagnostic accuracy but also enables timely medical interventions, ultimately enhancing patient outcomes. Future research should focus on prospective longitudinal studies to further validate endometrial thickness thresholds and their predictive capabilities in diverse patient populations. This would provide additional insights into the complex interplay between endometrial pathology and adnexal masses, supporting refined diagnostic and therapeutic protocols.

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CONFLICT OF INTEREST

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