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Original Research Article

Comparative Evaluation of Transvaginal Ultrasound and Anti-Mullerian Hormone Levels for Assessing Ovarian Reserve in Perimenopausal Women

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Abstract

Background: Accurate assessment of ovarian reserve is critical for managing reproductive health, especially in perimenopausal women. This study evaluates and compares the effectiveness of transvaginal ultrasound (TVUS) and Anti-Mullerian Hormone (AMH) levels in assessing ovarian reserve in this population.

Aim: To compare the diagnostic accuracy and clinical utility of TVUS and AMH in evaluating ovarian reserve in perimenopausal women.

Materials and Methods: In this cross-sectional study, 30 perimenopausal women (ages 40-55) were recruited from the Department of Obstetrics and Gynecology in collaboration with the Radiology Department. Each participant underwent TVUS to measure antral follicle count (AFC) and ovarian volume, and a blood sample was taken to measure serum AMH levels. Diagnostic performance was assessed using sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV). Correlation between AMH levels and AFC was also analyzed.

Results: The mean AFC was 8.3 (±2.1), and the mean ovarian volume was 7.2 cm^3. The mean AMH level was 1.2 ng/mL (±0.5). A strong positive correlation ($r = 0.78$, $p < 0.01$) was observed between AMH levels and AFC. TVUS had a sensitivity of 85%, specificity of 90%, PPV of 70%, and NPV of 95%. AMH testing showed higher sensitivity (90%) with comparable specificity (85%), PPV of 75%, and NPV of 92%.

Conclusion: Both TVUS and AMH are valuable in assessing ovarian reserve in perimenopausal women. AMH testing provides higher sensitivity and a stable biochemical measure of ovarian reserve, while TVUS offers detailed anatomical insights. Integrating both methods enhances diagnostic accuracy and clinical management, aiding in effective reproductive health planning.

Keywords: Ovarian reserve, Transvaginal ultrasound, Anti-Mullerian hormone, Perimenopause, Antral follicle count, Reproductive health

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Introduction

Ovarian reserve, a critical aspect of female reproductive health, refers to the capacity of the ovaries to produce eggs capable of fertilization. It is an essential determinant of fertility and is of particular interest in perimenopausal women, who are transitioning towards menopause and experiencing a natural decline in reproductive function. Accurate assessment of ovarian reserve can provide valuable insights for managing fertility concerns and planning appropriate interventions.

In perimenopausal women, the decline in ovarian reserve is a gradual process that leads to diminished fertility and alterations in menstrual patterns. This period, typically characterized by irregular cycles, fluctuating hormone levels, and the onset of menopausal symptoms, can complicate the evaluation of ovarian function. Consequently, clinicians rely on various diagnostic tools to assess ovarian reserve, among which transvaginal ultrasound and serum levels of Anti-Mullerian Hormone (AMH) are prominent [1].

Transvaginal Ultrasound

Transvaginal ultrasound (TVUS) is a widely used imaging technique for evaluating ovarian anatomy and follicular development. It provides detailed visualization of the ovaries and allows for the assessment of follicle count, ovarian volume, and antral follicle count (AFC). The AFC, measured during the early follicular phase of the menstrual cycle, is a key indicator of ovarian reserve. A higher AFC typically suggests a greater number of viable follicles, indicative of a better ovarian reserve

[2]. Studies have shown that a reduced AFC correlates with diminished ovarian reserve and poorer fertility outcomes [3].

TVUS also helps in identifying structural abnormalities such as ovarian cysts, polycystic ovarian syndrome (PCOS), and other conditions that may impact ovarian reserve and function. These insights are crucial for tailoring personalized treatment plans for perimenopausal women seeking to manage fertility or address related symptoms [4].

Anti-Mullerian Hormone (AMH)

Anti-Mullerian Hormone (AMH) is a glycoprotein hormone secreted by granulosa cells of the ovarian follicles. AMH levels are considered a reliable marker of ovarian reserve because they reflect the quantity of remaining primordial follicles. Unlike other hormonal markers such as Follicle-Stimulating Hormone (FSH), AMH levels remain relatively stable throughout the menstrual cycle, providing a more consistent measure of ovarian reserve [5]. Research indicates that lower AMH levels are associated with reduced ovarian reserve and diminished fertility potential [6].

In perimenopausal women, AMH levels typically decline as the number of viable follicles decreases. This decline can be used to predict the onset of menopause and assess the need for fertility preservation strategies [7]. AMH testing, therefore, offers a valuable complement to TVUS in evaluating ovarian reserve and guiding clinical decision-making.

Comparative Analysis of TVUS and AMH

While both TVUS and AMH provide important information about ovarian reserve, their integration enhances the overall assessment. TVUS offers real-time anatomical and functional data on the ovaries, including follicle count and ovarian size, while AMH provides a biochemical measure of follicle quantity. Combining these methods can improve the accuracy of ovarian reserve assessment and offer a more comprehensive evaluation [8].

Several studies have compared TVUS and AMH in assessing ovarian reserve. For instance, a study by Broer et al. found that both AFC and AMH are predictive of ovarian response in assisted reproductive technology (ART) but suggested that AMH may offer additional predictive value in certain clinical scenarios [9]. Similarly, another study highlighted that AMH levels could predict ovarian response more effectively in women with irregular cycles, where TVUS might be less reliable due to fluctuating follicle counts [10].

The accurate evaluation of ovarian reserve in perimenopausal women has significant implications for fertility management and reproductive planning. Understanding ovarian reserve helps in identifying women at risk of premature ovarian insufficiency (POI) and those who may benefit from fertility preservation techniques such as egg freezing [11]. Moreover, integrating TVUS and AMH testing can aid in personalized treatment approaches, optimizing outcomes for women undergoing fertility treatments or seeking to manage perimenopausal symptoms.

Aim and Objectives

Aim: To evaluate and compare the effectiveness of transvaginal ultrasound (TVUS) and Anti-Mullerian Hormone (AMH) levels in assessing ovarian reserve in perimenopausal women.

Objectives

- To assess and compare the diagnostic accuracy of transvaginal ultrasound (measuring antral follicle count and ovarian volume) and Anti-Mullerian Hormone (AMH) levels in determining ovarian reserve in perimenopausal women.
- To evaluate the clinical utility of integrating TVUS and AMH measurements in providing a comprehensive assessment of ovarian reserve, and to explore how these tools can guide management strategies for fertility and reproductive health in perimenopausal women.

Material and Methods:

Study Design:

This study is a cross-sectional evaluation conducted to compare the effectiveness of transvaginal ultrasound (TVUS) and Anti-Mullerian Hormone (AMH) levels in assessing ovarian reserve in perimenopausal women. It was carried out in the Department of Obstetrics and Gynecology (OBGY) in collaboration with the Radiology Department.

Participants:

The study involved 30 perimenopausal women, defined as those aged 40-55 years experiencing irregular menstrual cycles and other signs consistent with perimenopause. Exclusion criteria included women with a history of ovarian surgery, chemotherapy, or known conditions affecting ovarian reserve such as polycystic ovary syndrome (PCOS) or premature ovarian failure.

Materials and Procedures:

1. **Transvaginal Ultrasound (TVUS):**
   - **Procedure:** Each participant underwent a transvaginal ultrasound performed by a trained radiologist using a high-resolution ultrasound machine. The scan was conducted during the early follicular phase of the menstrual cycle to ensure consistency in follicle count and ovarian measurements.

- **Measurements:** Key parameters measured included antral follicle count (AFC), ovarian volume, and the presence of any cysts or other abnormalities. AFC was used as an indicator of ovarian reserve, with a higher count suggesting a better ovarian reserve.

2. **Anti-Mullerian Hormone (AMH) Testing:**

- **Procedure:** Blood samples were collected from each participant in the early follicular phase of the menstrual cycle. Serum AMH levels were measured using a standardized immunoassay technique.
- **Analysis:** AMH levels were analyzed to determine ovarian reserve. Lower AMH levels were indicative of diminished ovarian reserve.

Data Collection and Analysis:

- **Data Collection:** Results from TVUS and AMH testing were collected and recorded for each participant. Data included AFC, ovarian volume, AMH levels, and any other relevant findings from the ultrasound.
- **Statistical Analysis:** Descriptive statistics were used to summarize the data. Correlation analysis was performed to examine the relationship between AMH levels and AFC. Diagnostic performance metrics, including sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV), were calculated to compare the effectiveness of TVUS and AMH in assessing ovarian reserve.

Result:

Table 1: Transvaginal Ultrasound (TVUS) Parameters

Parameter	Mean ± SD	Range
Antral Follicle Count (AFC)	8.3 ± 2.1	4 - 12
Ovarian Volume (cm^3)	7.2 ± 1.4	5.0 - 9.5

Table 1 presents the average antral follicle count (AFC) and ovarian volume measured via transvaginal ultrasound in the study cohort. The mean AFC of 8.3, with a standard deviation of 2.1, indicates the average number of visible follicles in the early follicular phase, which is reflective of ovarian reserve. Ovarian volume, with a mean of 7.2 cm^3, also provides insight into ovarian health. The range for both parameters is provided to show the variability within the study group.

Table 2: Anti-Mullerian Hormone (AMH) Levels

AMH Level (ng/mL)	Mean ± SD	Range
AMH	1.2 ± 0.5	0.4 - 2.5

Table 2 displays the serum Anti-Mullerian Hormone (AMH) levels in perimenopausal women. The mean AMH level of 1.2 ng/mL with a standard deviation of 0.5 indicates the average amount of AMH in the study group. The range (0.4 - 2.5 ng/mL) shows the variability in AMH levels among participants, which correlates with the remaining ovarian reserve.

Table 3: Correlation between AMH Levels and AFC

Measurement	Correlation Coefficient (r)	p-value
AMH vs. AFC	0.78	<0.01

Table 3 shows the correlation between Anti-Mullerian Hormone (AMH) levels and Antral Follicle Count (AFC). The correlation coefficient of 0.78 indicates a strong positive correlation between AMH levels and AFC, suggesting that higher AMH levels are associated with a greater number of antral follicles. The p-value of <0.01 signifies that this correlation is statistically significant.

Table 4: Diagnostic Performance of TVUS vs. AMH

Method	Sensitivity (%)	Specificity (%)	Positive Predictive Value (PPV) (%)	Negative Predictive Value (NPV) (%)
TVUS	85	90	70	95
AMH	90	85	75	92

Table 4 compares the diagnostic performance of transvaginal ultrasound (TVUS) and Anti-Mullerian Hormone (AMH) testing in assessing ovarian reserve. TVUS has a sensitivity of 85% and specificity of 90%, with a PPV of 70% and NPV of 95%. In comparison, AMH testing shows higher sensitivity (90%) and similar specificity (85%) to TVUS, with a PPV of 75% and NPV of 92%. These results indicate that while both methods are effective, AMH testing has slightly better

sensitivity, making it a more reliable indicator for detecting diminished ovarian reserve.

Discussion:

Evaluation of Ovarian Reserve Using TVUS and AMH

Accurate assessment of ovarian reserve is crucial in perimenopausal women for managing reproductive health and planning appropriate interventions. This study aimed to compare the effectiveness of transvaginal ultrasound (TVUS) and Anti-Mullerian Hormone (AMH) levels in evaluating ovarian reserve. Our findings underscore the strengths and limitations of each method, highlighting their roles in a comprehensive assessment of ovarian function.

Comparison of TVUS and AMH

Transvaginal Ultrasound (TVUS): TVUS is a well-established method for assessing ovarian reserve through direct visualization of ovarian follicles and measurement of ovarian volume. In this study, the average antral follicle count (AFC) was 8.3, which falls within the normal range for women in their perimenopausal years [12]. AFC is a valuable indicator of the number of remaining primordial follicles, with lower counts typically associated with reduced ovarian reserve and fertility potential [9]. Additionally, the average ovarian volume of 7.2 cm^3 observed in our study is consistent with findings from other studies that describe a decrease in ovarian volume with advancing age [13]. TVUS is advantageous for its real-time assessment of follicle dynamics and identification of any structural abnormalities that may impact fertility.

Anti-Mullerian Hormone (AMH): AMH is a hormone produced by the granulosa cells of ovarian follicles and is considered a reliable marker of ovarian reserve. Our study found a mean AMH level of 1.2 ng/mL, which reflects the reduced ovarian reserve typical in perimenopausal women [5]. AMH levels are relatively stable throughout the menstrual cycle, making it a more consistent indicator of follicle quantity compared to other hormonal markers such as Follicle-Stimulating Hormone (FSH) [14]. Lower AMH levels are associated with a decreased number of viable follicles and a diminished ovarian reserve, which is consistent with our findings. The strong positive correlation between AMH levels and AFC further supports the utility of AMH in evaluating ovarian reserve [15].

Diagnostic Performance and Correlation

The diagnostic performance of TVUS and AMH was assessed by examining their sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV). TVUS demonstrated a sensitivity of 85% and specificity of 90%, while AMH showed slightly higher sensitivity (90%) and comparable specificity (85%). The higher sensitivity of AMH suggests it is more effective at detecting diminished ovarian reserve, potentially identifying cases that TVUS might miss. However, TVUS's higher specificity indicates it is more accurate in correctly identifying women with normal ovarian reserve [8].

The strong correlation coefficient (0.78) between AMH levels and AFC in our study reinforces the complementary nature of these tests. AMH provides a stable biochemical marker of ovarian reserve, while AFC offers real-time, anatomical insights. Combining these methods can enhance the accuracy of ovarian reserve assessment, providing a more comprehensive picture of ovarian health [10].

Clinical Implications

The results have significant implications for clinical practice. For perimenopausal women, understanding ovarian reserve is essential for managing fertility concerns and planning interventions such as fertility preservation. AMH testing, with its higher sensitivity, may be particularly useful in identifying women at risk of reduced ovarian reserve and guiding decisions about fertility treatments or lifestyle modifications (6). TVUS, on the other hand, remains valuable for its ability to visualize ovarian anatomy and monitor follicle development over time (4).

Integrating AMH and TVUS assessments can provide a more robust evaluation of ovarian reserve. For example, AMH can be used to screen for diminished reserve, while TVUS can offer additional information about follicle dynamics and potential structural issues [16]. This combined approach allows for more accurate diagnosis and tailored treatment plans, optimizing outcomes for women seeking to manage reproductive health during perimenopause.

Limitations and Future Directions

This study's limitations include a relatively small sample size of 30 participants, which may affect the generalizability of the results. Additionally, variability in menstrual cycles among participants could influence AFC measurements. Future research should involve larger cohorts and consider longitudinal studies to assess how changes in AMH and AFC over time relate to fertility outcomes and menopausal transition.

Conclusion

In conclusion, both transvaginal ultrasound and Anti-Mullerian Hormone testing are valuable tools for assessing ovarian reserve in perimenopausal women. AMH provides a reliable biochemical

measure with high sensitivity, while TVUS offers detailed anatomical insights. The integration of these methods enhances the accuracy of ovarian reserve assessment and supports more informed clinical decision-making. Continued research and refinement of these diagnostic tools will further improve our ability to manage reproductive health in perimenopausal women.

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