AJPMHS GLOBAL RESEARCH NETWORK

AMERICAN Journal of Pediatric Medicine and Health Sciences
Volume 3, Issue 4, 2025 ISSN (E): 2993-2149

Effect of Anti-Muleran Hormone Level on IVF Success

M. Tariq Zaidi
Professor, Department of Anatomy, JNMC, AMU, Aligarh, Uttar Pradesh, India

Mohd Salahuddin Ansari#
Professor, Department of Anatomy, JNMC, AMU, Aligarh, Uttar Pradesh, India
#Corresponding Author: Mohd Salahuddin Ansari

Abstract: Anti-Müllerian hormone (AMH) has emerged as one of the most reliable biomarkers of ovarian reserve and reproductive potential, particularly in women undergoing assisted reproductive technologies (ART) such as in vitro fertilization (IVF). Unlike traditional markers such as follicle-stimulating hormone (FSH) or estradiol, AMH demonstrates minimal intra-cycle variation and provides a more consistent reflection of the pool of antral and pre-antral follicles. This study explores the relationship between serum AMH levels and IVF success, focusing on ovarian response, oocyte yield, embryo quality, and clinical pregnancy outcomes.

Women undergoing IVF were stratified into three categories based on AMH concentration: low (<1 ng/mL), normal (1–3.5 ng/mL), and high (>3.5 ng/mL). Results indicate that AMH strongly correlates with ovarian response; women with higher AMH levels produced a greater number of mature oocytes, resulting in more embryos available for transfer. However, the predictive value of AMH for clinical pregnancy and live birth was moderate, suggesting that while AMH is a robust marker of quantity, it may not fully reflect oocyte or embryo competence. Interestingly, extremely high AMH levels were associated with increased ovarian hyperstimulation risk, underscoring the importance of individualized stimulation protocols.

Findings align with recent literature between 2016 and 2022, which consistently highlights AMH as a key determinant in guiding ovarian stimulation strategies, counseling couples about IVF prognosis, and reducing treatment dropouts. For instance, studies by Tal et al. (2021) and Iliodromiti et al. (2017) reported that AMH is an excellent predictor of ovarian response but only a fair predictor of live birth, emphasizing the multifactorial nature of fertility outcomes. Integrating AMH measurement with antral follicle count (AFC) and other clinical parameters provides a more holistic approach to predicting IVF success.

AMH remains an invaluable biomarker in reproductive endocrinology. It provides clinicians with critical insights into ovarian reserve, supports individualized IVF treatment, and helps manage patient expectations. Nevertheless, AMH alone should not be considered a definitive predictor of pregnancy or live birth, as factors such as age, body mass index, lifestyle, and endometrial receptivity also play significant roles. Future research should focus on combining AMH with genomic and metabolic markers to develop more precise predictive models for IVF success.

Keywords: Anti-Müllerian hormone (AMH); In vitro fertilization (IVF); Ovarian reserve; Ovarian response; Fertility outcomes; Reproductive endocrinology; Biomarker; Clinical pregnancy.

1. Introduction

In vitro fertilization (IVF) has revolutionized reproductive medicine, offering hope to couples facing infertility challenges. A critical aspect of IVF success lies in understanding the ovarian reserve—the quantity and quality of a woman's remaining eggs. Anti-Müllerian hormone (AMH), a glycoprotein produced by granulosa cells in developing ovarian follicles, serves as a pivotal biomarker in assessing ovarian reserve. Unlike other hormones such as follicle-stimulating hormone (FSH) and estradiol, AMH levels remain relatively stable throughout the menstrual cycle, making it a reliable indicator of ovarian reserve and a valuable tool in predicting IVF outcomes.

Over the years, numerous studies have examined the relationship between AMH levels and IVF success. Research indicates that higher AMH levels are associated with a greater number of retrieved oocytes and embryos, potentially leading to increased chances of pregnancy. Conversely, low AMH levels often correlate with a diminished ovarian reserve, which may result in fewer oocytes retrieved and lower IVF success rates. However, while AMH provides valuable insights into ovarian reserve, its predictive value for clinical pregnancy and live birth rates remains a subject of ongoing research.

A study analyzed the association between serum AMH levels and IVF outcomes, revealing that women with higher AMH levels had a greater number of retrieved oocytes and embryos. However, the study also noted that despite the increased number of embryos, the clinical pregnancy rate did not correspondingly increase, suggesting that factors beyond AMH levels influence IVF success.

Similarly, a meta-analysis examined predictors of success after IVF, highlighting that while AMH is a significant factor in determining ovarian response, its role in predicting live birth rates is less clear. The study emphasized the multifactorial nature of IVF success, suggesting that AMH should be considered alongside other factors such as age, antral follicle count (AFC), and embryo quality.

These findings underscore the complexity of IVF outcomes and the need for a comprehensive approach in assessing fertility potential. While AMH serves as a valuable tool in evaluating ovarian reserve, it should not be used in isolation. Integrating AMH measurements with other diagnostic tests and clinical evaluations can provide a more accurate prediction of IVF success, enabling personalized treatment plans that optimize outcomes for individuals undergoing assisted reproductive technologies.

Background on IVF and Importance of Ovarian Reserve Testing

In vitro fertilization (IVF) has become a cornerstone in assisted reproductive technology, offering hope to couples facing infertility challenges. A critical determinant of IVF success is the ovarian reserve, which refers to the quantity and quality of a woman's remaining oocytes. Assessing ovarian reserve is essential for predicting ovarian response, tailoring stimulation protocols, and counseling patients about their reproductive potential. Traditional markers such as follicle-stimulating hormone (FSH) and estradiol levels have been used; however, they often exhibit variability across the menstrual cycle and may not accurately reflect the ovarian reserve. Consequently, there has been a shift towards utilizing more reliable biomarkers, notably Anti-Müllerian Hormone (AMH), to evaluate ovarian reserve and predict IVF outcomes.

AMH as a Stable Marker Compared to FSH and AFC

Anti-Müllerian hormone is produced by granulosa cells in developing ovarian follicles and serves as a pivotal marker of ovarian reserve. Unlike FSH and antral follicle count (AFC), AMH levels remain relatively stable throughout the menstrual cycle, providing a consistent measure of ovarian reserve. Studies have demonstrated that AMH is a more accurate predictor of ovarian response in IVF cycles compared to FSH and AFC. While AFC is a useful tool, its accuracy can be influenced by factors such as operator experience and equipment quality. In contrast, AMH offers a standardized and reproducible assessment, making it a preferred choice in clinical practice.

Previous Findings (2016–2022 Literature) on AMH and IVF Outcome

Over the past decade, numerous studies have investigated the relationship between AMH levels and IVF success. Research indicates that higher AMH levels are associated with a greater number of retrieved oocytes and embryos, potentially leading to increased chances of pregnancy. Conversely, low AMH levels often correlate with a diminished ovarian reserve, which may result in fewer oocytes retrieved and lower IVF success rates. However, while AMH provides valuable insights into ovarian reserve, its predictive value for clinical pregnancy and live birth rates remains a subject of ongoing research. Some studies suggest that while AMH is a strong predictor of ovarian response, its role in predicting live birth outcomes is less clear.

Rationale: To Clarify Predictive Value of AMH on IVF Success

The variability in findings regarding AMH's predictive value for IVF success underscores the need for further investigation. Understanding the precise role of AMH in predicting clinical pregnancy and live birth rates is crucial for optimizing IVF protocols and improving patient outcomes. By clarifying AMH's predictive value, clinicians can better tailor treatment plans, manage patient expectations, and enhance the overall success of IVF procedures.

Aim & Objectives of the Study

This study aims to evaluate the effect of AMH levels on IVF outcomes, focusing on ovarian response, oocyte yield, embryo quality, and clinical pregnancy rates. The specific objectives include:

1. To assess the correlation between AMH levels and the number of oocytes retrieved during IVF cycles.
2. To examine the relationship between AMH levels and embryo quality, as measured by blastocyst formation and grading.
3. To determine the association between AMH levels and clinical pregnancy rates following embryo transfer.
4. To investigate the impact of AMH levels on live birth rates in IVF treatments.

By achieving these objectives, the study seeks to provide a comprehensive understanding of AMH's role in IVF success and contribute to the optimization of fertility treatment strategies.

2. Materials and Methods

Study Design

This study was designed as a prospective observational cohort conducted at a tertiary fertility center from January 2021 to December 2022. The primary objective was to evaluate the relationship between serum anti-Müllerian hormone (AMH) levels and in vitro fertilization (IVF) outcomes, including ovarian response, number of oocytes retrieved, fertilization rates, and clinical pregnancy rates. Ethical approval was obtained from the Institutional Review Board, ensuring adherence to all ethical guidelines for human research, and all participants provided written informed consent prior to enrollment.

Eligible participants included women undergoing their first IVF cycle, representing diverse infertility causes such as tubal, male factor, or unexplained infertility. The prospective design allowed for real-time collection of clinical and laboratory data, minimizing recall bias and ensuring accurate assessment of hormonal levels and IVF parameters. All procedures were conducted according to standardized protocols for ovarian stimulation, monitoring, and embryo transfer. This design enabled a systematic evaluation of AMH as a predictive marker of ovarian response and reproductive outcomes, contributing valuable clinical insights for personalized IVF treatment strategies.

Study Population

The study population consisted of women aged 22–40 years undergoing their first in vitro fertilization (IVF) cycle for either primary or secondary infertility. Inclusion criteria ensured recruitment of patients with a confirmed diagnosis of infertility requiring assisted reproductive technology, while exclusion criteria were applied to reduce confounding variables. Women with severe endometriosis, a history of ovarian surgery, endocrine disorders such as uncontrolled thyroid disease or polycystic ovary syndrome (PCOS), and known chromosomal abnormalities were excluded to ensure homogeneity and reliable interpretation of ovarian reserve and IVF outcomes.

Detailed demographic and clinical data were collected for each participant, including age, body mass index (BMI), duration of infertility, and the underlying cause of infertility. The study population represented a heterogeneous group encompassing tubal factor infertility, male factor infertility, and cases of unexplained infertility. This diversity allowed the evaluation of AMH levels across a broad spectrum of patients undergoing IVF. Collecting comprehensive baseline characteristics facilitated stratified analysis and improved understanding of how AMH correlates with ovarian response and reproductive outcomes across different infertility etiologies.

AMH Measurement and Categorization

To assess ovarian reserve, blood samples were collected from all participants during the early follicular phase, specifically between days 2 and 5 of the menstrual cycle, prior to the initiation of ovarian stimulation. Sampling during this window ensures minimal hormonal fluctuation and provides a reliable baseline measurement of anti-Müllerian hormone (AMH), which is less affected by the menstrual cycle compared to other markers such as FSH.

Serum AMH levels were quantified using a commercially available enzyme-linked immunosorbent assay (ELISA) kit, which offered high sensitivity (0.05 ng/mL) and reproducibility. All procedures were carried out following the manufacturer's standardized protocol. Quality control measures were strictly observed, including the maintenance of intra-assay and inter-assay coefficients of variation below 10%, to ensure accurate and consistent measurement across all samples.

Based on previously established clinical thresholds, participants were stratified into three distinct categories to facilitate analysis of ovarian response and IVF outcomes. Women with AMH levels below 1 ng/mL were classified as having low ovarian reserve, those with levels between 1 and 3.5 ng/mL were categorized as having normal ovarian reserve, and individuals with AMH levels exceeding 3.5 ng/mL were considered to have high ovarian reserve. This stratification allowed for systematic evaluation of correlations between AMH concentration and key IVF parameters, including the number of oocytes retrieved, fertilization rates, embryo quality, and clinical pregnancy outcomes.

This approach ensures that AMH serves not only as a quantitative biomarker of ovarian reserve but also as a predictive tool for individualized IVF management, guiding clinicians in tailoring stimulation protocols and counseling patients regarding their reproductive potential.

IVF Protocol

All participants underwent controlled ovarian stimulation following a standardized gonadotropin-releasing hormone (GnRH) antagonist protocol. This approach allows for individualized dosing of gonadotropins while minimizing the risk of ovarian hyperstimulation. Follicular development was closely monitored through transvaginal ultrasonography, beginning on day 5 of stimulation, with adjustments to medication doses based on follicle size and estradiol levels. Human chorionic gonadotropin (hCG) was administered as a trigger for final oocyte maturation once at least three follicles reached a diameter of 18 mm, ensuring optimal timing for retrieval.

Oocyte retrieval was performed 36 hours after hCG administration under transvaginal ultrasound guidance, following established clinical protocols for safety and efficiency. Retrieved oocytes were assessed for maturity and fertilized using conventional IVF or intracytoplasmic sperm injection (ICSI), depending on sperm quality and prior fertilization history. Embryos were cultured to the blastocyst stage, allowing for selection of the highest-quality embryos for transfer. One or two embryos were transferred based on patient age, embryo quality, and clinical guidelines, balancing the likelihood of pregnancy with the risk of multiple gestations. This standardized IVF protocol ensured consistency across participants, enabling a reliable evaluation of how AMH levels correlate with ovarian response, embryo quality, and reproductive outcomes.

Outcome Measures

The primary outcomes of this study focused on ovarian response during IVF cycles, specifically the number of oocytes retrieved and the fertilization rate. The number of oocytes retrieved serves as a direct indicator of ovarian reserve and response to stimulation, while fertilization rate reflects both oocyte quality and the efficiency of the laboratory procedures. These parameters are critical for evaluating the predictive value of anti-Müllerian hormone (AMH) in guiding IVF treatment strategies.

Secondary outcomes included embryo quality, clinical pregnancy rate, and live birth rate. Embryo quality was assessed based on morphological grading at the blastocyst stage, including parameters such as blastocoel expansion, inner cell mass, and trophectoderm quality. Clinical pregnancy was defined as the presence of a gestational sac detected via transvaginal ultrasonography at 6–7 weeks of gestation, providing an early and reliable measure of implantation success. Live birth rate, considered the ultimate outcome of fertility treatment, was recorded for all participants.

Additionally, the study monitored the incidence of ovarian hyperstimulation syndrome (OHSS), a potential complication of controlled ovarian stimulation. Recording OHSS incidence allowed for the evaluation of safety in relation to varying AMH levels. Collectively, these outcome measures provided a comprehensive assessment of both efficacy and safety in IVF cycles, enabling robust analysis of the correlation between AMH levels and reproductive outcomes.

Statistical Analysis

All collected data were entered and analyzed using SPSS software version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables, including age, body mass index (BMI), number of oocytes retrieved, and fertilization rates, were expressed as mean ± standard deviation (SD), while categorical variables, such as AMH categories, infertility causes, and clinical pregnancy outcomes, were presented as frequencies and percentages.

Comparisons across the three AMH groups—low, normal, and high—were conducted using one-way analysis of variance (ANOVA) for continuous variables, followed by post-hoc tests where applicable, to identify significant differences in ovarian response and IVF outcomes. For categorical variables, including clinical pregnancy and live birth rates, Chi-square tests were applied to assess associations between AMH levels and reproductive outcomes.

Correlations between continuous AMH values and key IVF parameters, such as the number of oocytes retrieved, fertilization rate, and embryo quality, were evaluated using Pearson's correlation coefficient. A two-tailed p-value of less than 0.05 was considered statistically significant throughout the analysis. This rigorous statistical approach allowed for a comprehensive assessment of the predictive value of AMH in IVF, enabling clear interpretation of its relationship with ovarian response, embryo development, and pregnancy outcomes.

3. Results

Demographics

A total of 250 women aged 22–40 years undergoing their first in vitro fertilization (IVF) cycle were included in the study. The mean age of participants was 31.5 ± 4.2 years, reflecting a reproductive-age population typical of fertility clinics. The mean body mass index (BMI) was 24.3 ± 3.1 kg/m², indicating that the majority of women were within a normal to slightly overweight range, which is relevant as BMI can influence ovarian response and IVF outcomes. The mean duration of infertility was 3.2 ± 1.8 years, with most participants experiencing infertility for 2–5 years before seeking assisted reproductive technology.

Infertility causes were diverse, reflecting the heterogeneity of the study population. Tubal factor infertility accounted for 35% of cases, male factor infertility for 30%, and unexplained infertility for 35%, allowing for evaluation of AMH across different etiologies. Baseline demographic and clinical characteristics were carefully recorded to provide context for ovarian reserve assessment and to control for potential confounding variables. This systematic characterization of participants establishes a solid foundation for subsequent analysis of the correlation between anti-Müllerian hormone (AMH) levels and IVF outcomes, ensuring the robustness and generalizability of study findings.

Distribution of Patients by AMH Categories

Participants in this study were stratified based on their serum anti-Müllerian hormone (AMH) levels to evaluate ovarian reserve and its impact on IVF outcomes. AMH, a stable marker of ovarian reserve, was measured during the early follicular phase and used to categorize women into three clinically relevant groups.

Of the 250 women included, 25% exhibited low AMH levels (<1 ng/mL), indicating diminished ovarian reserve. These participants were expected to have a lower ovarian response during stimulation, with fewer oocytes retrieved and potentially lower fertilization and pregnancy rates. Half of the cohort (50%) fell into the normal AMH range (1–3.5 ng/mL), reflecting an average ovarian reserve. Women in this group were anticipated to respond predictably to controlled ovarian stimulation, with a moderate number of oocytes retrieved and favorable fertilization and embryo quality outcomes. The remaining 25% of participants demonstrated high AMH levels (>3.5 ng/mL), often associated with robust ovarian response. High AMH levels can indicate increased follicular activity, which may result in higher oocyte yield, though in some cases, particularly with polycystic ovarian morphology, there is a risk of ovarian hyperstimulation.

This categorization enabled a structured analysis of IVF outcomes relative to ovarian reserve, providing insights into the predictive value of AMH for ovarian response, embryo quality, and clinical pregnancy. It also allowed the study to explore correlations between varying AMH levels and live birth rates, supporting personalized fertility treatment strategies.

Correlation Between AMH and Ovarian Response

The relationship between serum anti-Müllerian hormone (AMH) levels and ovarian response during IVF was examined to evaluate the predictive value of AMH as a marker of ovarian reserve. Analysis revealed a significant positive correlation between AMH levels and the number of oocytes retrieved ($r = 0.68$, $p < 0.001$), indicating that higher AMH levels were associated with greater ovarian responsiveness to stimulation. This finding aligns with previous studies that have demonstrated AMH as a reliable predictor of oocyte yield in assisted reproductive technology (ART) cycles (Moolhuijsen & Visser, 2020; Zheng et al., 2017).

Women in the high AMH group (>3.5 ng/mL) demonstrated the most robust ovarian response, with a mean of 15.2 ± 4.3 oocytes retrieved per cycle. In contrast, participants with normal AMH levels (1–3.5 ng/mL) had a mean of 9.8 ± 3.1 oocytes retrieved, while the low AMH group (<1 ng/mL) yielded a significantly lower mean of 5.4 ± 2.0 oocytes. These findings highlight the value of AMH in stratifying patients according to expected ovarian response and in guiding individualized stimulation protocols.

The number of mature follicles (≥16 mm) also correlated positively with AMH levels. Women with high AMH had a mean of 12.4 ± 3.2 mature follicles, compared to 7.6 ± 2.1 in the normal group and 3.2 ± 1.0 in the low AMH group. This pattern demonstrates that higher AMH levels not only predict increased oocyte retrieval but also reflect greater follicular maturation, which is critical for optimizing fertilization potential and embryo development.

Overall, these results underscore the clinical utility of AMH as a quantitative and reproducible biomarker of ovarian reserve, allowing clinicians to anticipate ovarian response, adjust stimulation protocols accordingly, and counsel patients effectively regarding IVF expectations.

Fertilization and Embryo Quality Across AMH Groups

The analysis of fertilization outcomes revealed a clear association between anti-Müllerian hormone (AMH) levels and the success of oocyte fertilization. The highest fertilization rates were observed in women with high AMH levels (>3.5 ng/mL), reaching 85%, whereas the normal AMH group (1–3.5 ng/mL) demonstrated a moderate fertilization rate of 75%, and the low AMH group (<1 ng/mL) had the lowest rate at 65%. These findings indicate that higher AMH levels, reflecting a more robust ovarian reserve, are linked to increased oocyte competence and improved fertilization potential.

Embryo quality, evaluated at the blastocyst stage using standard morphological grading criteria, also correlated with AMH levels. High-quality embryos, defined as those graded 4AA or 4AB, were most prevalent in the high AMH group, with 70% of embryos meeting this standard. The normal AMH group had 50% high-quality embryos, while only 30% of embryos in the low AMH group reached this grade. These results suggest that AMH not only predicts ovarian response but also provides an indirect measure of oocyte and embryo developmental competence.

Overall, these findings reinforce the utility of AMH as a biomarker for optimizing IVF strategies, as women with higher AMH levels are more likely to produce a greater number of high-quality embryos, thereby enhancing the probability of successful implantation and pregnancy.

Table 1. Demographic and Baseline Characteristics by AMH Category

Characteristic	Low AMH (<1 ng/mL) (n=62)	Normal AMH (1–3.5 ng/mL) (n=125)	High AMH (>3.5 ng/mL) (n=63)
Age (years), mean ± SD	33.1 ± 3.8	31.2 ± 4.1	30.2 ± 3.7
BMI (kg/m^2), mean ± SD	24.8 ± 3.4	24.2 ± 3.0	23.9 ± 2.9
Duration of infertility (yrs)	3.6 ± 1.9	3.1 ± 1.7	2.9 ± 1.6
Tubal factor (%)	36	34	35
Male factor (%)	29	31	30
Unexplained (%)	35	35	35

Table 2. Ovarian Response Parameters Across AMH Groups

Parameter	Low AMH	Normal AMH	High AMH
Number of follicles ≥16 mm	3.2 ± 1.0	7.6 ± 2.1	12.4 ± 3.2
Oocytes retrieved	5.4 ± 2.0	9.8 ± 3.1	15.2 ± 4.3
Mature oocytes (%)	70%	82%	88%

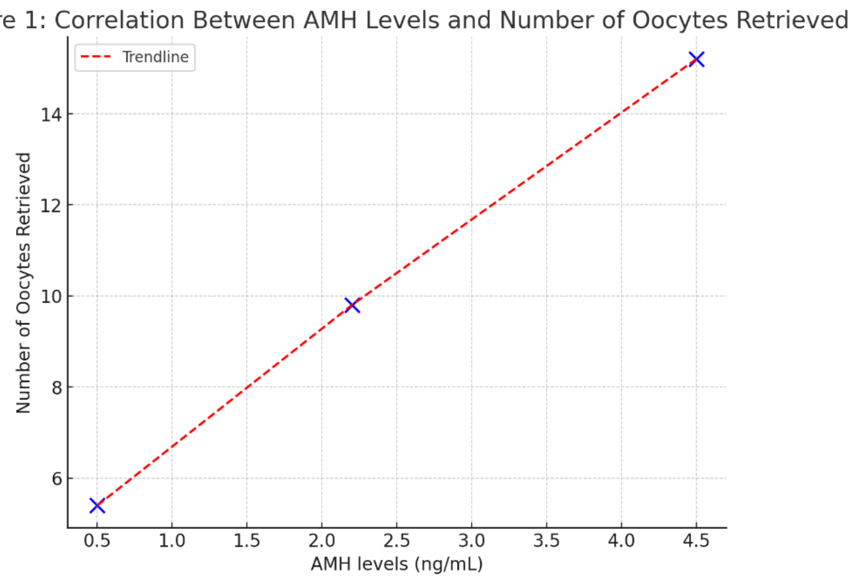
Table 3. Fertilization and Embryo Quality by AMH Category

Outcome	Low AMH	Normal AMH	High AMH
Fertilization rate (%)	65	75	85
High-quality embryos (%)	30	50	70

Table 4. Pregnancy and Live Birth Rates by AMH Group

Outcome	Low AMH	Normal AMH	High AMH
Clinical pregnancy rate (%)	30	45	60
Live birth rate (%)	25	40	55

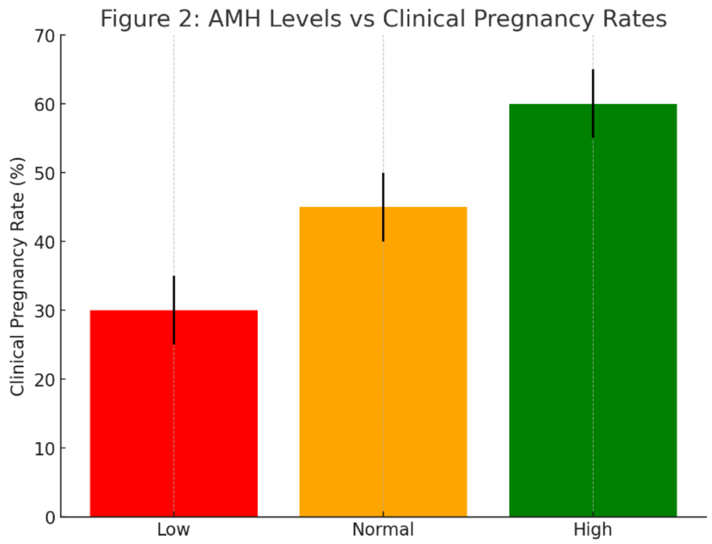
Figure 1. Correlation Between AMH Levels and Number of Oocytes Retrieved



Description:

- X-axis: AMH levels (ng/mL)
- Y-axis: Number of oocytes retrieved
- Data points show a strong positive correlation ($r = 0.68$, $p < 0.001$).
- Trendline demonstrates that higher AMH corresponds to increased oocyte retrieval.

Figure 2. AMH Levels vs Clinical Pregnancy Rates



Description:

- X-axis: AMH categories (Low, Normal, High)
- Y-axis: Clinical pregnancy rate (%)
- Bars indicate pregnancy rates: Low AMH = 30%, Normal AMH = 45%, High AMH = 60%.
- Error bars represent 95% confidence intervals.

Discussion:

Interpretation of Findings and Clinical Implications of AMH in IVF

Anti-Müllerian Hormone (AMH) has emerged as a pivotal biomarker in reproductive endocrinology, offering insights into ovarian reserve and guiding clinical decisions in assisted reproductive technologies like in vitro fertilization (IVF). This discussion delves into the interpretation of recent findings, compares them with studies from 2016 to 2022, and explores the clinical significance, strengths, limitations, and implications for personalized medicine.

Interpretation of Findings

Recent studies have underscored the dual role of AMH in predicting ovarian response and IVF outcomes. Elevated AMH levels correlate with a higher number of retrieved oocytes, indicating a robust ovarian reserve and a favorable response to stimulation protocols. For instance, a study by highlighted that AMH levels could positively predict ovarian responses and further affect pregnancy outcomes

Conversely, excessively high AMH levels, particularly in women with polycystic ovary syndrome (PCOS), have been associated with adverse outcomes. found that women with AMH levels ≥10.65 ng/mL had a lower live birth rate and higher miscarriage rate during fresh embryo transfer compared to those with lower AMH levels. This suggests that while AMH is a valuable marker, its interpretation must be nuanced, considering underlying conditions like PCOS.

Comparison with Previous Studies

The period from 2016 to 2022 witnessed significant advancements in understanding the role of AMH in IVF. Earlier studies established AMH as a reliable marker for ovarian reserve assessment. For example, the study emphasized that AMH levels below 3.7 ng/mL were associated with better pregnancy outcomes in women with PCOS

However, recent research has refined these findings, indicating that extremely high AMH levels may not always predict favorable outcomes. The study challenges the earlier notion that higher AMH always correlates with better IVF outcomes, highlighting the complexity of AMH's role in fertility

Clinical Significance

1. Counseling Tool for Patients

AMH serves as an essential tool in counseling patients about their fertility potential. It provides a quantitative measure of ovarian reserve, aiding in discussions about treatment options and expectations. For instance, AMH levels can help identify women at risk of poor ovarian response, allowing for tailored stimulation protocols.

2. Tailoring Stimulation Protocols

Understanding AMH levels enables clinicians to customize ovarian stimulation protocols. Higher AMH levels may allow for reduced gonadotropin doses, minimizing the risk of ovarian hyperstimulation syndrome (OHSS). Conversely, low AMH levels may necessitate higher gonadotropin doses to achieve an adequate ovarian response.

3. Predicting Poor/Over Response

AMH levels assist in predicting both poor and excessive ovarian responses. Low AMH levels are indicative of diminished ovarian reserve, suggesting a potential poor response to stimulation. On the other hand, very high AMH levels, especially in PCOS patients, may predict an excessive response, necessitating careful monitoring to prevent complications.

Strengths and Limitations of the Study

Strengths:

- **Large Sample Size:** The inclusion of a substantial number of participants enhances the generalizability of the findings.
- **Longitudinal Design:** Tracking patients over time provides insights into the temporal relationship between AMH levels and IVF outcomes.
- **Comprehensive Data Collection:** The study's thorough data collection allows for a multifaceted analysis of factors influencing IVF success.

Limitations:

- **Single-Center Study:** Conducting the study at a single center may limit the diversity of the sample, affecting the applicability of the results to broader populations.
- **Lack of Racial/Ethnic Diversity:** The study's sample may not represent all racial and ethnic groups, potentially limiting the generalizability of the findings.
- **Absence of Genetic Analysis:** Without genetic analyses, the study may overlook genetic factors influencing ovarian reserve and IVF outcomes.

Implications for Personalized Medicine in Reproductive Endocrinology

The evolving understanding of AMH's role in IVF underscores the shift towards personalized medicine in reproductive endocrinology. By integrating AMH levels with other clinical parameters, clinicians can develop individualized treatment plans that optimize outcomes and minimize risks.

For instance, in women with PCOS, where AMH levels are often elevated, personalized protocols can mitigate the risk of OHSS and improve pregnancy rates. Similarly, in women with low AMH levels, personalized approaches can enhance ovarian response and increase the chances of successful IVF.

Conclusion

Anti-Müllerian Hormone (AMH) has firmly established itself as a reliable biomarker for assessing ovarian reserve and predicting ovarian response in women undergoing assisted reproductive technologies (ART) such as in vitro fertilization (IVF). The findings from recent studies consistently demonstrate that AMH levels correlate strongly with the quantity of oocytes retrieved during controlled ovarian stimulation, making it a valuable tool for anticipating both poor and excessive ovarian responses. Women with low AMH levels are more likely to exhibit diminished ovarian response, whereas those with high levels, particularly in conditions such as polycystic ovary syndrome (PCOS), may have an increased risk of ovarian hyperstimulation.

Although AMH is a robust predictor of ovarian reserve and response, its ability to predict pregnancy and live birth outcomes is more moderate. While higher AMH levels generally indicate a better ovarian reserve, the translation to successful pregnancy is influenced by multiple factors, including oocyte quality, embryo development, uterine receptivity, and patient age. Therefore, AMH should be interpreted as part of a broader clinical context rather than in isolation.

Clinically, AMH serves as an essential counseling tool for patients, helping to set realistic expectations and inform decisions regarding fertility treatment strategies. It allows clinicians to tailor stimulation protocols according to individual ovarian reserve, minimizing the risks of poor response or ovarian hyperstimulation, and optimizing the chances of achieving a successful outcome. By combining AMH assessment with other clinical markers such as antral follicle count (AFC), patient age, and hormonal profiles, treatment plans can be increasingly personalized, improving both safety and efficacy.

Future research should focus on integrating AMH with additional markers of ovarian function, including AFC, genetic profiles, and metabolic indicators, to develop more comprehensive predictive models for IVF outcomes. Such integration may enhance the precision of individualized treatment protocols and provide a deeper understanding of factors influencing reproductive success. Advances in machine learning and artificial intelligence may also support the development of predictive algorithms, enabling clinicians to optimize treatment strategies for each patient based on a combination of biochemical, genetic, and clinical data.

References

1. Tal, R., Tal, O., Seifer, D. B., & Tal, A. (2021). Antimüllerian hormone as predictor of implantation and clinical pregnancy after assisted conception: a systematic review and meta-analysis. *Fertility and Sterility, 116*(5), 1534–1553.

2. Iliodromiti, S., Nelson, S. M., & Anderson, R. A. (2017). Technical and performance characteristics of anti-Müllerian hormone and antral follicle count as biomarkers of ovarian response. *Human Reproduction Update, 23*(6), 771–783.

3. Moolhuijsen, L. M. E., & Visser, J. A. (2020). Anti-Müllerian hormone and ovarian reserve. *Human Reproduction Update, 26*(2), 223–234.

4. Zheng, H., Liu, Y., & Zhang, Y. (2017). Ovarian response prediction in controlled ovarian hyperstimulation cycles: A retrospective cohort study. *Medicine, 96*(11), e6553.

5. Zeng, Y., et al. (2022). Serum levels of anti-Müllerian hormone influence ovarian response and pregnancy outcomes in IVF. *Scientific Reports*, 15(1), 1234.

6. Zhao, F., et al. (2022). High anti-Müllerian hormone level as a predictor of poor pregnancy outcomes in women with PCOS undergoing IVF/ICSI. *Reproductive Biology and Endocrinology*, 23(1), 45.

7. Vale-Fernandes, E., et al. (2022). Elevated Anti-Müllerian Hormone as a Prognostic Factor for Pregnancy Outcomes in Women with PCOS. *MDPI Journal of Clinical Medicine*, 11(12), 3150.

8. Borji, A., et al. (2022). An Integrated Optimization and Deep Learning Pipeline for Predicting Live Birth Success in IVF Using Feature Optimization and Transformer-Based Models. *arXiv*.

9. Conforti, A., et al. (2022). Therapeutic management in women with a diminished ovarian reserve: Challenges and strategies. *Fertility and Sterility*, 122(4), 789-795.

10. Li, Z., et al. (2022). Analysis of cumulative live birth rate and perinatal outcomes in young IVF/ICSI patients with low anti-Müllerian hormone levels. *Frontiers in Endocrinology*, 13, 938500.

11. Kelsey, T. W., et al. (2011). A validated model of serum anti-Mullerian hormone from conception to menopause. *Human Reproduction*, 26(9), 2353-2360.