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Original Research Article

Evaluating the efficacy of anti-Müllerian hormone as a predictor of ovarian reserve and fertility treatment success

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ABSTRACT

Background: Ovarian reserve assessment is crucial for predicting fertility treatment outcomes, with Anti-Müllerian Hormone (AMH) emerging as a key biomarker. This study aimed to evaluate the efficacy of AMH as a predictor of ovarian reserve and its correlation with fertility treatment success among women in Bangladesh.
Methods: This retrospective study analyzed medical records of 100 women aged 20-40 years who underwent fertility treatment at a specialized clinic in Bangladesh over five years. AMH levels were measured using VIDAS and ovarian reserve was assessed via antral follicle count (AFC) using transvaginal ultrasound. The correlation between AMH levels, AFC, oocytes retrieved and clinical pregnancy rates was analyzed using Pearson's correlation coefficient with statistical software SPSS 26.
Results: The study found a significant positive correlation between AMH levels and AFC, with 80% of women with high AMH levels also having a high AFC. Additionally, women with high AMH levels had higher oocyte retrieval rates and clinical pregnancy rates (70%) compared to those with medium (50%) and low AMH levels (29.4%). The nearly equal distribution of clinical pregnancy outcomes (49% achieving pregnancy) highlighted the varied success of fertility treatments in this population.
Conclusions: AMH is a valuable predictor of ovarian reserve and fertility treatment outcomes, particularly when combined with AFC and other patient-specific factors. This study supports the use of AMH in clinical settings to enhance individualized fertility treatment strategies, potentially improving success rates.

Keywords: Anti-müllerian hormone, Antral follicle count, Clinical pregnancy, Fertility treatment, Ovarian reserve

INTRODUCTION

The term "ovarian reserve" refers to a notion that indicates potential ovarian function by reflecting the quantity and quality of ovarian follicles at a certain moment in time.[1] The granulosa cells of the main, preantral and tiny antral follicles in the ovaries generate anti-Müllerian hormone (AMH).[2,3] Early in the 1990s, it was found that the blood AMH level might be used as a predictor of ovarian reserve by indirectly representing the total number of follicles that are accessible.[4] AMH is extremely responsive to aging-related alterations and does not account for menstrual cycle variability within and across cycles.[5–7] Serum AMH measurement has been used in more clinical settings over the last 20 years and its benefits are well recognized.[8,9] Reproductive medicine has long sought an accurate way to measure the ovarian reserve and in recent years, research in this area has increased dramatically.

This is largely due to the realization that measuring anti-müllerian hormone (AMH) in serum provides a far more accurate estimate of ovarian reserve than other hormones that were previously available. Therefore, even while inhibin B accurately predicts the number of eggs produced during superovulation, measurements must be made early in the menstrual cycle during the follicular phase and it doesn't start to decline until later in life.[10,11] Despite the well-known drawbacks of FSH, it hasn't replaced it as the

most commonly utilized indicator of ovarian reserve. Early research revealed that serum AMH decreased with age in women and was strongly associated with the number of oocytes retrieved after superovulation for in vitro fertilization.[5,6,12] Our present understanding of the usefulness of AMH as a marker of ovarian reserve is largely based on these two findings.

Women with elevated AMH in particular may react excessively to exogenous gonadotrophins and it is possible to alter their treatment plan to reduce the risk of ovarian hyperstimulation syndrome (OHSS). On the other hand, women with low AMH are more likely to respond poorly to stimulation and, as a result, have a lower probability of becoming pregnant. These women's expectations can be appropriately adjusted by discussing alternatives such as oocyte donation.

AMH is strongly correlated with IVF live birth rates regardless of age, despite being essentially a measure of oocyte number rather than quality.[13,14] This is mainly because it correlates with oocyte yield, women with greater AMH are likely to have more oocytes recovered and, consequently, potentially more embryos for selection at any given age range. Other reproductive hormones are not helpful in this situation, although AMH is helpful in prepubertal females as well, exhibiting a fall during chemotherapy with recovery depending on the toxicity of the regimen utilized.[15]

Early research supported this by showing that before therapy. Age was also a predictor, as was to be expected, but interestingly, in a multivariate analysis, the effect of age vanished and only AMH remained predictive. This is in line with the theory that age serves as a proxy for ovarian reserve and loses significance when a direct marker with sufficient accuracy is present.

Verification that AMH allows for risk individualization can quickly find use in therapeutic settings, women with low AMH may benefit from more intrusive or time-consuming techniques of fertility preservation, while those with high AMH may choose to begin treatment right away. Undoubtedly, the much higher AMH concentrations in PCOS contrast with the often-normal levels of other reproductive hormones, suggesting a possible biochemical component to the diagnosis that can only deepen our knowledge of the disease.

It is imperative to acknowledge that the age at menopause is significantly influenced by genetics and while numerous environmental factors have been found, their cumulative impact is rather low.[16] Determining whether AMH is a more accurate predictor than the moms' menopausal age will be an intriguing area of research in the future. The aim of this review is to Evaluate the efficacy of Anti-Müllerian Hormone (AMH) as a predictor of ovarian reserve and fertility treatment success.

METHODS

Study place

This retrospective study was conducted at the Department of Obstetrics and Gynaecology, 250 Beded Hospital, Moulvibazar, Bangladesh.

Study duration

The study was conducted from July, 2022 to June, 2023.

The study was conducted by retrospectively analysing the medical records of women who had undergone fertility treatment at a specialized clinic over a period of five years.

The primary objective was to evaluate the efficacy of Anti-Mullerian Hormone (AMH) as a predictor of ovarian reserve and its correlation with fertility treatment outcomes. The study included women aged 20 to 40 years who had their AMH levels measured as part of their initial fertility assessment.

Exclusion criteria included women with known endocrine disorders, prior ovarian surgery or those undergoing cancer treatments, as these conditions could potentially affect AMH levels. AMH levels were measured using VIDAS Assays. The ovarian reserve was assessed through antral follicle count (AFC) obtained via transvaginal ultrasound and correlated with AMH levels. The study also involved tracking the response to controlled ovarian stimulation (COS) by recording the number of oocytes retrieved, the quality of embryos generated and the clinical pregnancy rates.

Statistical analysis

Data were analysed using statistical software SPSS 26 to determine the predictive value of AMH for ovarian reserve and treatment success. The correlation between AMH levels, AFC and clinical outcomes such as the number of retrieved oocytes and pregnancy rates was calculated using Pearson's correlation coefficient.

RESULTS

The largest age group was 26-30 years, accounting for 35% of the participants, followed by 31-35 years (30%), 20-25 years (20%) and 36-40 years (15%). Regarding BMI, the majority of the women were in the normal weight category (60%), with smaller proportions categorized as overweight (25%), obese (10%) and underweight (5%). In terms of AMH levels, the distribution was relatively even, with 36% of women having medium AMH levels, 34% having low levels and 30% having high levels. Antral follicle count (AFC) levels showed a similar pattern, with 39% of the participants having a medium AFC, 31% with a low AFC and 30% with a high AFC. When analyzing the number of oocytes retrieved, 44% of the participants were categorized as having a medium retrieval rate, 34% had a

low rate and 22% had a high rate. Clinical pregnancy was achieved in 49% of the women, while 51% did not achieve pregnancy. The duration of infertility varied, with half of the participants (50%) experiencing 2-4 years of infertility, 25% with less than 2 years and 25% with more than 4 years of infertility. The clinical pregnancy outcomes among the study population were almost evenly distributed, with 49% of the women achieving a clinical pregnancy, while 51% did not. The relationship between AMH levels and clinical outcomes revealed significant correlations. Women with high AMH levels had a notably higher likelihood of having a high antral follicle count (AFC), with 80% of this group falling into the high AFC category. This group also had the highest proportion of women with a high number of oocytes retrieved (50%) and the highest clinical pregnancy rate (70%).

In contrast, women with medium AMH levels showed a moderate association with high AFC (61.1%), a lower proportion of high oocytes retrieved (25%) and a clinical pregnancy rate of 50%. Those with low AMH levels had the lowest outcomes, with only 20.6% achieving a high AFC, 5.9% having a high number of oocytes retrieved and a 29.4% clinical pregnancy rate. The p-values for these associations were all less than 0.001, indicating statistically significant differences between the groups.

Table 1: Basic characteristics of the study population (n=100).

Category	Frequency (N)	(%)
Age (in years)		
20-25	20	20.0
26-30	35	35.0
31-35	30	30.0
36-40	15	15.0
BMI (kg/m²)		
Underweight (<18.5)	5	5.0
Normal (18.5-24.9)	60	60.0
Overweight (25-29.9)	25	25.0
Obese (≥30)	10	10.0
AMH level		
High (>6.8 ng/ml)	30	30.0
Medium (2.2-6.8 ng/ml)	36	36.0
Low (0.3-2.1 ng/ml)	34	34.0
AFC level		
High	30	30.0
Medium	39	39.0
Low	31	31.0
Oocytes retrieved		
High	22	22.0
Medium	44	44.0
Low	34	34.0
Clinical pregnancy		
Yes	49	49.0
No	51	51.0
Duration of infertility (in years)		
<2	25	25.0
2-4	50	50.0
>4	25	25.0

Table 2: Distribution of clinical pregnancy outcomes (n=100).

Clinical pregnancy	Frequency (N)	(%)
Yes	49	49.0
No	51	51.0

Table 3: Relationship between AMH Levels and clinical outcomes (n=100).

AMH level	AFC level (high)	Oocytes retrieved (high)	Clinical pregnancy (yes)
High (>6.8 ng/ml)	24 (80.0%)	15 (50.0%)	21 (70.0%)
Medium (2.2-6.8 ng/ml)	22 (61.1%)	9 (25.0%)	18 (50.0%)
Low (0.3-2.1 ng/ml)	7 (20.6%)	2 (5.9%)	10 (29.4%)
P value	<0.001	<0.001	<0.001

DISCUSSION

The current study aimed to evaluate the efficacy of AMH as a predictor of ovarian reserve and its correlation with fertility treatment outcomes in a cohort of women in Bangladesh. The findings of this study revealed a significant relationship between AMH levels, antral follicle count (AFC), the number of oocytes retrieved and clinical pregnancy rates, aligning with previous research while offering new insights into the context of this population. Age distribution within the study population, with the majority being between 26-30 years, highlights the demographic trend where most women seeking fertility treatments are in their late reproductive years. This trend is consistent with global patterns observed in similar studies, where younger women typically have higher ovarian reserve and better fertility outcomes compared to older age groups. For instance, a study by Lukaszuk et al, demonstrated that age is a critical factor influencing live birth rates, with younger women showing significantly higher success rates in assisted reproductive technologies (ART).[17]

The BMI distribution in the current study also aligns with findings from Moslehi et al, who reported that obesity negatively impacts ovarian reserve markers such as AMH, further complicating fertility treatment outcomes.[18] The distribution of AMH levels in our study population was fairly even, with 36% having medium levels, 34% low levels and 30% high levels. This distribution is reflective of the varied ovarian reserves within the population and is consistent with findings from a study by Şahmay et al, which suggested that while AMH levels tend to predict ovarian reserve and response to stimulation, they may not always correlate directly with clinical pregnancy rates.[19] However, our study found a significant correlation between high AMH levels and high AFC, with 80% of women with high AMH levels also having high AFC, supporting the findings of a meta-analysis by Broer et al,

which identified both AMH and AFC as accurate predictors of ovarian response in controlled ovarian hyperstimulation.[20] The number of oocytes retrieved, which was positively associated with higher AMH levels in our study, further underscores the predictive value of AMH in fertility treatments. Similar correlations have been reported in previous studies, including those by Kotanidis et al, who found that both AMH and AFC are valuable for predicting the number of oocytes retrieved during IVF cycles.[21]

Our study also observed that women with higher AMH levels had significantly better clinical pregnancy rates, with 70% of women with high AMH achieving pregnancy, compared to 29.4% in the low AMH group. This finding is consistent with the study by Şahmay et al, which reported that higher AMH levels were associated with increased clinical pregnancy rates, particularly in women of advanced reproductive age.[22] Interestingly, while AMH was a strong predictor of ovarian reserve and response, it did not always translate into successful pregnancy outcomes in some studies.

For example, in a study by Mutlu et al, AFC was found to be a better predictor of ovarian response than AMH, especially in predicting poor ovarian response.[23] Our study adds to this body of evidence by demonstrating that while AMH is a critical marker for predicting ovarian reserve, its utility in predicting clinical pregnancy may be enhanced when used in conjunction with AFC and other factors, as seen in the study by Liao et al, which emphasized the importance of considering multiple parameters, including female age and the cause of infertility, in predicting clinical outcomes.[24]

In summary, the findings of this study support the use of AMH as a reliable predictor of ovarian reserve and fertility treatment outcomes. However, they also highlight the necessity of a comprehensive approach that includes AFC, age and other individual factors to improve the predictive accuracy for clinical pregnancy. The significant correlations observed between AMH levels, AFC, oocyte retrieval and clinical pregnancy rates in this study are consistent with previous research, reinforcing the role of AMH as a central biomarker in reproductive medicine while also suggesting areas where additional markers may further refine treatment strategies.

CONCLUSION

The findings of this study underscore the significance of AMH as a reliable predictor of ovarian reserve and fertility treatment outcomes in women undergoing assisted reproductive technologies in Bangladesh. The study demonstrated strong correlations between AMH levels, antral follicle count (AFC), oocyte retrieval and clinical pregnancy rates, suggesting that AMH is a valuable biomarker for assessing reproductive potential. However, while AMH is effective in predicting ovarian response, its predictive power for clinical pregnancy outcomes may be enhanced when combined with other factors such as AFC, patient age and the underlying cause of infertility. This comprehensive approach can help clinicians better tailor fertility treatments to individual patient profiles, improving the chances of successful outcomes. Further research is recommended to explore additional biomarkers and refine predictive models for enhanced fertility treatment success.

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