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Relationship between Serum Anti-mullerian Hormone and Sperms Characteristics in Infertile Iraqi Men

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ABSTRACT

The objective of the research was to investigate the potential correlation between serum anti-Müllerian hormone (AMH) levels and sperm parameters such as sperm concentration, sperm count, sperm motility, and sperm morphology.

A hundred male patients voluntarily participated in the study at a private andrology clinic in Al Najaf Al Ashraf City, Iraq, between October 2023 and November 2023. The patients were divided into four groups: 26 patients with oligozoospermia, 21 patients with asthenozoospermia, 28 patients with oligoasthenoteratozoospermia (OAT), and those with normozoospermia. Semen quality was evaluated by conducting a semen analysis according to the 2021 World Health Organization guidelines. The ELISA method was employed to measure the levels of AMH in serum samples. Biotechnology Instrument, USA, manufactured the ELIZA components that were used.

The average age of the participants was 30.85 ± 0.70 years, BMI was 27.60 ± 0.58 kg/m2, and serum AMH was 2.08 ± 0.11 ng/ml. We did not find any negative or positive correlation between AMH levels in the blood with sperm concentration, sperm count, sperm motility, and sperm morphology in all study groups. The results of this study showed that serum AMH is an unreliable marker for predicting spermatogenic abnormalities.

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KEYWORD

Anti-Mullerian hormone / Seminal Plasma / Sperm Count / Sperm Motility

1. Introduction

Infertility is a medical condition characterized by the inability to conceive a child after engaging in regular unprotected sexual activity for over one year or more. It can result from either sexual or non-sexual reasons, impacting around 10-15% of couples globally **(Khalaf, Abbood & AL-Ammar 2023 [1]).** A wide variety of environmental, genetic, and hormonal factors are linked to male infertility **(Dhafiri et al.,2022 [2])**. Nevertheless, it is estimated that approximately 30% of cases are idiopathic, which implies that the cause is unknown **(Fainberg & Kashanian, 2019 [3]).**

Anti-Mullerian hormone (AMH) is part of the transforming growth factor beta (TGF-β) superfamily. AMH is a glycoprotein that consists of two identical subunits and is connected by disulfide bonds. It has a molecular weight of 140 kilodaltons. The AMH gene is located on the p-arm of chromosome 19 **(Kucera et al., 2016 [4]).** Sertoli cells in males synthesize AMH during embryonic sex differentiation, which in turn triggers the regression of the Müllerian ducts. In humans, this process occurs within the initial 8 weeks of gestation **(Barbotin et al., 2019[5])**. In the absence of hormone production from the testes, the Müllerian ducts undergo automatic development, whereas the Wolffian ducts, which are responsible for the formation of male reproductive ducts, undergo automatic degeneration. The most prominent and precise action, facilitated by the AMH type II receptors, is the programmed cell death (apoptosis) of the target tissue, specifically the fetal Müllerian ducts **(Picard et al.,2017 [6])**. Throughout fetal development and even after birth, AMH continues to be secreted in high amounts until the onset of

puberty **(Al-Murshidi et al., 2019 [7])**. During puberty, Leydig cells produce an increase in testosterone (T), which leads to a decrease in AMH levels that remain at a significantly low level throughout an individual's adult life **(Edelsztein et al., 2016 [8])**. This decrease is caused by the maturation of Sertoli cells and the progression of meiotic germ cells within the seminiferous tubules **(Boukari et al., 2009 [9]; Aksglaede et al., 2010 [10])**. Additionally, in adulthood, Sertoli cells release AMH in two directions: the upper pole into the seminiferous tubules and the lower pole towards the interstitium and circulation. Consequently, the concentration of AMH in the circulation is diminished while it increases in seminal plasma **(Rey et al., 2003[11])**. Moreover, the concentrations of serum AMH during the prepubertal phase are approximately ten to twenty times. Higher than those observed in puberty **(Grinspon et al., 2011[12]).** The normal level of serum AMH in healthy men between the ages of 21 and 64 was 1-13 ng/ml **(Aksglaede et al., 2010 [10]).** The purpose of the current investigation was to examine the correlation between serum concentrations of AMH and sperm parameters in male patients with a variety of sperm abnormalities.

2. Patients and Methods

The ethical committee of the High Institute for Infertility Diagnosis and Assisted Reproductive Technologies at Al-Nahrain University granted sanction for this cross-sectional study. The investigation comprised 100 infertile men whose ages ranged from 20 to 45 years. The history of infertile men included their age, smoking, and body mass index (BMI). The specimens were submitted by individuals who visited a private andrology clinic in Al Najaf, Iraq, for consultations on male infertility between October 2023 and

November 2023. Blood and semen samples were collected from the participants of the study. The patients were divided into four separate groups based on the results of the semen analysis: 26 patients with oligozoospermia, 21 patients with asthenozoospermia, and 28 patients with oligoasthenoteratozoospermia (OAT). Males with cryptozoopermia, azoospermia, and endocrine diseases were excluded from this study.

Semen Analysis: A sample of seminal fluid was obtained by masturbation in a quiet, private room adjacent to the semen analysis place after two to seven days of abstention from sexual activity. Subsequently, the sample was quickly transferred to a disposable cup that was sterile, dried, and clean. The container label contains the following information: the name of the individual, their age, the duration of their abstinence, and the time of sample collection. The specimens were left in an incubator at 37º C for thirty minutes. to facilitate liquefaction. The sample was subjected to both macroscopic and microscopic examinations after the liquid semen was slightly mixed for a short time **(WHO, 2021[13]).**

Hormone Analysis: The blood and semen samples were collected and centrifuged at a rate of 2500 rpm per minute for 10 minutes. Then, serum and seminal plasma were separated and stored in aliquots at a temperature of -20 °C until the day of analysis to evaluate AMH in them. The ELISA assays were utilized following the manufacturer's instructions **(Biotechnology, USA [14])** to quantify the levels of AMH. AMH (ELK2336).

3. Statistical analysis

The data were analyzed using Microsoft Office 2010 and the Statistical Package for the Social Sciences (SPSS) version 23.0. Descriptive statistics, including frequency, range, mean, and standard error, were calculated to illustrate the data. The analysis of variance

(ANOVA) measure was employed to compare more than two distinct groups. Statistical significance was recognized when the p-value was equal to or less than 0.05, and the correlation between continuous variables was determined using Pearson's correlation coefficient (r).

4. Results

The participants' mean age was 30.85 ± 0.70 years, their BMI was 27.60 ± 0.58 kg/m2, and their serum AMH level was 2.08 ± 0.11 ng/ml. Fifty-three (52.0%) of the patients were smokers, and 47 (47.0%) were non-smokers. Table 1 shows that there were no significant differences between the four examined groups in terms of age (p=0.113), smoking (p=0.250), body mass index (p=0.460), and serum AMH levels (p= 0.288).

Table (1): **Age, Smoking, BMI, and serum AMH levels of the infertile men in current study**

Parameters (Mean±SE)		**Normozoo-spermia N.=25**	**Oligozoo-spermia N.=26**	**Asthenozoo-aspermia**	**AOT N.=28**	**p-value**
Age (years)		33.24± 1.87	30.69 ±0.85	33.00 ±1.25	30.04 ±1.23	0.113 ∀ NS
BMI (kg/m^2)		28.33± 1.57	27.22 ±0.58	26.07 ±0.91	28.47 ±1.25	0.460 ∀ NS
Smoking status	**Smokers**	13 (52.0%)	18 (69.2%)	9 (42.9%)	12 (42.9%)	0.250 ∀NS
	Nonsmokers	12 (48.0%)	8 (38.2%)	12 (57.1%)	15 (53.6%)	
Serum AMH (ng/ml)		2.33 ± 0.24	1.73 ± 0.23	1.81± 0.22	2.05 ± 0.23	0.288 ∀ NS

NS: Not significant (p > 0.05); **AOT:** Astheno-oligoteratozoospermia; **∀:** Analysis of variance (ANOVA)

Table 2 revealed that there was no statistically significant positive or negative association between serum AMH levels and seminal fluid parameters. Table 3 indicated that there was no statistically significant

association, either positive or negative, relationship between the level of serum AMH and the measures of semen quality in individuals with oligozoospermia. Table 4 presents that the group with asthenozoospermia did not exhibit any significant positive correlation between serum AMH levels and semen parameters. Table 5 shows there were no statistically significant positive or negative correlations observed between serum AMH and various semen parameters, including sperm concentration, sperm count, percentage of progressively motile sperm, percentage of non-progressively motile sperm, immotile sperm, and Abnormal morphology sperm.

Table (2): **Relationship of serum AMH with semen parameters among normozoospermia group(N=25)**

Parameters (Mean±SE)		Serum AMH	Seminal AMH
Sperm's concentration	r	- 0.062	0.033
	p-value	0.767 NS	0.851 NS
Sperm's count	r	0.303	- 0.127
	p-value	0.142 NS	0.544 NS
Progressively motile sperms %	r	- 0.168	0.030
	p-value	0.423 NS	0.886 NS
Non-Progressively motile sperms%	r	0.341	0.138
	p-value	0.096 NS	0.511 NS
Immotile sperms %	r	- 0.015	- 0.107
	p-value	0.943 NS	0.611 NS
Normal morphology %	r	0.047	0.269
	p-value	0.824 NS	0.194 NS

Table (3): **Association of serum AMH with semen parameters among oligozoospermia group(N=26)**

Parameters (Mean±SE)		Serum AMH	Seminal AMH
Sperm's concentration	r	- 0.145	- 0.249
	p-value	0.481 NS	0.220 NS
Sperm's count	r	- 0.118	- 0.148
	p-value	0.565 NS	0.472 NS
Progressively motile sperms %	r	- 0.122	- 0.272
	p-value	0.552 NS	0.179 NS
Non-Progressively motile sperms %	r	0.092	0.331
	p-value	0.654 NS	0.098 NS
Immotile sperms %	r	0.061	- 0.013
	p-value	0.767 NS	0.950 NS
Normal morphology %	r	- 0.137	- 0.008
	p-value	0.505 NS	0.968 NS

Table (4): **Correlations of serum AMH with semen parameters and among asthenozoospermia group(N=21)**

Parameters (Mean±SE)		Serum AMH	Seminal AMH
Sperm's concentration	r	- 0.012	- 0.221
	p-value	0.960 NS	0.335 NS
Sperm's count	r	- 0.125	- 0.051
	p-value	0.589 NS	0.827 NS
Progressively motile sperms %	r	- 0.138	- 0.138
	p-value	0.551 NS	0.551 NS
Non-Progressively motile sperms %	r	0.124	- 0.157
	p-value	0.591 NS	0.496 NS
Immotile sperms %	r	- 0.014	- 0.050
	p-value	0.950 NS	0.829 NS
Normal morphology %	r	0.436	0.436
	p-value	0.148 NS	0.051 NS

Table (5): **Association of serum and seminal fluids AMH with semen parameters and among AOT group(N=28)**

Parameters (Mean±SE)		Serum AMH	Seminal AMH
Sperm's concentration	r	- 0.178	- 0.080
	p-value	0.385 NS	0.697 NS
Sperm's count	r	- 0.230	- 0.017
	p-value	0.258 NS	0.935 NS
Progressively motile sperms %	r	0.103	- 0.059
	p-value	0.603 NS	0.767 NS
Non-Progressively motile sperms %	r	0.040	0.243
	p-value	0.842 NS	0.212 NS
Immotile sperms %	r	- 0.113	- 0.064
	p-value	0.568 NS	0.746 NS
Abnormal morphology sperms %	r	- 0.187	0.062
	p-value	0.340 NS	0.756 NS

5. Discussion

Although the anti-Müllerian hormone is a reliable marker for evaluating reserve eggs in females, it is therefore considered one of the factors causing infertility in women. However, in recent years, there has been widespread interest in studying this hormone in men and its correlation to infertility and spermatogenesis because AMH is secreted from Sertoli cells located in the seminiferous tubules in the testicle, which is the same site where germ cells are produced and transformed into mature sperm. Publications have conflicting views on whether serum AMH can serve as a dependable biomarker for decreased spermatogenesis in males suffering from infertility.

The purpose of the current study was to evaluate the correlation of serum AMH with sperm characteristics in four groups: normozoospermic,

oligozoospermia, asthenozoospermia, and OAT. Serum AMH levels are important clinical indicators for infants and children in predicting testicular function. Since AMH is only found in mature Sertoli cells, it can serve as a marker for semen quality **(Turhan et al., 2022 [15])**. We found no significant variations in serum AMH levels between the study groups, contradicting the results of a previous study conducted by **(Al-Naqeeb and Fakhrildin 2015 [16])**. However, some studies have data similar with our results **(Hassan, Ibrahim & El-Taieb 2020 [17])**. Also, the current study found no significant differences among groups in terms of age, body mass index, and smoking. These findings indicate that the demographic variables being examined did not affect this study. Nevertheless, the study's characteristics, such as the small sample size, one-time administration, and the lack of representation of the entire community of infertile males, Impose restrictions on these results. Several studies have confirmed the influence of demographic parameters such as age and BMI on spermatogenesis **(Shi et al., 2018 [18]; Alkubaisy, Rahim & Alkawaz, 2023 [19])**. Especially the effect of smoking on the DNA integrity of sperm and its direct relationship to male infertility **(Adnan, Abdulwahid & Abbood 2023 [20])**

Prior research has investigated the association between blood AMH levels and the quality of semen, but the results have been conflicted. Our results did not show any statistically significant correlations between serum AMH concentrations with sperm concentration, sperm count, sperm motility, and sperm morphology in the four study groups. Several studies have shown evidence that suggests a positive correlation between blood levels of AMH and men with normal sperm, oligozoospermic men, and asthenozoospermic men **(Peng et al.,2017 [21]; Liu et al., 2021[22].**

Holt et al.,2023 [23]). Nevertheless, other studies have found no substantial differences in serum AMH levels and sperm characteristics among males with various infertility causes **(Andersen et al., 2017 [24]; Aksglaede et al., 2018 [25]; Benderradji et al., 2022[26])**. In adult men, it is believed that AMH has a role in the proliferation of germ cells **(Fujisawa et al., 2002 [27])** and the development of the early stages of spermatocytes **(Turhan et al., 2022 [15])**. It also has an autocrine effect on Sertoli cells and a paracrine effect on Leydig cells, which works directly to inhibit Leydig cell differentiation and steroidogenesis and might be involved in sperm motility **(Matuszczak et al.,2013[28]; Iliadou et al., 2015 [29]).**

6. Conclusion

Although the anti-Müllerian hormone is a distinctive marker of Sertoli cell function, during this study, we did not observe any negative or positive correlations between AMH serum levels and spermatogenesis dysfunction. Therefore, we believe, based on these results, that serum AMH cannot be adopted as an effective marker in diagnosing infertility in men.

7. Limitation of the study

One of the study's limitations is its relatively small sample size, which would restrict how broadly the findings can be applied. Furthermore, the analysis was predicated on particular measurements and methodologies, which could cause biases in the measurements.

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Author Contribution

Zainab Ali Jaber performed the study, and Amal Abdulwahid Mohammed and Ali Ibrahim Rahim supervised the work .

Conflict of Interest

The authors declare no conflict of interest .

Ethical Clearance

The study was approved by the Ethical Approval Committee.

Financial Disclosure

There is no financial disclosure .

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