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Serum dehydroepiandrosterone sulfate and anti-Müllerian hormone levels as predictors of polycystic ovarian syndrome and premature ovarian failure in Iraqi women of reproductive age

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ABSTRACT

Infertility is defined as the inability of a couple to achieve pregnancy after one year of regular, unprotected sexual intercourse. Among its many causes are ovulatory disorders such as polycystic ovary syndrome (PCOS), primary ovarian insufficiency (POI; formerly known as "premature ovarian failure"), and anatomical abnormalities of the reproductive system. This case-control study included 120 women aged 20–40 years, divided into two groups: 60 healthy controls and 60 infertile patients, comprising 47 with PCOS and 13 with POI. Data were collected between November 2023 and May 2024 at the Gynaecology Hospital in Kerbala (Iraq). The serum levels of dehydroepiandrosterone sulfate (DHEA-S), anti-Müllerian hormone (AMH), luteinizing hormone (LH), follicle-stimulating hormone (FSH), oestradiol (E2), prolactin, and testosterone were measured using enzyme-linked immunosorbent assay (ELISA). In the PCOS group, serum AMH and DHEA-S levels were found to be significantly elevated (p<0.0001), while in the POI group, both markers were found to be significantly reduced (p<0.0001), compared to those of the control group. Moreover, in the PCOS group, the serum FSH levels were found to be significantly decreased (p<0.0001), whereas the prolactin, tes-

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tosterone, E2, and LH levels were found to be elevated. Conversely, in the POI group, the serum FSH, prolactin, testosterone, and LH levels were found to be significantly increased (p<0.0001), while the E2 levels were found to be decreased when compared to those of the control group. These findings suggest that AMH and DHEA-S are reliable biomarkers for assessing ovarian function, and could serve as sensitive indicators for the early diagnosis of PCOS and POI in women of reproductive age.

1. Introduction

Infertility refers to the inability to achieve pregnancy after one year of frequent, unprotected, and regular sexual intercourse[1]. It is now recognized as a global health concern by the World Health Organization, affecting approximately 48.5 million couples worldwide. Among the causes of female infertility are ovulatory disorders (25%), tubal factors (20%), and cervical abnormalities (approximately 3%)[2]. Ovarian disorders represent a significant clinical challenge and encompass several conditions. One of the most prevalent is polycystic ovary syndrome (PCOS); an endocrine disorder affecting women of reproductive age. PCOS is considered the most common cause of anovulatory infertility[3]. Although the precise pathophysiology of PCOS remains unclear, it is believed to involve hormonal imbalances, particularly elevated levels of androgens and other reproductive hormones[4]. Primary ovarian insufficiency (POI), previously referred to as "premature ovarian failure", is another complex reproductive endocrine disorder, with a global prevalence of approximately 3.5%[5]. POI is characterized by impaired ovarian function, leading to reduced oestrogen production, altered gonadotropin hormone levels, and amenorrhea, ultimately resulting in infertility[6].

Dehydroepiandrosterone sulfate (DHEA-S) is the most abundant circulating steroid hormone and serves as a key precursor of adrenal androgens[7]. It is secreted primarily by the zona reticularis of the adrenal cortex, as well as by the ovarian theca cells, the brain, and the gonads. DHEA-S plays a central role in the biosynthesis of oestradiol (E2) and testosterone. A diminished ovarian reserve (defined as a reduced quantity and quality of oocytes) has been associated with low DHEA-S levels. Conversely, elevated DHEA-S levels are often observed in women with PCOS; the leading cause of female infertility[8].

The anti-Müllerian hormone (AMH) is a glycoprotein secreted by granulosa cells of preantral and small antral follicles in the ovaries. It plays a critical role in folliculogenesis and growth differentiation. AMH is considered a highly specific and reliable marker of ovarian reserve, as it reflects the size of the growing follicular pool. Studies have shown that infertile women tend to have higher AMH levels than healthy controls, underscoring its utility in assessing ovarian health, infertility risk, and miscarriage potential. Moreover, aging significantly influences AMH levels, with women over the age of 35 typically experiencing reduced fertility and oocyte production[9].

The primary objective of this study was to investigate the relationship between ovulatory infertility and the serum levels of AMH and DHEA-S in Iraqi women.

2. Methodology

A case-control study was conducted in order to evaluate the fertility status and the hormonal profiles associated with POI and PCOS among women in Karbala, Iraq. Data were collected between November 2023 and May 2024 from the Fertility Unit at the Womens Obstetrics and Gynaecology Hospital in Karbala (Iraq). Participants were divided into two main groups: group A (consisted of 60 healthy women with no history of infertility, serving as the control group) and group B (consisted of 60 infertile wom-

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Table 1. Comparison of the serum levels of the herein studied biomarkers in polycystic ovary syndrome (PCOS), and primary ovarian insufficiency (POI) infertile patients, as compared to healthy control women. Abbreviations used: AMH, anti-Müllerian hormone; DHEA-S, dehydroepiandrosterone sulfate; E2, oestradiol; FSH, follicle-stimulating hormone; LH, luteinizing hormone; SD, standard deviation.

Parameters	Groups	Mean	SD	*p*-value
AMH (ng/mL)	PCOS group	10.99	2.37	0.0002
	POI group	0.6	0.39	
	Control group	3.11	0.60	
DHEA-S (μL)	PCOS group	2.79	0.53	<0.0001
	POI group	0.54	0.23	
	Control group	0.89	0.12	
FSH (mIU/mL)	PCOS group	5.83	2.30	0.0002
	POI group	33.51	3.61	
	Control group	8.10	2.15	
Prolactin (ng/mL)	PCOS group	29.24	4.99	0.0007
	POI group	26.06	3.04	
	Control group	13.44	3.30	
Testosterone (pg/mL)	PCOS group	58.53	17.39	0.0004
	POI group	7.24	2.01	
	Control group	5.34	0.90	
E2 (pg/mL)	PCOS group	186.25	48.23	<0.0001
	POI group	10.07	1.43	
	Control group	24.93	7.23	
LH (mIU/mL)	PCOS group	17.15	5.81	<0.0001
	POI group	19.77	2.88	
	Control group	2.93	1.28	

en diagnosed with ovarian disorders). This patient group was further subdivided into group I (consisting of 47 women diagnosed with PCOS) and group II (consisting of 13 women diagnosed with POI). Diagnoses were confirmed by consultant gynaecologists using transvaginal pelvic ultrasound (Toshiba Xario prime; UK), while PCOS was diagnosed according to the Rotterdam criteria.

The serum levels of AMH, DHEA-S, luteinizing hormone (LH), follicle-stimulating hormone (FSH), prolactin, E2, and testosterone were measured by using an enzyme-linked immunosorbent assay (ELISA), following the manufacturer's instructions (ELISA Kit; Cloud-Clone Corp., USA).

All participants provided informed consent prior to enrolment, in accordance with the Declaration of Helsinki. The study protocol and data collection procedures were reviewed and approved by the Ethics Committee of the Department of Clinical Laboratories of the College of Applied Medical Sciences of the University of Kerbala (approval number: IQ.UOK.CAMS.DCL.REC.4; date: 1/9/2024).

Statistical analysis was performed by using SPSS version 23. A *p*-value lower than 0.05 was considered as statistically significant. The homogeneity of variance was assessed using Levene's test, while data normality was evaluated using the Shapiro–Wilk test. One-way analysis of variance (ANOVA) was used for comparisons across groups, followed by Scheffé's and Duncan's *post hoc* tests for within-group comparisons. Graphs were generated using GraphPad Prism version 9.

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3. Results and Discussion

In the PCOS group, serum AMH and DHEA-S levels were found to be significantly elevated (p<0.0001), while in the POI group, both markers were found to be significantly reduced (p<0.0001), compared to those of the control group (Table 1). Moreover, in the PCOS group, the serum FSH levels were found to be significantly decreased (p<0.0001), whereas the prolactin, testosterone, E2, and LH levels were found to be elevated (Table 1). Conversely, in the POI group, the serum FSH, prolactin, testosterone, and LH levels were found to be significantly increased (p<0.0001), while the E2 levels were found to be decreased when compared to those of the control group (Table 1).

The elevated serum AMH levels observed in PCOS patients may be attributed to the increased number of small antral and preantral follicles, which are known to secrete AMH. It has been reported that granulosa cells in PCOS follicles produce up to 75 times more AMH than those in normal follicles. In contrast, the markedly reduced AMH levels in POI patients reflect diminished ovarian reserve and declining follicular activity, thereby reinforcing AMH's role as a sensitive biomarker for the early detection of POI.

The elevated serum DHEA-S levels observed in our PCOS patients may result from increased adrenal androgen production, possibly triggered by stress-related activation of the hypothalamic–pituitary–adrenal axis. This elevation contributes to the endocrine and metabolic disturbances characteristic of PCOS. Conversely, the reduced serum DHEA-S levels observed in our POI patients are consistent with impaired steroidogenesis and diminished ovarian reserve, as DHEA-S is a precursor in oestrogen biosynthesis.

On the other hand, the significant increase in the serum FSH levels among POI patients is likely due to reduced oestrogen feedback on the hypothalamic–pituitary axis, prompting compensatory gonadotropin release. This elevation correlates with the severity of ovarian failure. In PCOS, FSH levels were found decreased, likely due to disrupted gonadotropin-releasing hormone pulsatility, which favours LH over FSH secretion, thereby contributing to follicular arrest and anovulation.

Serum prolactin levels were found to be elevated in both PCOS and POI groups. In PCOS, hyperprolactinaemia may contribute to anovulation and polycystic ovarian morphology, although the underlying mechanisms remain unclear. In POI, the elevated prolactin may interfere with the synthesis of oestrogen and progesterone, further disrupting ovulatory function and menstrual regularity.

Serum testosterone levels were found to be markedly elevated in PCOS patients; a finding that is consistent with the hyperandrogenic profile of the syndrome. This may be the result of an increased LH-induced stimulation of the theca cells or insulin resistance, both of which enhance androgen production. In POI, serum testosterone levels were only found to be mildly elevated, likely due to residual adrenal or ovarian androgen secretion despite diminished ovarian function.

Serum LH levels were significantly elevated in both patient groups. In PCOS, this may reflect reduced hypothalamic sensitivity to negative feedback from E2 and progesterone, contributing to the hyperandrogenic state. In POI, elevated LH may result from diminished ovarian hormone production and impaired feedback regulation.

Finally, serum E2 levels were found to be significantly elevated in PCOS patients, likely due to an increased aromatization of androgens in the ovarian theca cells under elevated LH-induced stimulation. This hormonal imbalance contributes to follicular arrest and oligo-ovulation. In contrast, POI patients exhibited significantly reduced serum E2 levels, reflecting impaired follicular development and oestrogen synthesis due to ovarian insufficiency.

At this point, one should admit that a key limitation of this study is the relatively small sample size of POI patients. Future research should aim to include a larger cohort in order to enhance the statistical power and generalizability of the findings.

4. Conclusion

Our study has concluded that the serum AMH and DHEA-S were significantly elevated in women with PCOS compared to those of healthy controls, where-

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as these hormone levels were markedly reduced in women with POI. These hormonal alterations may play a role in the pathophysiology of both the reproductive and metabolic features of PCOS and POI. Furthermore, AMH and DHEA-S may serve not only as sensitive biomarkers for ovarian reserve and early diagnosis, but also as potential surrogate indicators of cardiovascular risk; an area warranting further investigation.

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Conflicts of interest

None exist.

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References

1. Akbaribazm M., Goodarzi N., Rahimi M. Female infertility and herbal medicine: an overview of the new findings. *Food Sci. Nutr.* 9(10), 5869–5882, 2021. DOI: 10.1002/fsn3.2523
2. Madziyire M.G., Magwali T.L., Chikwasha V., Mhlanga T. The causes of infertility in women presenting to gynaecology clinics in Harare, Zimbabwe; a cross sectional study. *Fertil. Res. Pract.* 7(1), 1, 2021. DOI: 10.1186/s40738-020-00093-0
3. Shareef M., Hamdan M.N.A. Letrozole ovulation induction in clomiphene citrate poor responders polycystic ovary patients. *Ann. Trop. Med. Public Health* 23(7), 914–922, 2020. DOI: 10.36295/ASRO.2020.23712
4. Petraglia F., Fauser B.C. (editors). Female Reproductive Dysfunction. Cham: *Springer*, 2020. DOI: 10.1007/978-3-030-14782-2
5. van Zwol-Janssens C., Pastoor H., Laven J.S.E., Louwers Y.V., Jiskoot G. Sexual function in women with premature ovarian insufficiency (POI): systematic review and meta-analysis. *Maturitas* 184, 107994, 2024. DOI: 10.1016/j.maturitas.2024.107994
6. Mo'minjonovna B.M. Reproductive changes in women with premature ovarian failure. *J. Med. Genet. Clin. Biol.* 1(2), 83–86, 2024. DOI: 10.61796/jmgcb.v1i2.292
7. Naelitz B.D., Sharifi N. Through the looking-glass: reevaluating DHEA metabolism through *HSD3B1* genetics. *Trends Endocrinol. Metab.* 31(9), 680–690, 2020. DOI: 10.1016/j.tem.2020.05.006
8. Zhang J., Jia H., Diao F., Ma X., Liu J., Cui Y. Efficacy of dehydroepiandrosterone priming in women with poor ovarian response undergoing IVF/ICSI: a meta-analysis. *Front. Endocrinol. (Lausanne)* 14, 1156280, 2023. DOI: 10.3389/fendo.2023.1156280
9. Alabbasi I.A., Al-Jawadi Z.A.M. The relationship of anti-Mullerian hormone (AMH) with infertile women. *Coll. Basic Educ. Res. J.* 19(1), 753–762, 2023.

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