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Relationship between semen parameters an reproductive hormones in men with abnormal semen analysis

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ABSTRACT

Seminal fluid analysis is an essential screening test, expresses critical information about sperms count, concentration, progressive motility, and morphology. Sperm production and maturation usually under the control of pituitary and testicular hormones. Thus, understanding the endocrine profile and its' interaction with semen parameters is an important step during the evaluation of fertility status of men. **The purpose**: The study aims to evaluate the interaction between hormonal profile (follicle stimulating hormone (FSH), luteinizing hormone (LH), and testosterone) and semen parameters in a group of men with impaired semen parameters.

Method: It is a comparative study which included a total of 90 men, 70 men were divided into 5 groups according to the results of SFA and 20 men were considered as a control group who had normal SFA. Serum was taken from all for men measuring testosterone, LH, and FSH concentrations using special Kits and the Enzyme-Linked Immunosorbent Assay (ELISA).

Result: The study showed that serum levels of FSH, LH and testosterone were significantly high (p-value $\leq$ 0.05) in azoospermia group followed by oligoasthenoteratozospermia and oligozospermia respectively. Together, men with impaired semen parameters had significantly higher (p-value 0.023) serum level of FSH than control group, with no significant difference regarding both serum levels of LH and testosterone. **Conclusions:** There is a close interaction between semen parameters and hormonal profile of men who complain with subfertility and assessing hormonal profiles together with seminal fluid analysis is essential during the evaluation of fertility potential of such group of men.

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Keywords: FSH, LH, Testosterone, Semen parameters.

INTRODUCTION

The inability of a man to conceive a woman with demonstrated reproductive capacity is known as male infertility. In the past, women were primarily blamed for infertility in couples, which meant that they bore the majority of the psychological and social costs. Cultural attitudes, a lack of awareness, and a lack of scientific knowledge are the main causes of this misunderstanding. After ruling out female-related causes and confirming that semen parameters do not match World Health Organization standards, male infertility is diagnosed [1].The known causes of male infertility are usually classified according to the location of the dysfunction into pre-testicular, testicular, and post-testicular categories [2]. Studies have shown that male factors are responsible for 40-50% of male infertility cases [3, 4]. Because the cause of infertility in more than half of male infertility cases is unknown, this condition is classified as idiopathic [5]. In addition to its role in regulating secondary sexual characteristics, testosterone is essential for the proper functioning and physiological development of the male reproductive organs. Maintaining high concentrations of testosterone within the testes is a prerequisite for efficient spermatogenesis and optimal sperm function [3]. Furthermore, androgenic activity is particularly important in supporting epididymal maturation and improving sperm motility [6]. Furthermore, the hypothalamic-pituitary-testicular axis must work together; any disruption in the pituitary gland's gonadotropic release of FSH and LH necessarily impairs testicular functioning, serving as a key cause of male infertility [7]. Semen is a complex biological fluid produced by the male reproductive glands and other reproductive organs, and may contain sperm. Its main role is to facilitate the fertilization of the female egg [8]. In humans, semen contains not only spermatozoa but also a number of biochemical components such as proteolytic and other enzymes, as well as fructose. These components comprise the seminal plasma, which increases sperm survival, provides energy, and serves as a suitable substrate for sperm motility [9]. Semen analysis and endocrine profiling are essential for assessing male reproductive capability and identifying subfertility [10]. The study aims to evaluate the interaction between hormonal profile (follicle stimulating hormone (FSH), luteinizing hormone (LH), and testosterone) and semen parameters in a group of men with impaired semen parameters.

MATERIALS AND METHODS

The study included 90 men. All were divided according to BIM an indicated in table (1), The age of the control subjects ranged from 20-45 years, while the age of patients ranged from 23-46 years. they recruited from the High Institute of Infertility Diagnosis and Assisted Reproductive Technology .Based on seminal fluid analysis, they divided into group 1(control group, n=20) exhibiting normal SFA and group 2, n=70 whom had abnormal SFA.

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Table 1. Classification of patient and control group according to BMI.

BMI	Control	patients
Normal	4	6
Over weight	12	44
Class I obesity	4	7
Class II obesity	0	9
Class III obesity	0	4

Group 2 was sub-divided according to semen parameter into:

- Oilgoastheonteratozoospermia (n=33)
- Asthenoteratozoospermia(n=18)
- Azoospermia(n=11)
- Asthenozoospermia(n=5)
- Oligozoospermia(n=3)

Semen sample collection

Seminal fluid was acquired from each man through masturbation between 9:00 and 11:00 a.m., following a period of obligatory sexual abstinence between 2-5 days. The samples were collected in to a clean, dry and sterile containers labeled with a serial number. Following a complete liquefaction in a room temperature, subsequent microscopic and macroscopic evaluations were carried out as soon as possible using World Health Organization (WHO) 2010 criteria.

Serological Analysis.

1. Serum sample collection and processing

"Venous blood from antecubital fossa were collected from all subjects (between 08:30 and 12:30 hours) after a period of at least 6 hours overnight fasting reduce metabolic interference. The serum was then separated from blood by centrifugation and divided into aliquots, aliquots were stored at -20°C until the time of hormonal analysis.

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2. Hormonal Profile with ELISA.

The serum levels of FSH, LH, and total testosterone were quantified using Commercial ELIA Kits and Enzyme-Linked Immunosorbent Assay (ELISA) platform Germany Company, Origin. All assays were performed according to the manufacturer's defined protocols, assuring good sensitivity and repeatability for the detection of reproductive biomarkers.

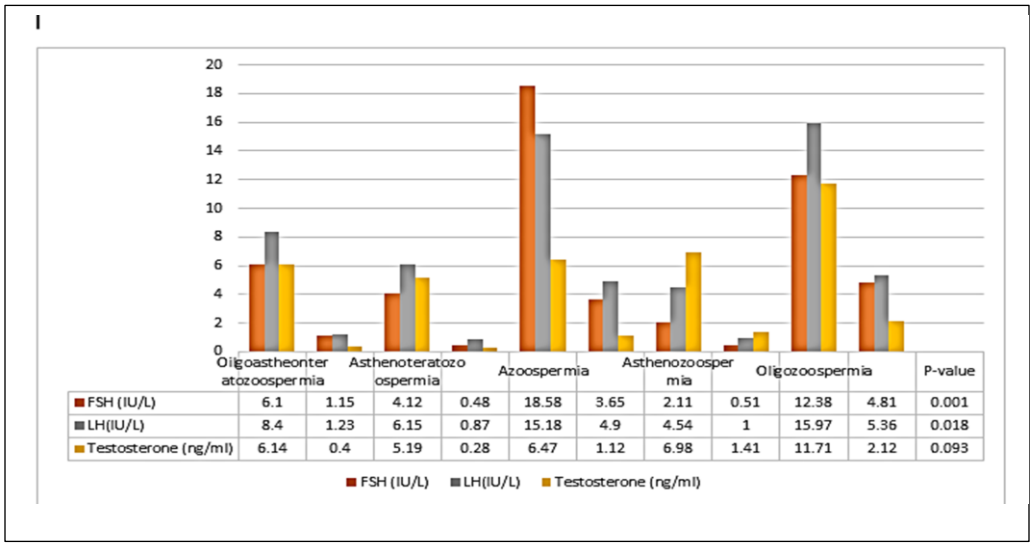
Data analysis.

Data were recorded using represented in Microsoft excel 2010 spreadsheet and analyzed using SPPS(version24). Mean and SD (Standard Deviation) were calculated and independent sample t test was used to assess the degree of statistical significance between the parameters. The variance was considered statistically significant at a p-value ≤ 0.05.

RESULTS

Hormone levels between subgroups

Figure 1 illustrates the serum levels of FSH, LH, and Testosterone Among different subgroups(Oilgoastheon, Teratozoospermia, Asthenoteratozoospermia, Azoospermia, Asthenozoospermia, and Oligozoospermiamen). A statistically significant increase in FSH and LH levels was observed among subgroup (p=0.001 and 0.0018respectively) whereas no significant difference was detected in testosterone level (p+0.0093). expressed as Mean ± SEM.



	Oilgoastheonteratozoospermia		Asthenoteratozoospermia		Azoospermia		Asthenozoospermia		Oligozoospermia		P-value
FSH (IU/L)	6.1	1.15	4.12	0.48	18.58	3.65	2.11	0.51	12.38	4.81	0.001
LH(IU/L)	8.4	1.23	6.15	0.87	15.18	4.9	4.54	1	15.97	5.36	0.018
Testosterone (ng/ml)	6.14	0.4	5.19	0.28	6.47	1.12	6.98	1.41	11.71	2.12	0.093

Figure 1. Serum levels of FSH, LH, and testosterone.

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While hormonal profile comparison between control and patients groups is best illustrated in table 1. There was significant difference regarding serum level of FSH between both groups being higher in patients' group at a p-value 0f 0.023, with no significant difference regarding LH and testosterone.

Table 2. Average serum hormone levels in the control and patients groups.

Hormone	Groups	Mean	SE	Minimum	Maximum	P-value
FSH (IU/L)	**Control**	2.61	0.30	0.77	5.21	***0.023**
	Patients	7.06	1.02	0.17	42.07	
	Total	6.07	0.82	0.17	42.07	
LH (IU/L)	**Control**	7.33	0.53	2.33	11.61	**0.435**
	Patients	8.93	1.08	0.62	60.71	
	Total	8.58	0.85	0.62	60.71	
Testosterone (ng/mL)	**Control**	6.17	0.56	2.74	10.99	**0.898**
	Patients	6.26	0.33	0.78	15.50	
	Total	6.24	0.28	0.78	15.50	

Data are presented as Mean ± SEM .

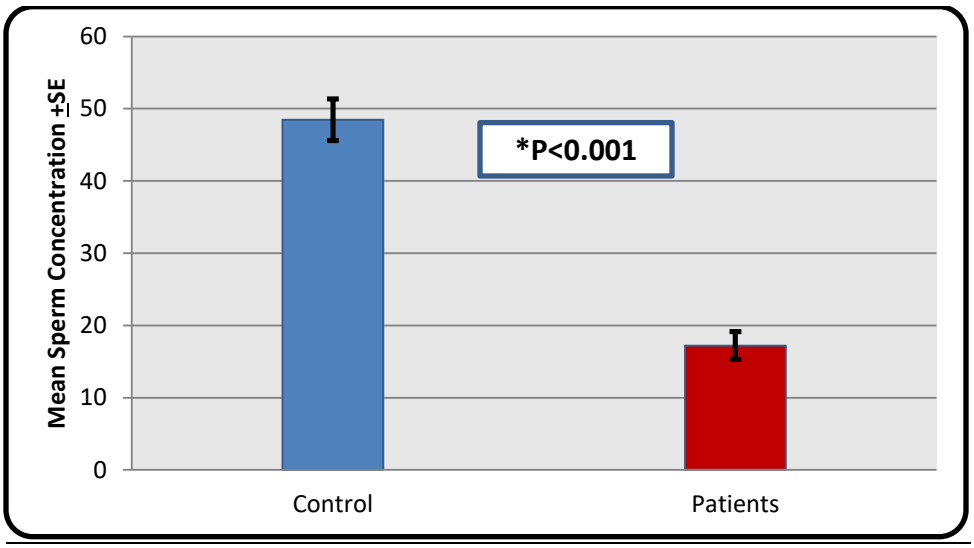

Figure 2. Comparison of mean sperm concentrations between control group and patients group.

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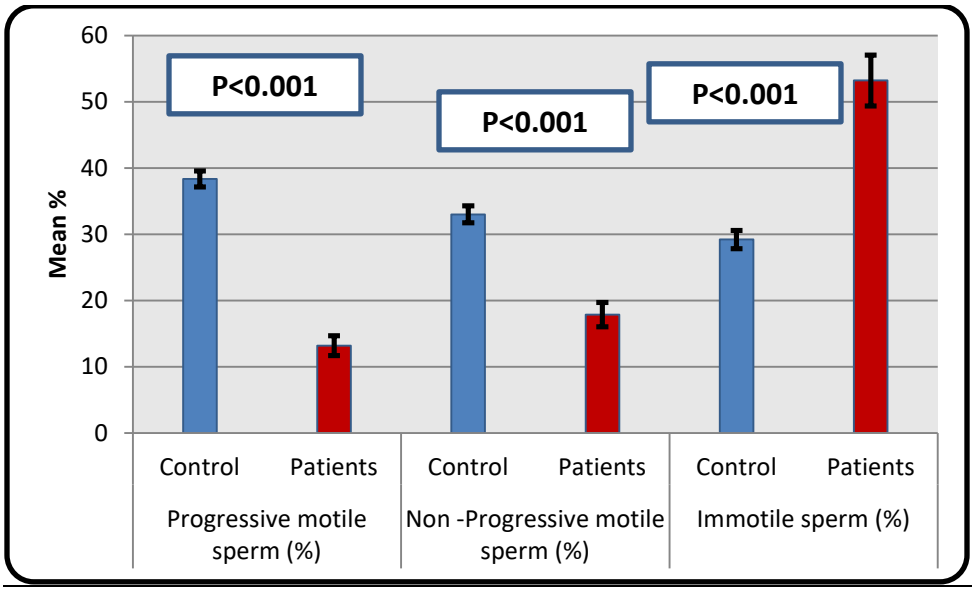

Figure 3. Comparison of mean progressively motile sperm%, non-progressively motile sperm % and immotile sperm %between control group and patients group

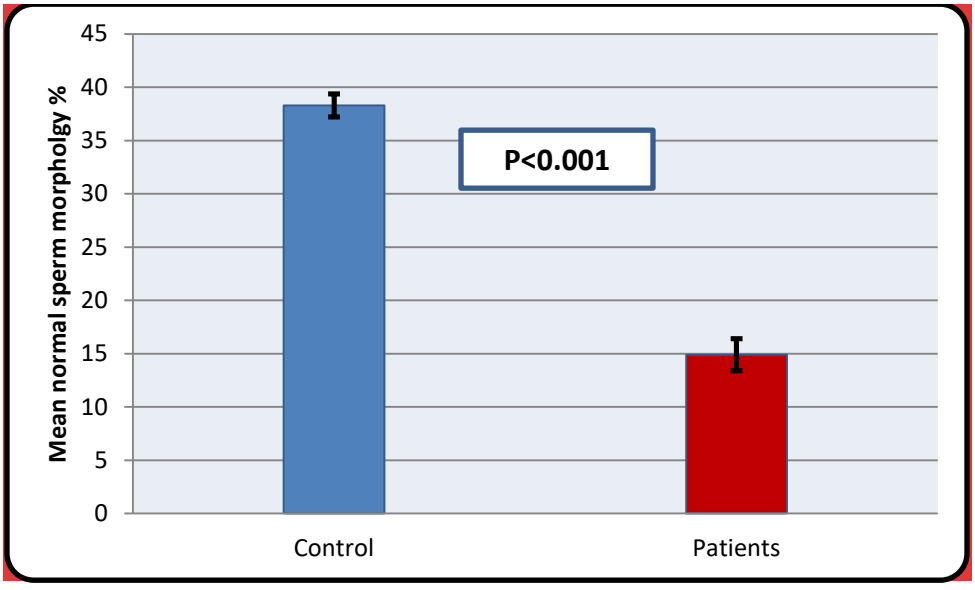

Figure 4. Comparison of mean normal morphology % between control group and patients' group.

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DISCUSSION

Gonadotropins and testosterone are essential for regulating germ cell proliferation. FSH, and testosterone are normally required for the quantitative production of spermatozoa. FSH acts directly on sertoli cells within the seminiferous tubules of testis to stimulate spermatogenesis, while LH acts indirectly through stimulating leydig testicular cells to produce testosterone [11]. Assessment of LH, FSH, and testosterone levels in serum are useful in the evaluation and treatment of Infertile men [12].A study by De Krester et al. exhibited that when seminiferous epithelium degenerated for any cause, serum FSH and LH levels were increased [13].

The hypothalamic-pituitary-testicular (HPT) axis is still clinically evaluated in the diagnosis and treatment of male reproductive dysfunction [11]. **as Table2** We observed findings of higher gonadotropin levels in specific subgroups are consistent with the findings of De Kretser et al. [13,14] who observed that serum FSH and LH levels often increase in proportion to the severity of seminiferous epithelium injury. This event indicates a compensatory process in which the pituitary gland increases gonadotropin secretion in response to diminished testicular input, a feature of primary testicular failure or severe spermatogenic Spermatogenic arrest . Our results revealed a significant increase in blood LH concentrations across various infertility groups, particularly those with azoospermia and oligospermia, compared to the control group with normal sperm count. These findings are consistent with previous research [15-18].

This revealed elevated gonadotropin levels, a state of hypergonadotropinemia, and compensatory gonadotropin levels, as illustrated in **Figure 1**. Luteinizing hormone (LH) levels in the two patient groups with impaired sperm motility, reduced sperm motility, and abnormal sperm morphology did not differ significantly from the control group, indicating that LH dysregulation is more common in cases of low sperm concentration than in cases of motility problems alone.

Similarly, serum follicle-stimulating hormone (FSH) levels in this study were significantly higher in the patient group, consistent with previous studies. [19,20,21]. A significant dose-response relationship was identified between the increase in FSH hormone and the decrease in sperm concentration and morphology. According to our results, people with baseline FSH levels (<2.8 IU/L) have a 13 times lower chance of having abnormalities compared to those with elevated levels (>7.5 IU/L), which is a strong indicator of poor sperm quality.

Regarding androgenic status, serum testosterone levels were statistically similar between the infertile subgroups and the control group. This finding is consistent with previous studies [13, 23].

This resilience is attributed to the ability of Leydig cells to survive, continuing to function despite extensive damage to the germinal epithelium
n contrast, the lack of significant fluctuations in testosterone in our group contradicts previous research [24, 25]. Who identified the cases of androgen deficiency? These discrepancies in the literature may be attributed to the etiologies of infertility; for example, infertility resulting from hypothalamic-pituitary insufficiency (GnRH deficiency) would lead to a concurrent decrease in both gonadotropins and testosterone [26].

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assessing testicular function and spermatogenesis is the primary objective of semen analysis. Compared to healthy individuals, the patient group exhibited significant abnormalities ($P < 0.001$) in all key semen parameters, including concentration, motility patterns, and morphology **(Figures 2-4).** These substantial reductions strongly suggest that the patients' pathological condition has a multifaceted negative impact on the quantity of seminal fluid produced by the seminiferous tubules, as well as on the quality of sperm maturation after ejaculation.

However, in our investigation, an increased FSH/LH ratio with normal testosterone levels indicates primary testicular disease rather than systemic endocrine failure.

Conclusions

There is a close interaction between semen parameters and hormonal profile of men who complain with subfertility and assessing hormonal profiles together with seminal fluid analysis is essential during the evaluation of fertility potential of such group of men.

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Conflict of Interest

Conflict of Interest: The authors declare that they have no conflicts of interest.

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