The assessment of serum Zinc, Testosterone Concentration and sperm quality in Infertile Males

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Abstract

Background: Male infertility is frequently caused by low sperm production or motility challenges. Zinc performs a major function in the biology of spermatogenesis in males. Objective: The aim of this paper was to evaluate serum zinc, testosterone concentrations, and several sperm parameters in infertile men. Methods: Sixty-four infertile males, ages ranging from 22 to 45 years, were enrolled in an infertility treatment center in Misrata, Libya. WHO guidelines were used to examine the sperm samples. Serum zinc concentration was determined by a photometric method, while serum testosterone was determined by a chemiluminescence immunoassay method. Result: Infertile males have significantly lower serum zinc and testosterone concentrations than fertile men. Serum zinc was lower in infertile patients who had a low sperm count, weak sperm motility, and abnormal morphology. Conclusion: Zinc has a considerable impact on a variety of sperm parameters and testosterone concentration. The result indicates that estimating serum zinc levels may help to improve the investigation and treatment of infertile males.

I. INTRODUCTION

Zinc is the second-most prevalent trace element in the body and is crucial for the healthy operation of the male reproductive system and fertilization (1). Several biochemical processes, involving more than two hundred enzymes, rely on zinc (2). Zinc has been linked to the growth of the testicles and the maturation of sperm in addition to being essential for the generation of testosterone and upholding a healthy volume of semen (2). It is essential for initial spermatogenesis from germ cells to sperm cells, as well as sperm cell maturation, ejaculation, liquefaction, sperm cell motility, spermatozoa binding, prostasomes, capacitation, and fertilization (3). Zinc deficiency causes decreased sperm quality, idiopathic male infertility, and a lower chance of fertilization (4). Zinc deficiency in the testes is associated with hypogonadism, abnormal secondary sexual characteristics, and other reproductive disorders (5). During ejaculation, the prostate releases more zinc into the seminal plasma and plays an important role in sperm release and motility (6).

Zinc is essential for the production, storage, and transport of major sex hormones, including testosterone, which is thought to be a critical regulating hormone for spermatogenesis (7). Zinc insufficiency is linked to lower testosterone levels and sperm count (8). In reality, zinc has a significant impact on a variety of sperm parameters (9). As a result, identifying male infertility is mostly dependent on sperm analysis (sperm count and motility). This element is considered to be a natural aromatase enzyme inhibitor. When testosterone is converted to estrogen by aromataze enzymes, less testosterone is produced because the pituitary gland is prevented from producing the chemicals lutein and follicle stimulation, which encourage the production of testosterone (2).

The spermatozoa's cell membrane and nuclear chromatin are stabilized by zinc in seminal plasma (10), preserving the testis from deteriorating alterations (11). In the capping and acrosome response mechanisms, it might have regulatory effects (12). It helps sperm remain steadily attached from head to tail, and eliminating it causes this attachment to break off (13). Antioxidant effects that fight reactive oxygen species (ROS) have been attributed to zinc; it influences apoptosis and has antiapoptotic qualities (14, 15), all of which may have a significant impact on reproduction. Since protein synthesis and DNA transcription are two of the most important processes in the formation of germ cells (16), it acts as a cofactor for more than eighty metalloenzymes involved in these processes. Additionally, steroid hormone receptors' genetic expression is thought to be influenced by zinc finger proteins (17). Men with idiopathic subfertility had lower zinc levels in their seminal plasma than fertile controls (18). Zinc deficiency has been linked to lower sperm count and testosterone concentration (19). However, many recent studies have focused on the biochemical significance of zinc in serum or seminal plasma, but the link between zinc and routinely established factors of sperm quality has been contentious (20).

Since zinc concentration in blood affects spermatogenesis, we conducted this study to assessment of serum zinc, testosterone concentration and semen quality in infertile males.

II. MATERIALS AND METHODS

2.1. Patients

This cross-sectional study was carried out in infertility treatment center at Misrata city for the period from December 2019 – May 2020. Sixty-four infertile male subjects, without any treatment who had regular intercourse for at least 12 months without conception with their partners, and eighteen males who had normal sperm count considered as normospermic control group, aged 22 – 45 years. Subjects were classified to five groups, the azoospermia (No sperm in the ejaculate), oligozoospermia (Total sperm count less than 39 million per ml), Asthenozoospermia implies impaired motility (progress motility < 32 %), teratozoospermia (abnormal sperm morphology) less than 4% and normozoospermia (sperm counts more than 39 million per ml) according to WHO criteria.

The questionnaire was distributed to dental patients who use (non-steroidal) analgesics without a prescription, and the number of cases participating in the study was 102, including 41 males and 61 females. The data was collected by interviewing patients personally, and most of the questions were answered with complete credibility.

Semen samples were obtained by masturbation after an abstinence period of 3 days. After liquefaction, samples were immediately examined by conventional semen analysis to determine the sperm count, sperm motility and sperm morphology according to WHO criteria. 5 ml of blood samples were taken from each subject in the morning. After centrifugation, serum was freezed until analyzed for testosterone and zinc. Serum zinc was estimated by photometric method using Cobas integra 400 plus, serum testosterone was estimated by Chemiluminescence immunoassay method using Cobas E411.

2.3. Statistically analysis

The MedCalc statistical software package for biomedical research was used to process the results of the laboratory tests, provided the data as tables and figures with a one-way ANOVA test.

III. Results

Table 1 shows the means of zinc among sperm parameters. Azospermic (49.11), oligospermic (55.11), Asthenozospermic (62.06), teratozospermic, (79.8), and normospermic (119.2) control groups differed from each other statistically significantly. These results are listed along with their statistical significance levels.

Table (1) The means of zinc among semen parameters

Comparisons test	Mean	SE of diff.	Mean Diff.	95.00% CI of diff.	Adjusted P Value
Normozoospermia	119.2	3.053	70.06	62.42 - 77.69	<0.0001
Azoospermia	49.11				
Normozoospermia	119.2	3.053	64.06	56.42 - 71.69	<0.0001
Oligozoospermia	55.11				
Normozoospermia	119.2	3.053	57.11	49.47 - 64.75	<0.0001
Asthenozoospermia	62.06				
Normozoospermia	119.2	3.612	39.37	30.33 - 48.40	<0.0001
Teratozoospermia	79.8				

Table 2 shows the mean blood levels of testosterone and zinc in the two groups. Infertile patients had serum zinc and testosterone levels that were considerably lower than normospermic (P 0.05) compared to the fertile control group (mean serum zinc, 2.69; mean serum testosterone, 2.59).

Table (2): The mean of serum zinc concentration and serum testosterone concentration in infertile and control groups.

Parameters	Infertile (n=100)	fertile (n=50)	P-value
Serum zinc concentration (µg/dl)	2.69± 1.63	119.17± 2.72	< 0.05
Serum testosterone concentration (ng/ml)	2.59 ± 0.18	5.90 ± 0.25	< 0.05

Table 3 displays the serum zinc concentration with various semen characteristics. Infertile men's zinc levels are on average lower than that of fertile men in all sperm parameters, including total sperm count (66.50), advance motility (53.54), and morphology (50.50). In all sperm parameters, the serum zinc was considerably decreased (P 0.0001).

Table (3): serum zinc concentration with semen parameters

parameters	Fertile (n=50)	Infertile (n=100)	Sig
T. sperm count (million/ml)	66.50 ± 21.69	20.92 ±31.17	P < 0.0001
Progress motility %	53.54±8.30	6.31±11.64	P < 0.0001
Morphology %	50.50±12.29	4.85±6.0	P < 0.0001
Testosterone (ng/ml)			

IV. Discussion

Zinc affects infertility in men by a variety of approaches, including lowering blood testosterone levels and semen volume (21); it is uncertain what role zinc has in the synthesis of testicular testosterone. However, zinc is necessary for the production of nucleic acids as well as the function of many enzymes (21). Zinc deficiency may cause abnormalities in nucleic acid production. Cellular proliferation is likely impacted by zinc's key function in testicular function (22). Testosterone, a steroid that promotes the growth of sexual features, is the most significant male hormone generated by the testis (23). It is well known that testosterone and zinc have a close association, although the specifics of this association are yet unknown (23). One of the organs with the highest zinc content is the prostate. The primary factor influencing the prostate's zinc level is believed to be testosterone (23). One of zinc's roles may be to regulate testosterone metabolism at the cellular level, and zinc is also thought to modulate testosterone metabolism in the prostate (23).

The results of the present study showed that there was a significant decrease in serum zinc level among the infertile group compared with the normal control group. Similar results have been reported by another investigator (10). However, this finding was in conflict with others (10). The lowest values of serum zinc presented may be due to consuming staple foods that are low in zinc or a large amount of bread, rice, cereal proteins, and grains that contain phytic acid, which inhibits zinc absorption (24), or they may be caused by conditional factors including: alcoholism, malabsorption, chronic renal failure, and chronically debilitating diseases (25). Furthermore, the decrease in serum zinc concentration was significantly correlated with sperm count. Zinc has been shown to be very important for conception, successful implantation, and pregnancy (25, 26). There is evidence that zinc plays a vital role in the physiology of spermatozoa and spermatogenesis (27). It appears that the abnormal concentrations of this substance are related to disturbances in the secretory activity of the seminal vesicles (27). In this study, there was a significantly low level of serum zinc in oligozoospermic and azoospermic males. Similar results have been reported by Hasan et al. (10). Our results are also incompatible with several studies (28). As a result, sperm count concentration was affected by serum zinc deficiency.

Our results also showed that the zinc concentration was significantly decreased in the serum of asthenozoospermic patients. This result is compatible with that observed by others (29). A study demonstrated the effect of zinc on the motility viability, acrosome reaction, and fertilizing capacity of humans (12).

The hormone testosterone is required for normal sperm function Since zinc plays an important role in the conversion of testosterone into its biologically active form, 5-hydroxy-dihydrotestosterone (10).

Our study results, which showed a decreased sperm count, diminished motility, and a raised proportion of atypical shapes, corroborated with the results of a study conducted previously (30), demonstrated that a lack of zinc results in atrophy of the seminiferous tubules, defeat of spermatogenesis, and a reduction in testosterone output. Zinc insufficiency affects how sensitive the Leydig cell is to gonadotropins and may result in primary hypogonadism (31). Furthermore, the disruption of hormonal homeostasis that occurs in zinc deficiency can lead to a decrease in the number of testosterone receptors, which, in turn, can reduce the androgenic-stimulatory effects on male reproductive organs (3).

The authors concluded that an adequate seminal concentration of zinc is required for normal sperm function (32). Zinc was also shown to be necessary for maintaining the stability of sperm chromatin and membrane and inhibiting apoptosis for normal sperm morphology (33). The result of this study showed decreased levels of zinc in teratozoospermic patients. This result is agreed upon by another investigator

(34). A study demonstrated the effect of zinc on the morphology (34).

Conclusion

On the basis of the present observations and those of others, zinc may contribute to fertility through their effects on various semen parameters. Adequate seminal plasma concentration of zinc is required for normal sperm function and related to motility and morphology of sperm in infertile males. It seems that the estimation of serum zinc may help in the investigation and improving semen quality and fertility in infertile males.

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