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Impact of Seminal Plasma Trace Elements Magnesium and Cadmium ' on Seminal Parameters among Infertile Sudanese Males in Khartoum State-Sudan

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Abstract:-

➢ ***Background:***

Male factors contribute for 40%–50% of cases of infertility, which affects 8%–12% of the world's population. Macro and trace components found in human seminal plasma are essential for the health and normal function of semen. Magnesium and cadmium levels in seminal plasma were measured as part of this study's attempt to connect these levels with male fertility.

➢ ***Objectives:***

To determine the Impact of Seminal Plasma Trace Elements Magnesium and Cadmium ' on Seminal Parameters among Infertile Sudanese Males in Khartoum State-Sudan.

➢ ***Methods:***

Between November 2021 and April 2022, all semen samples utilized in this comparative cross-sectional case-control study were collected from willing patients visiting Banoon and Ashmeeg Fertility Centres in Khartoum state. Males who had been diagnosed as infertile made up the study's case group (n = 150), while healthy males whose fertility had been established by prior successful fertility centers made up the study's control group (n = 150). The Buck model 210 VGP atomic absorption spectrophotometer was used to estimate the concentrations of TEs magnesium and cadmium. The SPSS version 23 was used for all analyses, in depended t testing was used to compare parameters between case and control and person correlation for correlate magnesium and cadmium with seminal analysis parameter . A P-value of 0.05 or lower was deemed statistically significant.

➢ ***Results:***

Seminal cadmium levels were significantly greater and magnesium levels were lower in infertile men (p. value 0.000). Magnesium was found to have a strong negative association with semen volume (r=-.266 with p=0.008) and a substantial positive correlation with sperm count and motility (r=.994 and.216 with p=0.01 and 0.03). However, there was a negative connection between morphology and cadmium (r=-.362; p = 0.10).

➢ ***Conclusion:***

According to the current study's findings, we conclude that, infertile men have high cadmium and low magnesium. Low magnesium has a direct impact on sperm count, sperm motility, and semen volume Conversely, sperm morphology is directly impacted by elevated cadmium.

I. INTRODUCTION

Infertility affects 8%–12% of the world's population, and male factors account for 40%–50% of these instances [1-3].Despite the rapid advancements in reproductive medicine, the root causes of male infertility are still not fully understood. A few risk factors for poorer sperm quality include age, environment, occupational exposure, socioeconomic status, and nutritional status [2]. Infertility is also brought on by hypogonadism, varicocele, cryptorchidism, hereditary causes, etc. In about 25% of couples, there is no known cause or rationale for the issue [4]. Magnesium (Mg), copper (Cu), zinc (Zn), and iron (Fe) are among the macro and trace elements found in human seminal plasma and play crucial roles in the quality and normal operation of semen [5][6]. Mg functions as an intracellular calcium (Ca) antagonist and is necessary as the primary cofactor for kinase enzymes [7, 8]. Mg levels that are higher than Ca levels enhance the erection and ejaculatory processes [9]. The sperm is propelled by the tail's twisting motion, which involves interactions between tubulin fibers and the side arm of the dynein motor and necessitates ATP and magnesium [10]. Significant variations in the concentration of trace elements, such as magnesium, in the sperm seem to be associated with aberrant spermatozoal activity and fertility [11]. On the other hand, any metal chemical element with a high density that is harmful at low concentrations is referred to as heavy metal. These include thallium, lead, cadmium, chromium, cadmium, mercury, and arsenic. Heavy metals can infiltrate the water supply system through home and commercial waste, have the ability to bio accumulate, and can

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even devastate the soil. In hormonal regulation and reproductive systems, heavy metals have harmful consequences. Male sperm production and fertility may be negatively impacted by exposure to heavy metals by promoting the generation of ROS [12,13]. In the process of human reproduction, oxidative stress is crucial. Excessive ROS levels harm spermatozoa in humans and damage their plasma membrane, which finally results in sperm failure. In male infertility, ROS performs significant physiological and pathological roles and has potential implications for reproductive biology [14]. Cadmium, arsenic, and lead, among the numerous types of heavy metals, are thought to be the main poisons impacting reproductive function. As a result, this study sought to improve knowledge of the effect of the amount of magnesium and cadmium on seminal quality among infertile Sudanese males.

II. MATERIAL AND METHOD

A. Study Setting and Design

All semen samples used in this comparative cross-sectional study were obtained from consenting patients attending Banoon and Ashmeeg Fertility Centers, Khartoum state, between November 2021 to April 2022. Prior to the study, ethical approval of performing this research was obtained from Ashmaig fertility center administration and Banoon fertility center administration. The study population was include a diagnosed infertile males (n = 150) as case group and healthy males with proven fertility confirmed by previous successful Fertility Centers as control group (n = 150). (inclusion and exclusion criteria)

B. Semen Collection and Sample Preparation

After two to three days of abstinence, semen samples were collected in accordance with World Health Organisation (WHO) norms [19] into a sterile, non-toxic polypropylene container. Following the recommendations of the WHO grading system, samples were allowed to liquefy at 37 C for 30 min. [WHO reports., 2010]. Normozoospermic fertile control group (n = 50) samples were assigned to one of the following groups based on the results of the semen analysis. These samples demonstrated normal parameters, including sperm concentration of 15 106 sperm/mL, total sperm motility of 40%, normal morphology of 4% of sperm, and a minimum volume of 1 mL. The second group, thenozoospermics (AST), had normal sperm concentration of 15 106 sperm/mL and normal morphology of 4% of sperm but had lower than normal levels of total sperm motility (40%). There were 50 members in this group.

Then, samples underwent centrifuged at 400g for 15 minutes to prepare them for the collection of seminal plasma. After that, seminal plasma was kept at -80°C till the estimation of magnesium and cadmium.

C. Measurements of TE Levels

The Buck model 210 VGP atomic absorption spectrophotometer was used to estimate the concentrations of the TEs magnesium and cadmium. Plasma in the seminal. Magnesium and cadmium were heated in 6 mol/L nitric acid for 60 min., followed by two washes with deionized water, in all the glassware used for the measurement. In order to digest the semen, ultrapure nitric acid was used. Samples were digested in a microwave oven system after being diluted with concentrated nitric acid in a 1:10 dilution and mixed with the solution to accomplish mineralization. Seminal plasma samples were diluted to a final volume of 10 mL with demineralized Milli-Q water for cadmium tests and 1% lanthanum chloride for magnesium measurements at the conclusion of the digestion procedure. The samples were then put into an atomic absorption spectrophotometer for the purpose of detecting cadmium with an 8 mA hollow cathode lamp current.

D. Statistical Analysis

The IBM SPSS version 23 computer program was used for all analyses, and two-sided testing was used. A P-value of 0.05 or lower was considered statistically significant.

III. RESULTS

From the Banoon and Ashmeeg Fertility Centers, one hundred and fifty Sudanese males with normal semen parameters and one hundred and fifty infertile Sudanese men were selected. The average age of the men in the case was 38.76 years old, with ages ranging from 25 to 53. Males in the control group ranged in age from 19 to 55, with a mean age of 37.96 years. With p-values of 0.6464 and 0.2785, respectively, there was no difference in the mean age or semen volume between the normozoospermic control and asthenozoospermic infertile groups. On the other hand, the infertile group had much higher aberrant morphology with p and significantly lower total sperm motility and count (Table 1).

Table 1: Semen Analysis between Fertile and Infertile Groups

Variables		**Infertile Men**	**Fertile Men**	***P. Value***
Age		38.76 ± 5.87	37.96 ± 10.8	0.646
Morphology(abnormal %)		.5574 ± 0.18	.3634 ± 0.07	0.001
Count ($\times 10^6$)		71.504 ± 5.10	76.856 ± 7.8	0.001
Motility	Progressive motility	27.15 ± 3.10	61.37± 4.30	0.001
	Sluggish motility	11.34 ± 2.70	10.91±1.30	0.697
	Non motile	61.51 ± 5.20***	27.69 ±1.6	0.001
Volume		2.728 ±0.41	2.840 ± 0.60	0.278

Seminal cadmium levels were significantly greater and magnesium levels were lower in infertile men (p. value 0.000).

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Table 2: Cadmium and Magnesium Levels between Fertile and Infertile Groups

Variables	Infertile men	Fertile men	*p. value*
Cadmium (mg/dl)	.036920 ± 0.0023	.035040 ± 0.0016	0.000
Magnesium (mg/dl)	54.638 ± 5.83	68.5786 ± 7.105	0.000

Magnesium was found to have a strong negative association with semen volume (r=-.266 with p=0.008) and a substantial positive correlation with sperm count and motility (r=.994 and.216 with p=0.01 and 0.03). However, there was a negative connection between morphology and cadmium (r=-.362; p = 0.10).

Table 3: Correlations between Different Parameters of Semen Analysis, Magnesium and Cadmium Level

Variable		Magnesium	Cadmium
Count	Pearson Correlation	.994	.450
	p-value	.001	.109
Volume (ml)	Pearson Correlation	-.266	.081
	p-value	.008	.421
Morphology, (ab%)	Pearson Correlation	-.237	-.362
	p-value	.098	.010
Motile (Progressive)	Pearson Correlation	.216	-.037
	p-value	.031	.715
Motile (Slugg)	Pearson Correlation	-.041	.184
	p-value	.687	.067

IV. DISCUSSION

For spermatogenesis, sperm maturation, motility, capacity, and function, trace elements are crucial. Low male fertility rates and poor sperm quality are caused by these trace element deficiencies, which also have a deleterious impact on spermatogenesis [16]. These study was done to investigate the seminal magnesium and cadmium on fertile and non-fertile men and determine their effect on semen analysis parameters and found that, low magnesium in infertile men and this result agrees with Feda Aljaser et al. (2021). which found a significant decrease in seminal magnesium in infertile males with p-value < 0.001[17] because magnesium is a crucial trace element and a key enzyme activator in the phosphorus transfer reaction. It also plays a role in spermatogenesis and impacts sperm motility, which is supported by the current study which found significant negative correlation between semen volumes with magnesium levels. (P=0.008). and significant positive correlation with sperm motility. (P=.031) this also this finding agrees with Feda Aljaseret al. (2021). On the regulation of hormones and reproductive functions, heavy metals are harmful. They impair the regulation of endogenous hormones and have a detrimental effect on endocrine function. Cadmium is thought to be the heavy metal most harmful to reproductive health among all other forms of heavy metals. With a p-value of 0.001, this study found that the mean level of seminal plasma cadmium was substantially greater in male infertility than in a fertile group. This finding is consistent with those of Ahmed Zak et al. (2018) and Ademola C.et al. (2017) [18, 19]. The morphology of sperm is significantly negatively correlated with the quantity of cadmium. (P=.010). our study found that there is no effect of cadmium on semen volumes, sperm count, and sperm motility with cadmium level. These findings concur with those of Ahmed Zak et al. 2018 and Ademola C. et al. 2017, but disagree with those of this study at the levels of other seminal parameters. There is a substantial negative link between semen quantities, sperm count, and sperm motility with cadmium level, according to research by Ahmed Zak et al. (2018) and Ademola C. et al. (2017), with a P-value of 0.01[18, 19].

V. CONCLUSION

According to the current study's findings, we conclude that, infertile men have high cadmium and low magnesium. Low magnesium has a direct impact on sperm count, sperm motility, and semen volume Conversely, sperm morphology is directly impacted by elevated cadmium.

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