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Evaluation of Male Infertility and Physiological Role of Zinc

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ABSTRACT

Zinc in human semen seems to play an important role in the physiology of spermatozoa. Our aim is the relationship between concentration of zinc in seminal plasma and semen quality. The results revealed that serum zinc levels in infertile men group were lower than in the fertile men group. In addition, seminal plasma zinc levels were lower in the infertile men group than in the fertile men group. The significance of zinc and other factors presents in seminal plasma in different types of causes of male infertility for the functional properties of human spermatozoa appear to be of importance since such studies may give hints to new ways of regulating male fertility.

Introduction:

Male infertility is the inability to conceive a baby after one year of unprotected sex in the absence of female causes. Most causes of male infertility reflect an abnormal sperm count or quality. Although it only takes one sperm to fertilize an egg, in an average ejaculate a man will eject nearly 200 million sperm. However, because of the natural barriers in the female reproductive tract only about 40 sperm will ever reach the vicinity of an egg. There is a strong correlation between the number of sperm in an ejaculate and fertility. In about 90% of the cases of a low sperm count, the reason is deficient sperm production. Unfortunately, in about 90% of cases, the cause for the decreased sperm formation cannot be identified. Other causes of male infertility may include ductal obstruction, ejaculatory dysfunctions, and infections or disorders of the accessory glands[1]. Prostate gland is the largest accessory gland of the male reproductive tract and there is a good deal of research being conducted on the prostate. Yet it remains one of the least understood structures in the body. One area of study concentrates on the major function of the gland, the production and the secretion of minerals that play an important role in prostate and the reproductive system functions.

Zinc in human semen seems to play an important role in the physiology of spermatozoa (processes of fertility, reproduction and sexual maturation). It is secreted by the prostate in small vesicles called protasomes. Zinc (Zn) in seminal plasma stabilizes the cell membrane and nuclear chromatin of spermatozoa. It may also have an antibacterial function[2]. Zinc is a component of semen and it is though that at least 1 mg of zinc is excreted by an ejaculum. At a biochemical level, zinc's primary role as a component of zinc metalloenzymes, many enzymes of the cell nucleus involved with genetic information transfer and cellular replication are metalloenzymes of zinc. Zinc also participates in RNA metabolism, prostatic fluid and ocular tissues contain the highest levels of zinc in the body[3]. Our aim was to evaluate the zinc levels in male subjects and to correlate the same with semen parameters and thereby to assess the relationship of seminal zinc levels and male reproductive parameters.

Material and Methods:

The present study was conducted in Department of Pathology, Pacific Institute of Medical Sciences, Umarada, Udaipur, Rajasthan, India during the period from August 2015 to March 2016. Rajasthani men in the age range of 22 to 45 years with no apparent chronic or acute disease were selected for the study, 30 men of known fertility and 40 infertile men were studied. The infertile men were unable to be fathers of children for at least 2 year; their wives were considered fertile based on extensive gynaecologic evaluations. At the first interview for the infertile men, a complete history was obtained, especially with respect to any history of sexual dysfunction. Physical examination was performed to exclude patients with chromosomal abnormalities. None of the subjects were on drug treatment or on especial diet and none of the subjects used vitamin supplements. Statistical analysis was done using SPSS-18. The differences between means of more than two groups were tested by performing ANOVA. The Pearson's correlations (r,p) and regression equation were calculated between each of the measured parameters to assess the shape of relationship based on the highest (r) value obtained.

Results and Discussion:

Table 1 shows the demographic characteristics of the fertile and infertile men. The results revealed that serum zinc levels in infertile men group were lower than in the fertile men group (P<0.001). In addition, seminal plasma zinc levels were lower in the infertile men group than in the fertile men group (P<0.001). Table 2 shows, there was no significant correlation between serum zinc and the parameters of semen quality in both groups. Moreover, no significant correlation between semen zinc and the parameters of semen quality in both groups.

Table 1: Evaluation of semen quality, hormones, and Zinc concentrations in fertile and infertile men groups:

variables	Fertile men group (N=30)		Infertile men group (N=40)		P-value
	Mean±SD	Range	Mean±SD	Range	
Count (60-150x106/ml)	96.6±63.1	57-154	36.28±28.01	0-98	0.001
Motility (>60%)	96.1±16.5	55-95	18.0±11.02	0-60	0.001
Morphology (>70%)	80.0±74.5	70-90	66.9±21.8	0-90	0.001
LH (1-5mIu/ml)	4.5±1.02	1.5-5.0	2.7±3.01	0.9-23	**
FSH (1-9mIu/ml)	4.0±2.07	2.8-9.8	6.4±1.0	0.9-34.5	**
Testosterone (8.2-34.6nmol/L)	24.5±4.05	15.8-33.0	15.0±4.2	7.0-44.0	0.001
Serum Zn (70-120µg/dl)	120.7±1.8	90.6-162	87.5±23.2	36-147.4	0.001
Seminal plasma Zn (1.2-3.9nmol/L)	3.01±0.1	2.5-3.8	1.4±0.5	0.39-2.7	0.001

*(Statistically Significant (P<0.05) ** NS (Not Significant)

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Table 2: The correlation coefficient (r) between Zinc concentration and parameters of semen quality for both groups:

Group	variables	Count	Motility	Morphology
Fertile men group (N=30)	Serum Zn	-0.088	-0.270	-0.061
	Seminal Plasma Zn	0.048	0.11	-0.348
Infertile men group (N=40)	Serum Zn	-0.004	-0.022	-0.459
	Seminal Plasma Zn	-0.031	-0.167	0.079

The present data are in agreement with those of Bonde et al[5], who reported that not sperm concentration but sperm quality determines fertilizing capacity of spermatozoa. Although, the most cases of male infertility are nonendocrine in origin. However, routine evaluation of hormonal parameter is not warranted unless sperm density is extremely low or there is clinical suspicion of an endocrinopathy. A scrotal varicocele is the most common causative finding in infertile men[6]. To explain the abnormalities in spermatogenesis with varicocele, the most point have been proposed was the abnormal blood flow can interfere with testosterone production, which in turn can interfere with sperm production and this in agreement with our results that about 25% of infertile men had varicocele. We did not find any difference in the our data and in those previously published in the literature for that the serum zinc and semen zinc levels were significantly lower in infertile patients than fertile males[7], in contrast to other reports, that unable to find a significant difference in serum and semen zinc levels between fertile and infertile men[8,9].

The lack of correlation between zinc concentration and semen quality found in our study suggests that biochemical complexity of seminal fluid attempts to perform such simple correlations between seminal plasma component and andrological parameters are likely to produce inconsistent results. These effects include no significant correlation between the total amount of zinc per ejaculate and sperm quality[10] with no statistically significant correlation between zinc concentration and the motile sperm concentration[11]. However, our results are in contrast to other studies that showed zinc-related decrease in human semen quality[12,13]. Most previous results of colorimetric methods and the present method found that the results obtained using the proposed method were not statistically different from those obtained by atomic absorption spectrophotometry[14,15].

The high level of zinc found in semen is due primarily to the secretions of the prostate gland and reflects prostatic stores. Serum zinc may be a reasonable indicator of zinc status. The lack of correlation between serum zinc and semen zinc found in our study suggests that mild zinc deficiency may lower serum zinc while the larger prostate zinc stores remain unaffected. However, we observed 25% had varicocele, which is enlargement of the internal spermatic veins that drain the testes. The significant decrease of the zinc in seminal plasma of varicocele men were significantly lower than in the normal subjects. This decrease indicated an impairment of the prostatic function or secretion due to decreases the availability of oxygen and nutrient required for sperm live. The Krebs's cycle provides a major source of adenosine triphosphate energy and produce molecules that are starting point for a number of vital metabolic pathways for the cell, citrate that been chelated with zinc and their evidence that zinc required for oxygen consumption by sperm. Varicocele decreases the concentration of zinc and decreases the availability of oxygen for live sperm.

Conclusion:

These findings suggest that the zinc has positive effect on sperm count and morphology. The fact that zinc plays a positive role in influencing the process of spermatogenesis cannot be ruled out. Further studies to elucidate the significance of zinc and other factors presents in seminal plasma in different types of causes of male infertility for the functional properties of human spermatozoa appear to be of importance since such studies may give hints to new ways of regulating male fertility.

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