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The Effect of Genital Tract Infections on Sperm DNA Integrity: A Comparative Study Between Infertile and Fertile Men

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Abstract: Male infertility is a complex condition often associated with impaired semen quality and molecular abnormalities. This study aimed to evaluate conventional semen parameters, round cell concentration, and sperm DNA fragmentation in infertile men diagnosed with Asthenozoospermia, Oligoasthenozoospermia, and Oligoasthenoteratozoospermia, compared to a fertile control group. Semen samples were collected and analyzed following World Health Organization (WHO) guidelines. The results showed a significant increase ($p < 0.05$) in round cell concentration in the Asthenozoospermia (12.76 ± 1.08), Oligoasthenozoospermia (14.62 ± 0.75), and Oligoasthenoteratozoospermia (12.82 ± 0.79) groups compared to controls. Additionally, sperm DNA fragmentation levels were significantly higher ($p < 0.05$) in infertile men—Asthenozoospermia (78.76 ± 0.72), Oligoasthenozoospermia (86.85 ± 1.08), and Oligoasthenoteratozoospermia (95.24 ± 0.35) than in the control group (50.70 ± 1.01). Significant differences ($p < 0.05$) were observed between all infertile groups and controls across the assessed parameters. These findings indicate that elevated round cell concentration and sperm DNA fragmentation are key markers of impaired semen quality and may contribute to male infertility. Comprehensive assessment of these parameters could improve diagnostic accuracy and inform targeted therapeutic strategies. Conclusion: The findings of this study highlight the significant elevation of round cell concentration and sperm DNA fragmentation in infertile men with Asthenozoospermia, Oligoasthenozoospermia, and Oligoasthenoteratozoospermia compared to fertile controls. These alterations reflect underlying seminal and molecular dysfunctions that likely contribute to impaired fertility potential. The integration of round cell assessment and sperm DNA fragmentation analysis with conventional semen evaluation may enhance diagnostic precision and guide more effective, individualized treatment strategies for male infertility.

Keywords: Sperm parameter, sperm DNA fragmentation, Infections.

Introduction

Male infertility is a multifactorial condition contributing to nearly 50% of all cases of couple infertility(1). While conventional semen analysis is including assessments of sperm concentration, motility, and morphology, has long been the standard for evaluating male fertility potential, it often fails to uncover the underlying causes in a significant proportion of cases(2). One such underlying factor that has garnered increasing attention is sperm DNA fragmentation, which reflects the integrity of genetic material carried by spermatozoa(3).

Recent studies suggest that genital tract infections may play a significant role in disrupting sperm DNA integrity(4). Infections caused by bacteria, viruses, or sexually transmitted pathogens can generate oxidative stress, trigger inflammatory responses, and damage the testicular environment, ultimately leading to increased DNA fragmentation in sperm(5). Elevated levels of SDF have been

associated with reduced fertilization rates, poor embryo quality, recurrent pregnancy loss, and failure in assisted reproductive techniques (ART)(6,7).

Despite this growing body of evidence, the precise impact of infection on sperm DNA integrity remains inadequately explored in many populations(8,9).

This study aims to compare sperm DNA fragmentation levels between infertile men diagnosed with infections and healthy fertile controls.

Materials and Methods

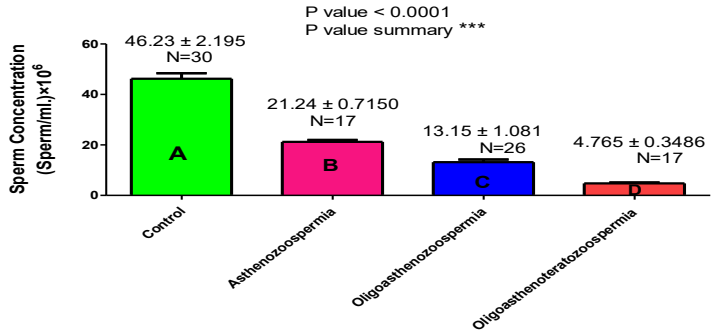
The patient was selected after examination for the presence of infection and semen was collected according to the approved method (WHO,2010) from infertile patients as well as the control group from the Infertility Center at Al-Sadr Teaching Hospital and microscopic analysis was used to classify infertility cases and the average age of the patients was (35±32) years and 60 samples were collected from the patients and 30 samples from the control group and a total of 90 samples(10,11).

Statistical Analysis

Statistical analyses were performed using GraphPad Prism 5 to find the mean and standard error (±SE) and the t-test was used to test statistical differences between samples at the ($P < 0.05$) level to show the significance of the results. MegaStat was chosen to find the relationships between the parameters.

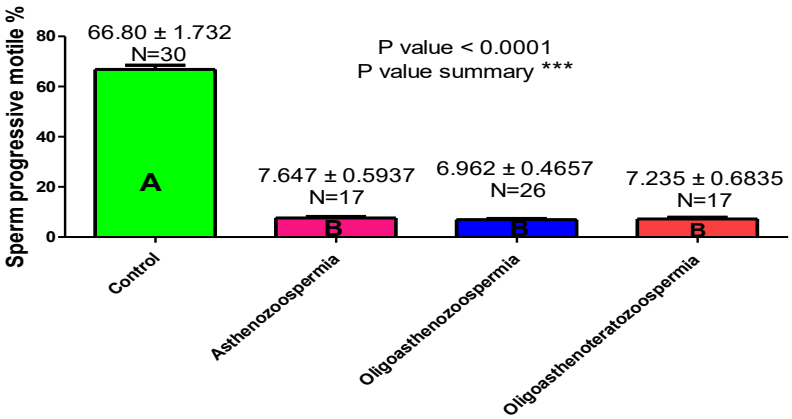
The Result

The result indicated a significant decrease ($p<0.05$) in the sperm concentration , sperm normal morphology and sperm progressive motile in infertile patient Asthenozoospermia , Oligoasthenozoospermia and Oligoasthenoteratozoospermia comparison with control group as shown in figures (1,2,3).



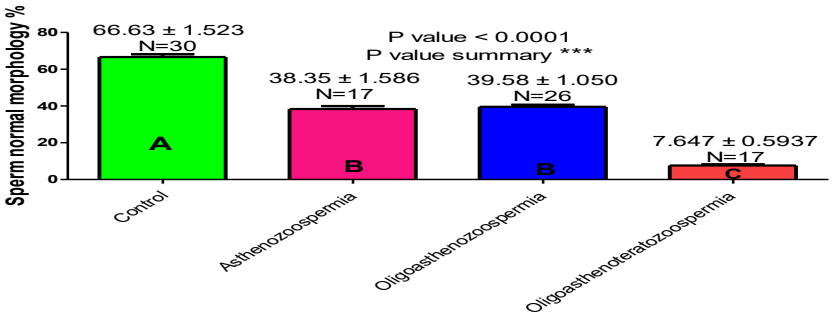
Figure(1): The comparison of sperm concentration between infertile patients Asthenozoospermia , Oligoasthenozoospermia and Oligoasthenoteratozoospermia with control.

*Different later indicates significant ($p < 0.05$)



Figure(2): The comparison of sperm progressive motile between Asthenozoospermia, Oligoasthenozoospermia, and Oligoasthenoteratozoospermia with control.

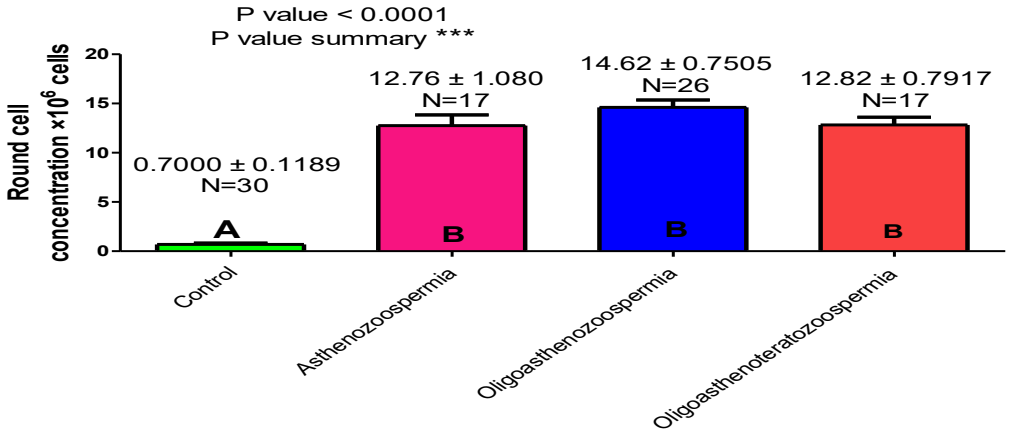
*Difference later indicates significant ($p<0.05$)



Figure(3): The comparison of Sperm normal morphology between Asthenozoospermia, Oligoasthenozoospermia, Oligoasthenoteratozoospermia as compares with control.

*Difference later indicates significant ($p<0.05$)

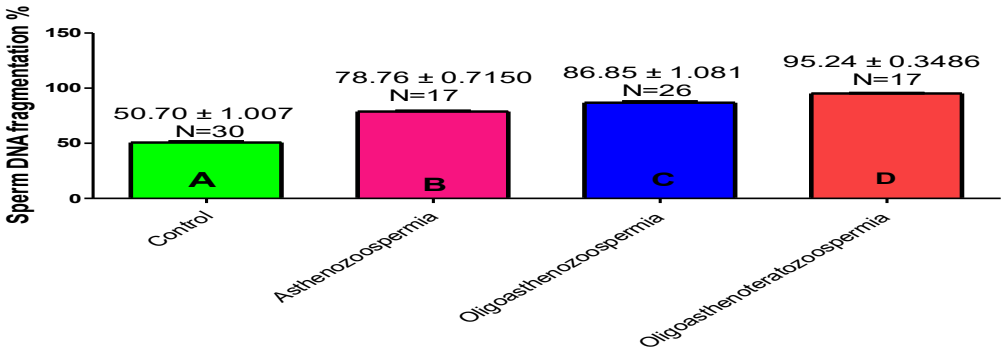
The results showed a significant increase ($p<0.05$) of Round cell concentration in infertile men Asthenozoospermia (12.76±1.080) and Oligoasthenozoospermia (14.62 ±0.7505) and Oligoasthenoteratozoospermia (12.82± 0.7917) compared with control group (0.7000± 0.1189). as shown in figure (4).



Figure(4): The comparison of Round cell concentration×10^6 cells between Asthenozoospermia, Oligoasthenozoospermia, Oligoasthenoteratozoospermia and unexplained with control.

*Difference later indicates significant ($p<0.05$)

The results showed a significant increase ($p<0.05$) of Sperm DNA fragmentation in infertile men Asthenozoospermia (78.76 ± 0.7150) and Oligoasthenozoospermia (86.85 ± 1.081) and Oligoasthenoteratozoospermia (95.24 ± 0.3486) compared with control group (50.70 ± 1.007), While there was a significant difference ($p<0.05$) between control and men infertility (Asthenozoospermia ,Oligoasthenozoospermia and Oligoasthenoteratozoospermia) as shown in figure (5).



Figure(5): The comparison of Sperm DNA fragmentation between Asthenozoospermia, Oligoasthenozoospermia, Oligoasthenoteratozoospermia with control.

*Difference later indicates significant ($p<0.05$)

Discussion

The present study highlights the detrimental impact of genital tract infections on sperm quality and DNA integrity in infertile men. A significant decrease ($p < 0.05$) in sperm concentration, normal morphology, and progressive motility was observed in patients with Asthenozoospermia, Oligoasthenozoospermia, and Oligoasthenoteratozoospermia when compared with the control group. These findings are consistent with previous studies that have linked genital infections to impaired spermatogenesis and sperm function (12,13).

Infections of the male reproductive tract can lead to oxidative stress, characterized by excessive production of reactive oxygen species (ROS), which are known to damage the sperm plasma membrane and induce DNA fragmentation. The inflammation associated with these infections can disrupt the blood-testis barrier, impair sperm maturation, and interfere with the antioxidant defense mechanisms within the seminal plasma. This results in higher levels of sperm DNA fragmentation (SDF), a marker of genomic instability that has been strongly associated with reduced fertility potential(14,15).

Men with Oligoasthenoteratozoospermia (OAT), the most severe group examined, exhibited the most pronounced impairment in all sperm parameters, suggesting a cumulative effect of infection and oxidative stress on multiple aspects of sperm health(16,17). These alterations compromise the ability of sperm to fertilize the oocyte and may also affect embryo development, implantation, and pregnancy outcomes(18).

Our findings underscore the importance of routine screening for genital tract infections in the evaluation of male infertility. Early diagnosis and treatment of infections may help restore semen quality and reduce sperm DNA damage, thereby improving the chances of natural conception or enhancing the success of assisted reproductive techniques (ART)(19,20).

The present study demonstrates a significant increase in sperm DNA fragmentation (SDF) among infertile men, specifically those diagnosed with Asthenozoospermia, Oligoasthenozoospermia, and Oligoasthenoteratozoospermia, compared to fertile controls. The highest SDF level was observed in patients with Oligoasthenoteratozoospermia, followed by Oligoasthenozoospermia and Asthenozoospermia, in contrast to the control group. The differences were statistically significant ($p < 0.05$), indicating a strong association between increased DNA fragmentation and male infertility severity(21,22).

One of the proposed mechanisms linking infertility with elevated SDF is oxidative stress, which often arises from genital tract infections, leukocytospermia, or environmental exposures. Infections can trigger inflammatory responses that result in the overproduction of reactive oxygen species (ROS), which in turn damage the sperm's nuclear DNA. Additionally, the inability of spermatozoa to repair DNA damage due to limited cytoplasmic content further exacerbates the problem(23).Notably, patients with Oligoasthenoteratozoospermia (OAT)—a condition involving abnormalities in sperm count, motility, and morphology—exhibited the most severe DNA fragmentation. This suggests that the accumulation of multiple sperm defects may synergistically increase susceptibility to DNA damage(24).

The clinical implications of these findings are substantial. Routine assessment of sperm DNA integrity may offer valuable insight into unexplained infertility cases and provide prognostic information for ART outcomes. Moreover, identifying and treating underlying causes, such as infections or lifestyle factors that contribute to oxidative stress, could help improve sperm DNA quality (25).

Conclusion

The findings of this study highlight the significant elevation of round cell concentration and sperm DNA fragmentation in infertile men with Asthenozoospermia, Oligoasthenozoospermia, and Oligoasthenoteratozoospermia compared to fertile controls. These alterations reflect underlying seminal and molecular dysfunctions that likely contribute to impaired fertility potential. The

integration of round cell assessment and sperm DNA fragmentation analysis with conventional semen evaluation may enhance diagnostic precision and guide more effective, individualized treatment strategies for male infertility.

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