DOI: https://doi.org/10.53350/pjmhs20231709221

ORIGINAL ARTICLE

To Find the Effect of Microsurgical Varicocelectomy on Sperm Motility in Infertile Men

MIR ABID JAN[1], IRSHAD KHAN[2], MUHAMMAD SHAHID BHATTI[3], SHAHJEHAN[4], KHADIJA SALEEM[5], KHALIL UR REHMAN[6]
[1]Assistant Professor, Department Of Andro-Urology, Institute of Kidney Diseases, MTI - Hayatabad Medical Complex / Khyber Girls Medical College, Peshawar KPK, Pakistan
[2]Medical Officer, Temergara Medical College/ Temergara Teaching Hospital, Dir Lower KPK
[3]Associate Professor, Department Of Urology And Transplantation, Pir Abdul Qadir Shah Institute Of Medical Sciences, Gambat
[4]Associate Professor, Department of Urology, King Edward Medical University / Mayo Hospital, Lahore
[5]Assistant Professor, Department of Pathology, University Medical and Dental College, Faisalabad.
[6]Registrar, Department of Andrology-Urology Unit, Institute of Kidney Diseases, MTI Hayatabad Medical Complex/ Khyber Girls Medical College, Peshawar
Correspondence to: Khalil Ur Rehman, Email: drkhalil0334@gmail.com

ABSTRACT

Background: Varicocele is a common cause of male infertility, significantly impacting sperm motility and count. Microsurgical varicocelectomy is a widely accepted treatment for varicocele, aimed at improving semen parameters and fertility potential in affected men.

Objective: This study aimed to evaluate the effect of microsurgical varicocelectomy on sperm motility and sperm count in infertile men with clinical varicocele.

Material and Methods: This prospective interventional study was conducted at Institute of Kidney Diseases, MTI - Hayatabad Medical Complex, Peshawar, from October 2022 to March 2023. A total of 23 infertile men with clinically palpable varicocele (Grades I–III) were enrolled. Participants underwent subinguinal microsurgical varicocelectomy performed by an experienced surgeon. Semen analysis, assessing sperm motility and sperm count, was performed pre-operatively and three months post-operatively. Data were analyzed using SPSS version 25, and statistical significance was determined using paired t-tests with a p-value of <0.05.

Results: Significant improvements were observed in sperm motility and sperm count post-operatively. Mean sperm motility increased from 24.95% (±2.967) to 41.98% (±4.353) ($p<0.001$), while mean sperm count improved from 2.97 million/mL (±1.168) to 9.85 million/mL (±2.994) ($p<0.001$). These improvements were consistent across age groups, varicocele grades, and infertility durations, with non-obese participants showing more pronounced benefits.

Conclusion: Microsurgical varicocelectomy significantly improves sperm motility and sperm count in infertile men with varicocele. It is an effective treatment option for enhancing semen parameters and addressing male infertility.

Keywords: Varicocele, Microsurgical varicocelectomy, Male infertility, Sperm motility, Sperm count

INTRODUCTION

Infertility is a pressing global health concern, affecting approximately 15% of couples, with male infertility contributing to nearly 50% of these cases. Among male-specific causes, varicocele—a condition involving the abnormal enlargement of veins within the scrotum—is a leading factor in infertility, as it impairs spermatogenesis and disrupts sperm quality, particularly motility[1]. Microsurgical varicocelectomy has emerged as a widely recognized treatment option that effectively improves semen parameters, especially sperm motility, which is a crucial determinant of male fertility[2].

The link between varicocele and oxidative stress is well-documented. Oxidative stress, driven by an imbalance between reactive oxygen species (ROS) and antioxidants, leads to damage in sperm cells, including lipid peroxidation and DNA fragmentation[3]. Microsurgical varicocelectomy mitigates oxidative stress by improving testicular blood flow and restoring normal testicular temperature, thereby enhancing sperm motility and overall sperm quality[4]. Meta-analytic evidence suggests that the procedure significantly boosts sperm motility, emphasizing its importance in treating varicocele-induced infertility[5].

Although the benefits of varicocelectomy are established, variations in treatment outcomes across patient populations and surgical approaches present ongoing challenges. Factors such as varicocele grade, baseline semen quality, and the presence of comorbid conditions play key roles in determining the success of the surgery[6]. Innovations such as optical magnification during the procedure have further enhanced its precision and efficacy, reducing the risk of complications and improving the overall surgical outcome[7].

Recent studies have also explored the molecular mechanisms that underpin improvements in sperm motility after varicocelectomy, such as enhanced antioxidant enzyme activity, reduced germ cell apoptosis, and hormonal balance restoration[8]. Additionally, the procedure has been shown to improve sperm DNA integrity, a critical factor for successful fertilization and embryo development[9]. Microsurgical varicocelectomy has proven particularly effective in men with severe oligoasthenoteratozoospermia, resulting in improvements in both natural conception and ART outcomes[10].

Overall, microsurgical varicocelectomy remains a cornerstone in the management of male infertility, with growing evidence supporting its efficacy in improving sperm motility and fertility outcomes. As surgical techniques continue to improve, the potential for even greater success rates in treating varicocele-induced infertility increases[11,12].

Varicocele is one of the leading reversible causes of male infertility, often associated with impaired sperm motility, reduced sperm count, and increased DNA fragmentation. Despite advancements in assisted reproductive technologies, natural conception remains a priority for many infertile couples. Microsurgical varicocelectomy has been shown to improve semen parameters and fertility outcomes, yet variations in patient characteristics, such as age, varicocele grade, obesity, and duration of infertility, may influence its efficacy. This study aims to evaluate the impact of microsurgical varicocelectomy on sperm motility and sperm count across diverse patient profiles, providing evidence to guide clinical decision-making and optimize treatment strategies for infertile men with varicocele.

MATERIALS AND METHODS

This prospective interventional study was conducted at Institute of Kidney Diseases, MTI - Hayatabad Medical Complex, Peshawar, from October 2022 to March 2023. Written informed consent was obtained from all participants after explaining the study's purpose, potential risks, and benefits. The study aimed to evaluate the impact of microsurgical varicocelectomy on sperm motility in infertile men with varicocele. Men aged 20–45 years with clinically palpable varicocele (Grades I–III), confirmed by physical

Received on 05-04-2023
Accepted on 09-08-2023

examination and Doppler ultrasonography, were included in the study if they had been infertile for at least one year and had normal hormonal profiles, including FSH, LH, and testosterone. Exclusion criteria included a history of prior varicocele repair or testicular surgery, obstructive azoospermia, significant urological conditions such as hydrocele or testicular tumors, and chronic illnesses like diabetes or hypertension.

The sample size was determined based on previously reported changes in sperm motility after varicocelectomy. Pre-surgery sperm motility was reported as 27.3% (±15.6), and post-surgery motility was 39.4% (±14.2) [13]. Using a mean difference of 12.1%, a standard deviation of 14.9%, a significance level of 0.05, and a power of 90%, the required sample size was estimated to be 16 participants. To account for possible dropouts, 23 participants were enrolled in the study.

A total of 23 patients with infertility due to varicocele were included. Of these, 15 patients underwent bilateral varicocelectomy, and 8 underwent unilateral (left-sided) varicocelectomy. All surgeries were performed by a single experienced surgeon using the subinguinal microsurgical approach. This procedure involved ligating the internal spermatic veins while preserving the testicular artery and lymphatics. Post-operative care consisted of analgesics, scrotal support, and restrictions on strenuous activities for six weeks.

The primary outcome measure was sperm motility, which was assessed pre-operatively and three months post-operatively. Semen samples were collected through masturbation after 3–5 days of abstinence and analyzed within one hour of collection. Sperm motility was recorded as the percentage of motile spermatozoa.

Data were analyzed using SPSS version 25. Continuous variables, such as sperm motility, were presented as means ± standard deviations. Comparisons between pre- and post-operative motility were performed using the paired t-test, with a p-value of <0.05 considered statistically significant.

RESULTS

The study included 23 infertile male participants with a mean age of 33.09 years (±7.639), a mean BMI of 23.93 (±3.891), and an average duration of infertility of 5.22 years (±2.969). All participants were analyzed without missing data.

The overall results showed a significant improvement in semen parameters after microsurgical varicocelectomy (Table 1). The average sperm motility increased from 24.95% (±2.967) before surgery to 41.98% (±4.353) after surgery, while the average sperm count improved from 2.97 million/mL (±1.168) to 9.85 million/mL (±2.994). Both changes were statistically significant ($p < 0.001$), indicating the effectiveness of the procedure in improving sperm motility and sperm count in infertile men.

The analysis by age groups revealed similar significant improvements (Table 2). In the 20–35 years age group, sperm motility increased from 25.46% to 42.62%, and sperm count improved from 3.17 million/mL to 8.46 million/mL. In the 36–45 years age group, sperm motility increased from 24.29% to 41.15%, and sperm count improved from 2.72 million/mL to 11.66 million/mL. All changes were highly significant ($p < 0.001$), demonstrating the effectiveness of varicocelectomy across different age ranges.

When participants were grouped by obesity status, both obese and non-obese men benefited from the surgery (Table 3). In obese participants, sperm motility improved significantly from 22.10% to 44.20% ($p = 0.007$), but the increase in sperm count, from 2.38 million/mL to 10.01 million/mL, was not statistically significant ($p = 0.120$). In contrast, non-obese participants showed significant improvements in both sperm motility (25.38% to 41.65%) and sperm count (3.06 million/mL to 9.83 million/mL), with p-values less than 0.001. These results suggest that while both groups benefit, improvements are more consistent in non-obese participants.

Duration of infertility was also a significant factor (Table 4). In participants with 1–5 years of infertility, sperm motility improved from 24.46% to 41.86%, and sperm count increased from 2.70 million/mL to 9.94 million/mL ($p < 0.001$). In those with 6–10 years of infertility, sperm motility rose from 25.59% to 42.14%, and sperm count increased from 3.33 million/mL to 9.74 million/mL, both with p-values less than 0.001. These findings suggest that varicocelectomy is effective regardless of the duration of infertility. Lastly, the analysis by varicocele grade demonstrated significant improvements in semen parameters across all grades (Table 5). For Grade I varicocele, sperm motility increased from 24.54% to 42.30%, and sperm count rose from 2.84 million/mL to 10.44 million/mL ($p < 0.001$). In Grade II varicocele, motility improved from 25.62% to 40.24%, and sperm count increased from 2.68 million/mL to 8.59 million/mL ($p = 0.001$ and $p = 0.014$, respectively). Grade III varicocele showed the highest improvements, with motility increasing from 25.22% to 42.80% and sperm count improving from 3.50 million/mL to 9.72 million/mL ($p < 0.001$ and $p = 0.012$, respectively). These results highlight the consistent benefits of microsurgical varicocelectomy, irrespective of varicocele grade, with slightly greater absolute improvements observed in higher grades.

Table 1: Pre- and Post-Surgical Comparison of Sperm Motility and Sperm Count

Variable	Pre-Test Mean ± SD	Post-Test Mean ± SD	p-value
Sperm Motility (%)	24.95 ± 2.967	41.98 ± 4.353	<0.001
Sperm Count (million/mL)	2.97 ± 1.168	9.85 ± 2.994	<0.001

Table 2: Pre- and Post-Surgery Comparison by Age Groups

Variable	Age Group	Pre-Surgery Mean ± SD	Post-Surgery Mean ± SD	p-value
Sperm Motility (%)	20-35 Years (N=13)	25.46 ± 3.128	42.62 ± 3.838	<0.001
	36-45 Years (N=10)	24.29 ± 2.759	41.15 ± 5.032	<0.001
Sperm Count (million/mL)	20-35 Years (N=13)	3.17 ± 0.967	8.46 ± 2.546	<0.001
	36-45 Years (N=10)	2.72 ± 1.401	11.66 ± 2.620	<0.001

Table 3: Pre- and Post-Surgery Comparison by Obesity Status

Variable	Obesity Status	Pre-Surgery Mean ± SD	Post-Surgery Mean ± SD	p-value
Sperm Motility (%)	Obese (N=3)	22.10 ± 0.954	44.20 ± 3.900	0.007
	Non-Obese (N=20)	25.38 ± 2.936	41.65 ± 4.410	<0.001
Sperm Count (million/mL)	Obese (N=3)	2.38 ± 0.543	10.01 ± 4.556	0.120
	Non-Obese (N=20)	3.06 ± 1.218	9.83 ± 2.862	<0.001

Table 4: Pre- and Post-Surgery Comparison by Duration of Infertility

Variable	Duration Group	Pre-Surgery Mean ± SD	Post-Surgery Mean ± SD	p-value
Sperm Motility (%)	1-5 Years (N=13)	24.46 ± 3.262	41.86 ± 4.806	<0.001
	6-10 Years (N=10)	25.59 ± 2.556	42.14 ± 3.934	<0.001
Sperm Count (million/mL)	1-5 Years (N=13)	2.70 ± 1.252	9.94 ± 3.084	<0.001
	6-10 Years (N=10)	3.33 ± 0.994	9.74 ± 3.034	<0.001

Table 5: Pre- and Post-Surgery Comparison by Varicocele Grade

Variable	Varicocele Grade	Pre-Surgery Mean ± SD	Post-Surgery Mean ± SD	p-value
Sperm Motility (%)	Grade I (N=12)	24.54 ± 2.897	42.30 ± 5.496	<0.001
	Grade II (N=5)	25.62 ± 3.171	40.24 ± 2.848	0.001
	Grade III (N=6)	25.22 ± 3.361	42.80 ± 2.520	<0.001
Sperm Count (million/mL)	Grade I (N=12)	2.84 ± 1.186	10.44 ± 2.759	<0.001
	Grade II (N=5)	2.68 ± 1.169	8.59 ± 3.897	0.014
	Grade III (N=6)	3.50 ± 1.162	9.72 ± 2.849	0.012

DISCUSSION

The findings of this study are consistent with existing literature, highlighting the effectiveness of microsurgical varicocelectomy in improving semen parameters in infertile men with varicocele. Significant improvements in sperm motility and sperm count observed in this study align with previous findings by Ghazi et al.[13], who reported increases in sperm motility from 27.3% to 39.4% and sperm concentration from 13.4 million/mL to 20.2 million/mL post-surgery. Similarly, Cannarella et al.[14] conducted a meta-analysis demonstrating improvements across all semen parameters, including total motility, progressive motility, and sperm concentration, further reinforcing the role of varicocelectomy in enhancing male reproductive potential.

The reduction in sperm DNA fragmentation observed in previous studies provides critical insights into the molecular benefits of varicocelectomy. Ghazi et al.[13] showed a significant decrease in DNA fragmentation index (DFI) from 21.5% to 13.1%, supporting the notion that varicocelectomy enhances sperm genomic integrity. This improvement is particularly important for successful fertilization and embryo development. Zini et al.[15] also emphasized the role of varicocelectomy in improving chromatin compaction and DNA integrity, critical factors in spermatogenesis and fertilization success. Similarly, Soetandar et al.[16] reported a significant mean reduction in DFI by 5.46%, confirming the procedure's effectiveness in improving sperm DNA integrity and supporting its role in reducing infertility risk.

In patients with severe male factor infertility, such as severe oligozoospermia or azoospermia, the benefits of varicocelectomy extend beyond conventional semen parameter improvement. Takeuchi et al.[17] demonstrated significant increases in motile sperm count in men with severe infertility, enabling natural conception in some cases. Majzoub et al.[18] also found that varicocelectomy improved total motile sperm count in men with severe oligozoospermia, broadening their fertility treatment options and reducing the need for invasive techniques like testicular sperm extraction or ICSI.

The role of varicocelectomy in isolated asthenozoospermia is also noteworthy. Arafa et al.[19] found significant improvements in total and progressive sperm motility post-surgery, further supporting the utility of varicocelectomy in cases with motility-specific abnormalities. These findings are in line with the current study, which demonstrated a significant increase in sperm motility across all patient groups.

The timing of semen parameter improvement post-surgery is an important consideration. Mei et al.[20] suggested that optimal improvements occur within three months of surgery, with no significant gains observed beyond six months. This timeline provides valuable guidance for clinicians counseling patients on planning conception after varicocelectomy. Emerging evidence highlights the impact of varicocelectomy on molecular and metabolic factors associated with spermatogenesis. Zhang et al.[21] reported that varicocelectomy reverses metabolic abnormalities caused by varicocele, enhancing sperm quality and function. These molecular-level changes may underpin the improvements observed in semen parameters and fertility outcomes.

CONCLUSION

In conclusion, microsurgical varicocelectomy significantly improves sperm motility and sperm count in infertile men with varicocele, as demonstrated by the substantial post-operative enhancements observed in this study. These improvements were consistent across different age groups, duration of infertility, and varicocele grades, with non-obese participants showing more consistent benefits. The findings underscore the efficacy of varicocelectomy in enhancing semen parameters and its potential to improve fertility outcomes, making it a valuable treatment option for male infertility caused by clinical varicocele.

REFERENCES

1. Kocabaş M, Kutluyer F, Ertekin Ö, Aksu Ö, Başcınar N. Improvement of sperm motility of Oncorhynchus mykiss and Salvelinus fontinalis by L-tryptophan. Systems Biology in Reproductive Medicine. 2019;65(3):187-193.
2. Huijben M, Huijsmans RLN, Lock M, Kemp VF, Kort LD, Breda JHMK. Clomiphene citrate for male infertility: A systematic review and meta-analysis. Andrology. 2023;11(6):987-996.
3. Eisenberg ML, Esteves S, Lamb DJ, Hotaling JM, Giwercman A, Hwang K, Cheng YS. Male infertility. Nature Reviews Disease Primers. 2023;9(1):1-22.
4. Huang B, Wang Z, Kong Y, Jin M, Ma L. Global, regional and national burden of male infertility in 204 countries and territories between 1990 and 2019: an analysis of global burden of disease study. BMC Public Health. 2023;23(1):1-12.
5. Xu W, Yuan Y, Tian Y, Cheng CS, Chen Y, Zeng L, et al. Oral exposure to polystyrene nanoplastics reduced male fertility and even caused male infertility by inducing testicular and sperm toxicities in mice. Journal of Hazardous Materials. 2023;454:131470.
6. Calogero A, Cannarella R, Agarwal A, Hamoda TAA, Rambhatla A, Saleh R, et al. The Renaissance of Male Infertility Management in the Golden Age of Andrology. World Journal of Men's Health. 2023;41(2):237-254.
7. Wagner AO, Turk A, Kunej T. Towards a Multi-Omics of Male Infertility. World Journal of Men's Health. 2023;41(3):272-288.
8. Yuan Y, Tan Y, Qiu X, Luo H, Li Y, Li R, Yang X. Sperm telomere length as a novel biomarker of male infertility and embryonic development: A systematic review and meta-analysis. Frontiers in Endocrinology. 2023;13:CRD42022303333.
9. Kaltsas A. Oxidative stress and male infertility: The protective role of antioxidants. Medicina. 2023;59(1):1-9.
10. Takalani NB, Monaneng EM, Mohlala K, Monsees T, Henkel R, Opuwari C. Role of oxidative stress in male infertility. Reproduction and Fertility. 2023;4(1):1-10.
11. Bhattacharya I, Sen Sharma S, Majumdar S. Etiology of male infertility: an update. Reproductive Sciences. 2023;30(1):1-10.
12. Agarwal A, Cannarella R, Saleh R, Boitrelle F, Gul M, Toprak T, et al. Impact of varicocele repair on semen parameters in infertile men: A systematic review and meta-analysis. World Journal of Men's Health. 2022;41(3):289-310.
13. Ghazi S, Abdelfattah H. Effect of microsurgical varicocelectomy on sperm DNA fragmentation in infertile men. Middle East Fertility Society Journal. 2011;16(2):149-53.
14. Cannarella R, Shah R, Hamoda TA, et al. Does varicocele repair improve conventional semen parameters? A meta-analytic study of before-after data. World J Mens Health. 2024;42(1):92.
15. Zini A, Azhar R, Baazeem A, Gabriel MS. Effect of microsurgical varicocelectomy on human sperm chromatin and DNA integrity: a prospective trial. Int J Androl. 2011;34(1):14-9.
16. Soetandar A, Noegroho BS, Siregar S, Adriansjah R, Mustafa A. Microsurgical varicocelectomy effects on sperm DNA fragmentation and sperm parameters in infertile male patients: A systematic review and meta-analysis of more recent evidence. Arch Ital Urol Androl. 2022;94(3):360-5.
17. Takeuchi T, Nagao K, Aono N, et al. Beneficial effect of microsurgical varicocelectomy on semen parameters and clinical outcome in severe male factor infertility. Fertil Steril. 2014;102(3):e191.
18. Majzoub A, ElBardisi H, Covarrubias S, et al. Effect of microsurgical varicocelectomy on fertility outcome and treatment plans of patients with severe oligozoospermia: an original report and meta-analysis. Andrologia. 2021;53(6):e14059.
19. Arafa M, Alkabbani M, Elbardisi H, et al. Effect of microsurgical

subinguinal varicocele repair in infertile patients with isolated asthenozoospermia. Fertil Steril. 2023;120(4):e306-7.
20. Mei Y, Ji N, Feng X, Xu R, Xue D. Don't wait any longer, conceive in time: a systematic review and meta-analysis based on semen parameters after varicocelectomy. Int Urol Nephrol. 2024.
21. Zhang X, Deng C, Liu W, et al. Effects of varicocele and microsurgical varicocelectomy on the metabolites in semen. Sci Rep. 2022;12(1):5179.

This article may be cited as: Jan MA, Khan I, Bhatti MS, Shahjehan, Saleem K, Rehman KU: To Find the Effect of Microsurgical Varicocelectomy on Sperm Motility in Infertile Men. Pak J Med Health Sci, 2023;18(9): 221-224.