TIBBIYOT
TA'LIMI & INNOVATSIYALARI

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- 14.00.02 - Morfologiya;
- 14.00.03 - Endokrinologiya;
- 14.00.04 - Otorinolaringologiya;
- 14.00.05 - Ichki kasalliklar;
- 14.00.06 - Kardiologiya;
- 14.00.07 - Gigiena;
- 14.00.08 - Oftal'mologiya;
- 14.00.09 - Pediatriya;
- 14.00.10 - Yuqumli kasalliklar;
- 14.00.11 - Dermatologiya va venerologiya;
- 14.00.12 - Tibbiy reabilitologiya;
- 14.00.13 - Nevrologiya;
- 14.00.14 - Onkologiya;
- 14.00.15 - Patologik anatomiya;
- 14.00.16 - Normal va patologik fiziologiya;
- 14.00.17 - Farmakologiya va klinik farmakologiya;
- 14.00.18 - Psixiatriya va narkologiya;
- 14.00.19 - Klinik radiologiya;
- 14.00.20 - Tibbiy genetika;
- 14.00.21 - Stomatologiya;
- 14.00.22 - Travmatologiya va ortopediya;
- 14.00.23 - Hamshiralik ishini tashkil etish;
- 14.00.24 - Sud tibbiyoti;
- 14.00.27 - Xirurgiya;
- 14.00.28 - Neyroxirurgiya;
- 14.00.41 - Xalq tabobati;
- 14.00.35 - Bolalar xirurgiyasi;
- 14.00.34 - Yurak-qon tomir xirurgiyasi

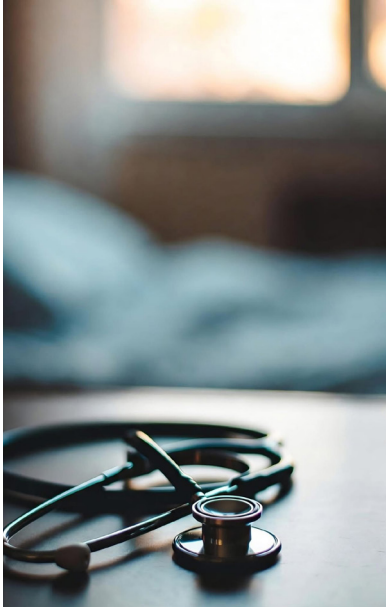
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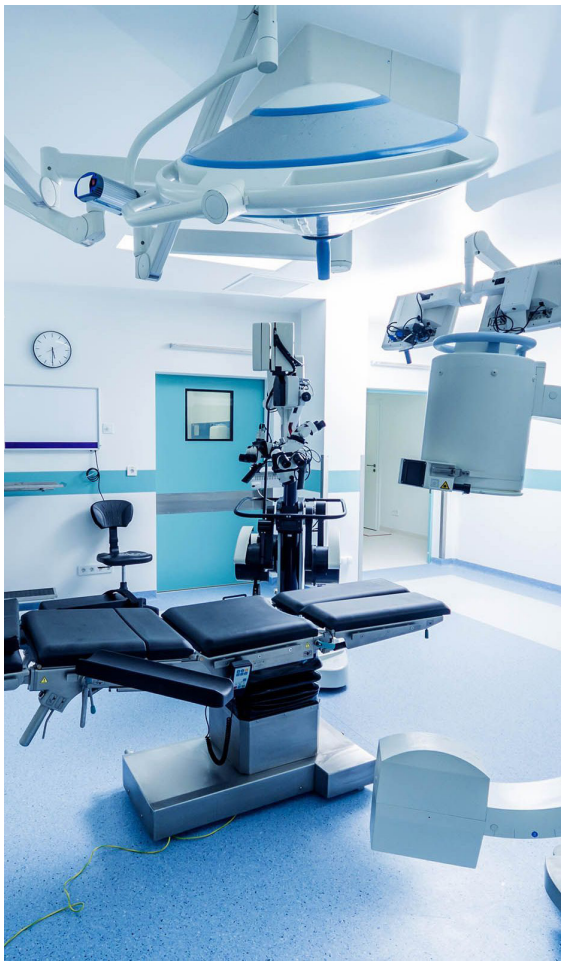
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“Tibbiyot ta'limi va innovasiyalari” ilmi elektron jurnali 29.04.2025-yildan O‘zbekiston Respublikasi Prezidenti Adminstratsiyasi huzuridagi Axborot va ommaviy kommunikatsiyalar agentligi tomonidan C-5669801 reyestr raqami tartibi bo‘yicha ro‘yxatdan o‘tkazilgan. Litsenziya raqami: №745444.

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MUNDARIJA

ОЦЕНКА РЕЗУЛЬТАТОВ КОМПЛЕКСНОГО ЛЕЧЕНИЯ ОСТЕОМИЕЛИТА ВЕРХНЕЙ ЧЕЛЮСТИ У БОЛЬНЫХ САХАРНЫМ ДИАБЕТОМ 2 ТИПА 22
Махкамов Зохидхужа Хасанхон угли, Рузиматов Акмалбек Санжарбек угли, Аллаяров Абдулло Улугбек угли

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ASSOCIATION OF VARICOCELE SEVERITY WITH SEMEN PARAMETERS IN INFERTILE MEN FROM THE FERGANA REGION: A CROSS-SECTIONAL STUDY

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Abstract: Background: Varicocele is a potentially reversible cause of male infertility; however, its effects may vary depending on the severity of the condition. Aim: To examine the distribution of varicocele grades and their associations with semen quality among infertile men in the Fergana region. Methods: A cross-sectional study was conducted among infertile men diagnosed with grade I, II, or III varicocele. Semen was assessed in terms of sperm concentration, vitality, motility, and morphology. Varicocele severity and venous diameter were also characterized. Results: Semen abnormalities increased with the severity of varicocele. The most pronounced deterioration was observed in grades II and III. Sperm motility and morphology showed adverse associations with increasing varicocele grade. The proportion of sperm head abnormalities increased from 40.0% in grade I to 61.6% in grade II and 69.15% in grade III. These findings indicate impairment of sperm morphofunctional characteristics as varicocele severity increases. Conclusions: Among infertile men from the Fergana region, increasing varicocele severity was associated predominantly with reduced sperm motility and abnormal morphology. Grades II and III warrant clinical attention and may require consideration of surgical management, whereas grade I may be managed conservatively. Assessment of varicocele grade may help guide evaluation and treatment decisions.

Key words: varicocele, semen analysis, ultrasound examination, varicocele grade.

Annotatsiya: Dolzarbligi: Varikotsele erkaklar bepushtligining potensial qaytar sabablaridan biri hisoblanadi, biroq uning ta’siri kasallikning og‘irlik darajasiga qarab farq qilishi mumkin. Maqsad: Farg‘ona viloyatidagi bepusht erkaklar orasida varikotsele darajalarining tarqalishini va ularning sperma sifati bilan bog‘liqligini o‘rganish. Metodlar: Ko‘ndalang (kross-seksion) tadqiqotda I, II yoki III darajali varikotsele tashxisi qo‘yilgan bepusht erkaklar baholandi. Sperma spermatozoidlar konsentratsiyasi, yashovchanligi, harakatchanligi va morfologiyasi bo‘yicha tahlil qilindi. Shuningdek, varikotsele og‘irlik

darajasi va venalar diametri baholandi. Natijalar: Varikotsele og‘irlik darajasi ortishi bilan spermogramma ko‘rsatkichlaridagi og‘ishlar ko‘payib bordi. Eng sezilarli yomonlashuv II va III darajalarda kuzatildi. Spermatozoidlar harakatchanligi va morfologiyasi varikotsele darajasining ortishi bilan salbiy bog‘liqlikni ko‘rsatdi. Spermatozoidlar boshchasi anomaliyalari ulushi I darajada 40,0% dan II darajada 61,6% ga va III darajada 69,15% gacha oshdi. Ushbu natijalar varikotsele og‘irlik darajasi ortishi bilan spermatozoidlarning morfofunksional xususiyatlari buzilishini ko‘rsatadi. Xulosalar: Farg‘ona viloyatidagi bepusht erkaklar orasida varikotsele og‘irlik darajasining ortishi, asosan, spermatozoidlar harakatchanligining pasayishi va morfologiyasining buzilishi bilan bog‘liq bo‘ldi. II va III darajalar alohida klinik e’tiborni talab qiladi hamda jarrohlik yo‘li bilan davolash masalasini ko‘rib chiqishni taqozo etishi mumkin. I darajada esa konservativ davolash usulini qo‘llash mumkin. Varikotsele darajasini baholash tekshiruv hamda davolash taktikasini tanlashda yordam berishi mumkin.

Kalit so‘zlar: varikotsele, spermogramma (sperma tahlili), ultratovush tekshiruvi, varikotsele darajasi.

Аннотация: Введение: Варикоцеле является потенциально обратимой причиной мужского бесплодия, однако его влияние может варьироваться в зависимости от степени тяжести заболевания. Цель: изучить распределение степеней варикоцеле и их взаимосвязь с качеством спермы среди мужчин с бесплодием в Ферганской области. Методы: В одномоментном (поперечном) исследовании были обследованы мужчины с бесплодием, у которых диагностировано варикоцеле I, II или III степени. Сперма оценивалась по концентрации, жизнеспособности, подвижности и морфологии сперматозоидов. Также оценивались степень тяжести варикоцеле и диаметр вен. Результаты: Выраженность отклонений в показателях спермограммы возрастала по мере увеличения степени тяжести варикоцеле. Наиболее выраженное ухудшение наблюдалось при II и III степенях. Подвижность и морфология сперматозоидов демонстрировали отрицательную связь с увеличением степени тяжести варикоцеле. Доля аномалий головки сперматозоидов увеличилась с 40,0% при I степени до 61,6% при II степени и 69,15% при III степени. Полученные данные свидетельствуют о нарушении морфофункциональных характеристик сперматозоидов по мере увеличения тяжести варикоцеле. Выводы: среди мужчин с бесплодием из Ферганской области увеличение степени тяжести варикоцеле было связано преимущественно со снижением подвижности и нарушением морфологии сперматозоидов. II и III степени требуют особого клинического внимания и могут служить основанием для рассмотрения вопроса о хирургическом лечении, тогда как при I степени возможно консервативное ведение пациентов. Оценка степени варикоцеле может помочь в выборе тактики обследования и лечения.

Ключевые слова: варикоцеле, анализ спермы (спермограмма), ультразвуковое исследование, степень варикоцеле.

INTRODUCTION

Infertility is clinically defined as the inability to achieve a recognized pregnancy after 12 or more months of regular unprotected sexual intercourse [1–5]. It is estimated to affect approximately 8–12% of couples worldwide [1], with the male partner identified as the sole or a contributing factor in 30–50% of cases [2]. At the population level, an infertility prevalence of approximately 4.2% among couples has been reported in Beijing, China [6]. Recognized risk factors for male infertility include obstructive pathology, genetic abnormalities, endocrine dysfunction, occupational exposures, advancing age, dietary factors, and ejaculatory disorders [4,5]. The recognized causes of male infertility encompass a broad etiological spectrum, including idiopathic testicular insufficiency, accessory gland infections, acquired testicular damage, chromosomal abnormalities, obstruction of the vas deferens or ejaculatory duct, immunological factors, and varicocele [7–9]. This etiological heterogeneity underscores the necessity for a comprehensive and systematic diagnostic evaluation of the infertile male [7].

Varicocele is characterized by abnormal dilatation and elongation of the pampiniform venous plexus of the spermatic cord, producing the classic “bag of worms” appearance on physical examination [8,10]. Varicocele is detected in approximately 14–20% of adolescents and adults in the general population [5,10], with prevalence estimates of 15–20% among unselected males and 30–40% among men presenting with infertility [11]. Among men with primary infertility, varicocele is present in 35–40% of cases, a pattern consistent with progressive testicular dysfunction over time [13–19]. Varicocele demonstrates a marked left-sided predominance, occurring on the left in 85–90% of cases. This anatomical predisposition is attributable to the perpendicular drainage of the left testicular vein into the left renal vein [24]. Bilateral testicular dysfunction may occur through collateral retroperitoneal venous anastomoses, and subclinical right-sided varicocele may be detectable by ultrasonography even in the absence of clinical findings [11,17]. These observations suggest that unilateral varicocelectomy alone may be insufficient to fully address the underlying pathophysiology in affected men [22]. Scrotal Doppler ultrasonography has increasingly been adopted as a valuable adjunct to physical examination in the diagnostic evaluation of varicocele [22,23]. The pathophysiological mechanisms by which

varicocele impairs male fertility are multifactorial. Elevation of intrascrotal temperature is regarded as a central mechanism, given that optimal spermatogenesis requires a temperature of 33–34°C [20]. Additional implicated mechanisms include the retrograde reflux of adrenal and renal metabolites, Leydig cell dysfunction, elevated reactive oxygen species (ROS), reduced antioxidant capacity, and venous stasis-induced hypoxia [11,21].

LITERATURE REVIEW

Studies have demonstrated a clear association between increasing varicocele severity and deterioration in semen quality. Men with higher-grade varicocele generally exhibit lower sperm concentrations and reduced motility. In particular, Zamyatnin et al. reported that 61.2% of men with grade III varicocele had pathozoospermia, indicating substantial impairment of semen quality (Zamyatnin et al., 2021) [14]. Varicocele severity has also been associated with abnormalities in sperm morphology. Ma et al. showed that men with grade III varicocele had a significantly lower proportion of morphologically normal spermatozoa compared with controls (Ma et al., 2013) [15]. These findings suggest that appropriate management of varicocele may improve reproductive outcomes in affected men. Surgical correction has been reported to contribute to the restoration of semen parameters and improvement of reproductive potential (Baazeem et al., 2011) [13]. The above-mentioned study by Zamyatnin et al., which included 442 young men, demonstrated progressive deterioration in semen quality with increasing varicocele grade: pathozoospermia was observed in 25.0% of men with grade I varicocele, 47.3% with grade II, and 61.2% with grade III, compared with 27.4% among men without varicocele. Higher-grade varicocele (grades II–III) was also associated with a reduced proportion of morphologically normal spermatozoa [14].

Despite these observations, the precise molecular basis of varicocele-associated infertility has not been fully elucidated. Furthermore, the exact impact of varicocele on semen quality remains incompletely defined, with existing studies frequently limited by small sample sizes and heterogeneous methodologies. Notably, not all men with varicocele exhibit infertility, indicating the presence of modifying factors. The aim of this cross-sectional study was to evaluate the association between varicocele severity and semen parameters in infertile men from the Fergana region. Infertile men with clinically diagnosed varicocele were evaluated using scrotal Doppler ultrasonography and semen analysis. Sperm concentration, vitality, motility, and morphology were compared across different grades of varicocele.

RESEARCH METHODOLOGY

This prospective cross-sectional study included 96 patients with varicocele who presented to Uromed ABK Clinic during 2025. Patients sought medical care primarily because of infertility, scrotal pain, and discomfort. The following inclusion and exclusion criteria were applied during patient selection. Inclusion criteria: Male patients aged 18–39 years; Doppler ultrasonography-confirmed grade I, II, or III varicocele; and the presence of infertility and/or impaired spermatogenesis. Exclusion criteria: Concomitant inflammatory diseases of the scrotum or testes other than varicocele, including orchitis and epididymitis, and a history of previous surgical treatment for varicocele. Patients were classified according to the condition of the testicular venous system using Doppler ultrasonography and were diagnosed with grade I, II, or III varicocele. Doppler ultrasonography was performed according to standardized criteria, including the presence of reflux in the testicular veins, as well as the persistence and duration of venous reflux.

Semen analysis was performed in the laboratory in accordance with World Health Organization (WHO) standards. The following parameters were assessed: sperm concentration (million/mL), motility (A: progressive motility; B: non-progressive or reduced progressive motility; C: immotile spermatozoa), morphology (normal and abnormal forms), and sperm vitality (percentage of viable spermatozoa). The study data were statistically analyzed using Microsoft Excel. Differences in semen parameters among patients with grade I, II, and III varicocele were evaluated using the following statistical methods: analysis of variance (ANOVA) to identify statistically significant differences in semen parameters among the three varicocele grades; correlation analysis to assess the relationship between varicocele severity and semen parameters; and confidence intervals (CIs) to estimate the precision and statistical reliability of the obtained results. Statistical significance was assessed using p-values, with $p < 0.05$ considered statistically significant.

ANALYSIS AND RESULTS

For statistical analysis, patients were classified into three groups according to varicocele grade. Representative Doppler images of grade 0 (Figure 1, A–D), grade I (Figure 1, E–H), grade II (Figure 2, A–D), and grade III (Figure 2, E–H) are shown. Dilatation of the pampiniform plexus was assessed by measuring the right, left, and maximum vein diameters in the relaxed supine position and during the Valsalva maneuver (Figures 1 and 2).

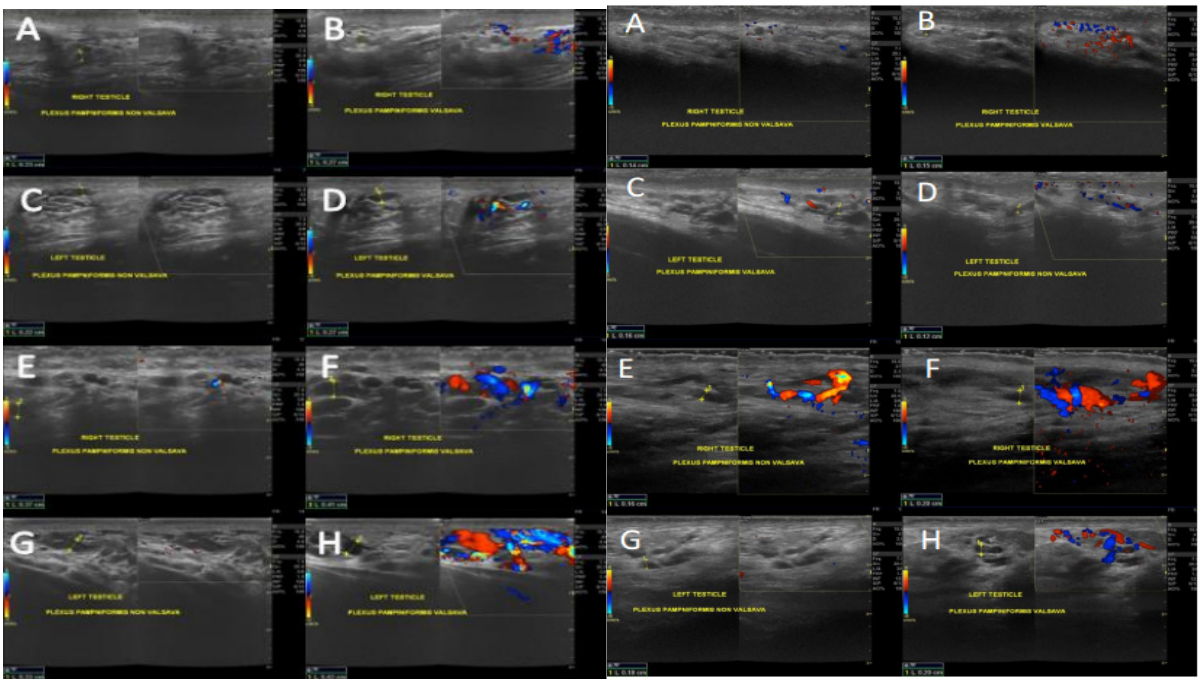


Figure 1. Color Doppler Ultrasonographic Assessment of the Pampiniform Plexus of the Right and Left Testes.
Figure 2. Color Doppler Ultrasonographic Evaluation of the Pampiniform Plexus of Both Testes Under Different Imaging Conditions

Doppler Ultrasound of Grade 0 Varicocele. A represents the right testis, and C represents the left testis. Both show a pampiniform plexus vein diameter of less than 2 mm in the relaxed supine position. B and D show the pampiniform plexus on both the left and right sides, with an increased diameter of less than 2 mm. Doppler Ultrasound of Grade I Varicocele. E represents the right testis, and G represents the left testis. Both show a pampiniform plexus vein diameter of less than 2 mm in the relaxed supine position. The diameters of both the right (F) and left (H) pampiniform plexus veins increase to 2–3 mm during the Valsalva maneuver. Doppler Ultrasound of Grade II Varicocele. A represents the right testis, and C represents the left testis. Both show a pampiniform plexus vein diameter of less than 3 mm in the relaxed supine position. The diameters of both the right (B) and left (D) pampiniform plexus veins increase to 2–3 mm during the Valsalva maneuver.

Doppler Ultrasound of Grade III Varicocele. E represents the right testis, and G represents the left testis. Both show a pampiniform plexus vein diameter of more than 3 mm in the relaxed supine position. The diameters of both the right (F) and left (H) pampiniform plexus veins increase to more than 3 mm during the Valsalva maneuver. A total of 96 patients aged 18–39 years were included in the study, with a mean age of 26.7 years. According to varicocele severity, 28 patients (29.17%) had grade I varicocele, 39 (40.63%) had grade II varicocele, and 29 (30.21%) had grade III varicocele. The study findings demonstrated that deterioration in the morphofunctional characteristics of spermatozoa was substantially more pronounced in patients with grade II and III varicocele than in those with grade I varicocele. The comparative changes in semen parameters according to varicocele grade are presented in Table 1.

Table 1. Comparative Analysis of Semen Parameters Across Different Grades of Varicocele

Varicocele grade	Sperm concentration (million/mL)	Viable spermatozoa (%)	Progressive motility (%)	Morphological abnormalities (head/ midpiece/cavity, %)
Grade I	141.0	84.5	65.5	40.0 / 10.6 / 20.78
Grade II	142.9	63.3	45.28	61.6 / 9.2 / 29.2
Grade III	129.0	67.5	46.8	69.15 / 10.66 / 20.22

In patients with grade II varicocele, the mean sperm concentration was 142.9 million/mL, ranging from a minimum of 20 million/mL to a maximum of 220 million/mL. The proportion of viable spermatozoa was 63.3%, while non-viable spermatozoa accounted for 36.7%. Regarding motility, 45.28% of spermatozoa exhibited

progressive motility, 17.87% showed reduced motility, and 36.85% were immotile. Morphological abnormalities were observed in the sperm head in 61.6% of cases, in the midpiece in 9.2%, and in the third morphological category in 29.2% of cases, indicating that abnormalities in this category were markedly more frequent than in patients with grade I varicocele. In patients with grade III varicocele, the mean sperm concentration was 129 million/mL, ranging from a minimum of 2 million/mL to a maximum of 210 million/mL. The proportion of viable spermatozoa was 67.5%, while non-viable spermatozoa accounted for 32.5%, which was broadly comparable to the values observed in grades I and II. Regarding motility, 46.8% of spermatozoa exhibited progressive motility, 17.17% showed reduced motility, and 27.55% were immotile. Morphological abnormalities were observed in the sperm head in 69.15% of cases, in the midpiece in 10.66%, and in the third morphological category in 20.2% of cases.

Statistical analysis demonstrated no significant differences in mean sperm concentration among patients with grade I, II, and III varicocele ($p > 0.05$). However, patients with grade III varicocele exhibited an exceptionally low minimum sperm concentration of 2 million/mL. The proportions of viable and non-viable spermatozoa were also comparable among the three groups ($p > 0.05$). In contrast, significant differences were observed in sperm morphology, particularly in the frequency of head abnormalities ($p < 0.05$). Abnormalities in the third morphological category were most pronounced in patients with grade II varicocele, and the differences among the groups were also statistically significant ($p < 0.05$).

DISCUSSION

The present study investigated the association between varicocele severity and semen parameters in 96 infertile men from the Fergana region. The main finding was that higher grades of varicocele were accompanied by more pronounced alterations in several morphofunctional characteristics of spermatozoa. In particular, progressive motility and sperm morphology showed clear deterioration in patients with grade II and III varicocele compared with those with grade I varicocele, whereas mean sperm concentration did not differ significantly among the three groups. These findings indicate that the adverse reproductive effects of varicocele may be reflected more strongly in the functional and morphological characteristics of spermatozoa than in sperm concentration alone.

Mean sperm concentration was 141.0 million/mL in grade I, 142.9 million/mL in grade II, and 129.0 million/mL in grade III varicocele. Although the lowest mean value was observed in the grade III group, the between-group difference was not statistically significant ($p > 0.05$). However, an important observation was the very low minimum sperm concentration of 2 million/mL in grade III varicocele, compared with a minimum of 20 million/mL in both grades I and II. This finding suggests substantial interindividual variability in spermatogenic impairment among men with severe varicocele. Therefore, varicocele grade alone may not completely predict sperm concentration, and additional biological and clinical factors may contribute to the extent of spermatogenic dysfunction. A more evident relationship was observed between varicocele severity and sperm motility. Progressive motility decreased from 65.5% in grade I to 45.28% in grade II and 46.8% in grade III varicocele. Thus, patients with grades II and III varicocele demonstrated substantially lower progressive motility than those with grade I varicocele. Although the difference between grades II and III was relatively small, the overall pattern suggests that clinically more advanced varicocele is associated with impaired sperm functional capacity. This finding is consistent with previous reports demonstrating deterioration in semen quality with increasing varicocele severity [14,16].

The most pronounced changes in the present study were observed in sperm morphology. The proportion of head abnormalities increased progressively from 40.0% in grade I to 61.6% in grade II and 69.15% in grade III varicocele. Statistical analysis confirmed a significant difference in the frequency of head abnormalities among the groups ($p < 0.05$). This progressive increase suggests that sperm morphology, particularly abnormalities involving the head, may be especially sensitive to increasing varicocele severity. These findings are consistent with the report by Ma et al., who demonstrated impaired sperm morphology in infertile men with varicocele [15]. The observed deterioration in sperm morphology and motility can be explained by the multifactorial pathophysiology of varicocele. Venous stasis and impaired pampiniform plexus function may disrupt scrotal thermoregulation and increase testicular temperature. In addition, retrograde reflux of renal and adrenal metabolites, hypoxia, Leydig cell dysfunction, excessive production of reactive oxygen species, and reduced antioxidant capacity have all been proposed as mechanisms contributing to spermatogenic impairment [11,18,21]. Oxidative stress may damage sperm membranes, mitochondria, and structural components involved in sperm maturation, thereby providing a plausible biological explanation for the decrease in progressive motility and increase in morphological abnormalities observed in patients with higher-grade varicocele. Our findings are also broadly consistent with previous clinical studies showing a relationship between varicocele grade and semen quality. Zamyatnin et al. reported a high frequency of pathozoospermia among men with grade III varicocele [14], while

Ariyati et al. demonstrated an association between varicocele grade and semen analysis parameters [16]. Furthermore, the large multicenter study by Damsgaard et al., which included 7,035 young men, showed that varicocele was independently associated with impaired semen quality and altered reproductive hormone levels [9].

Taken together, these findings support the concept that increasing varicocele severity may be accompanied by progressive functional impairment of the testes, although the magnitude of this effect may vary considerably among individuals. An important feature of our results is that the deterioration in semen quality was not uniform across all parameters. While sperm morphology and progressive motility showed marked changes, sperm concentration and vitality did not demonstrate statistically significant differences among the three varicocele grades. This heterogeneity may explain why not all men with varicocele develop the same degree of infertility. Age, duration of infertility, duration of varicocele, bilateral involvement, testicular volume, hormonal status, oxidative stress, lifestyle factors, and individual susceptibility may modify the effects of varicocele on spermatogenesis. From a clinical perspective, the findings suggest that infertile men with grade II and III varicocele may warrant particularly careful evaluation of semen quality, especially sperm motility and morphology.

However, because the present study was cross-sectional and did not evaluate postoperative changes or pregnancy outcomes, the results should not be interpreted as evidence that varicocele grade alone determines the indication for surgical treatment. Previous studies have reported improvements in semen parameters following appropriately selected varicocele repair [12,13], but therapeutic decisions should be based on a combination of clinical findings, semen abnormalities, symptoms, testicular characteristics, reproductive goals, and established treatment recommendations. The present study has several limitations. First, it was conducted at a single clinical center and included a relatively limited sample of 96 patients, which may restrict the generalizability of the findings. Second, no control group of infertile men without varicocele or fertile men was included, preventing direct assessment of the independent effect of varicocele itself. Third, the cross-sectional design does not allow causal conclusions regarding the relationship between increasing varicocele grade and deterioration in semen quality. In addition, potentially important confounding variables, including smoking status, body mass index, testicular volume, reproductive hormone levels, duration of infertility, and oxidative stress markers, were not included in the present analysis. Future multicenter prospective studies with larger sample sizes, appropriate control groups, multivariable statistical adjustment, and longitudinal follow-up before and after treatment are therefore required.

CONCLUSION

Overall, the present study provides regional evidence that increasing varicocele severity is associated predominantly with deterioration in sperm motility and morphology among infertile men from the Fergana region. The progressive increase in sperm head abnormalities from grade I through grade III represents one of the clearest findings of the study, whereas mean sperm concentration remained relatively preserved despite substantial individual variability. These results emphasize the importance of comprehensive semen assessment rather than reliance on sperm concentration alone when evaluating reproductive impairment in men with varicocele.

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