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RESEARCH ARTICLE

Evidence from Hormonal and Semen Profiles Across Age Groups for Early Varicocelectomy

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Abstract

Objective: To evaluate age-related differences in hormonal and semen parameter responses following varicocelectomy in adolescents and adults, and to explore whether early surgical intervention is justified in younger patients.

Materials and Methods: We retrospectively analyzed 82 patients who underwent subinguinal varicocelectomy and had complete pre- and postoperative hormone and semen profiles. Patients were divided into two age-based groups, group 1 (<21 years, n=30) and group 2 (>30 years, n=52). Hormonal parameters included serum FSH, LH, and total testosterone. Semen parameters included sperm concentration, motility, and morphology. Outcomes were assessed 6-12 months postoperatively.

Results: Both groups exhibited significant improvements in semen parameters postoperatively, with no significant differences in the degree of improvement between groups (p>0.05). In contrast, a significant increase in testosterone levels was observed only in group 2 (p=0.017), and this hormonal improvement was significantly greater than in group 1 (p=0.009). FSH levels were higher in group 2 preoperatively (p=0.006) and postoperatively (p=0.002), yet no significant intragroup changes in FSH or LH were detected.

Conclusion: While varicocelectomy improves semen parameters in both adolescents and adults, meaningful hormonal recovery appears to be limited to older patients. These findings suggest that early surgical intervention may not be necessary for all adolescents and highlight the importance of individualized, hormone-informed treatment strategies. Prospective studies with longer follow-up are warranted to guide age-specific clinical decision-making.

Keywords: adolescent, adult, hormone profile, semen analysis, varicocelectomy

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INTRODUCTION

Varicocele is characterized by the abnormal dilation of the pampiniform venous plexus, is the most prevalent surgically correctable cause of male infertility. Its prevalence is estimated at approximately 15% in the general male population and increases to 35-44% in men with primary infertility, and up to 81% in those with secondary infertility (1).

In adolescents and young adults, the clinical significance and management of varicocele remain subjects of debate. While varicocelectomy has been associated with improvements in semen parameters and testicular volume in this population, the overall quality of evidence is limited. Moreover, long-term data on fertility and paternity rates are lacking. As a result, current expert consensus and guidelines typically classify the presence of abnormal semen parameters in adolescents and young adults as a relative indication for surgical intervention, with conservative follow-up often recommended (2). The uncertainty surrounding the outcomes of adolescent varicocelectomy, coupled with parental concerns about potential infertility in adulthood, can create disagreement between physicians and families during the decision-making process (3).

By contrast, in adult men, particularly those over 30 years of age, there is more consistent evidence supporting varicocelectomy for improving semen quality and fertility outcomes. A comprehensive meta-analysis demonstrated that treatment of any grade varicocele in infertile men significantly enhances sperm concentration, motility, and natural conception rates (4).

Despite these findings, few studies have directly compared the outcomes of varicocelectomy across different age groups. Evaluating age-related differences in surgical efficacy is crucial for developing clear and individualized treatment strategies (5-7).

In this study, we aim to evaluate the changes in semen and also hormone levels following varicocelectomy in two distinct age groups: those under 21 years and those over 30 years. By analyzing pre- and post-operative hormone and semen parameters, we seek to determine whether our clinical outcomes are consistent with current literature and to clarify the impact of patient age on the response to varicocelectomy.

MATERIALS AND METHODS

This retrospective cohort study was conducted at the Urology Department of a tertiary care training and research hospital. Institutional review board approval was obtained prior to data collection (Approval No: 2025/07/05/050). A total of 754 patients who presented between January 2015 and December 2022 with symptoms such as scrotal pain, swelling, testicular atrophy, or infertility were screened using the hospital's electronic medical records system. Patients diagnosed with varicocele based on physical examination and/or scrotal Doppler ultrasonography were identified (n=232). Exclusion criteria included a history of inguinal or scrotal surgery (n=25), prior chemotherapy or radiotherapy due to any malignancy (n=9), absence of at least two consecutive preoperative semen analyses (n=57), and incomplete preoperative or postoperative hormonal profile (n=59). After applying the exclusion criteria, 82 patients were included in the final analysis. These patients were divided into two groups according to age at the time of surgery: group 1, patients aged <21 years (n=30), and group 2, patients aged >30 years (n=52) (Figure 1). An intentional age gap between the two groups was created to ensure a clear distinction between the younger, developing patient cohort and the established adult cohort, the latter primarily presenting with infertility.

Surgical Technique

All patients underwent standard subinguinal varicocelectomy performed under general/regional anesthesia. Through a 2-3 cm transverse incision made just below the external inguinal ring, the spermatic cord was exposed and isolated. Dilated veins were identified and ligated using 3-0 silk sutures under direct vision, without the aid of optical magnification. Care was taken to preserve the testicular artery and lymphatics, and the cremasteric and external spermatic veins were also ligated when clearly visualized. The surgical procedure was completed by repositioning the spermatic cord and closing the layers in anatomic fashion (8).

Hormonal and Semen Analysis

All patients had comprehensive semen analyses and hormonal evaluation both preoperatively and postoperatively. Semen samples were collected by masturbation following 3-4 days of sexual abstinence. Parameters assessed included sperm

concentration (million/mL), progressive motility (%), and normal morphology (%). Hormonal profiles included serum levels of FSH, LH, and total testosterone. Postoperative assessment was performed within 6-12 months following surgery.

Statistical Analysis

Descriptive statistics included mean, standard deviation, median, minimum, maximum, frequency, and percentage values. The distribution of continuous variables was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests. For non-normally distributed quantitative independent variables, the Mann-Whitney U test was used. The Wilcoxon signed-rank test was applied for dependent quantitative variables with a non-normal distribution. For categorical independent variables, the Chi-square test was used, and Fisher's exact test was applied when the assumptions for the Chi-square test were not met. All statistical analyses were performed using IBM SPSS Statistics for Windows, Version 28.0 (IBM Corp., Armonk, NY, USA).

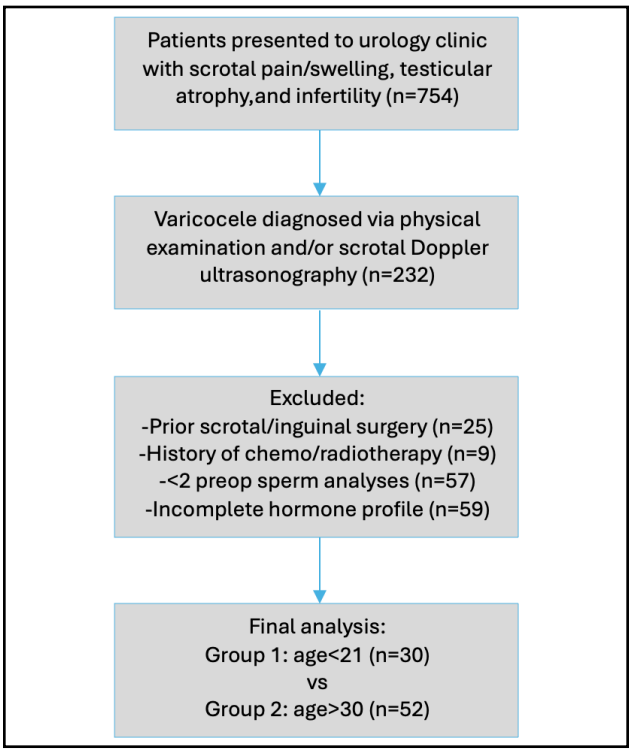

Figure 1. Study Flowchart

Table 1. Comparison of Groups in Terms of Clinical Features

		Group 1 (n=30)		Group 2 (n=52)		p value
		n	%	n	%	
Pain		20	66.7%	4	7.7%	<0.001[a]
Infertility		0	0.0%	46	88.5%	<0.001[a]
Atrophy		2	6.7%	0	0.0%	0.131[a]
Varicose appearance		8	26.7%	2	3.8%	0.002[a]
Varicocele degree right	0	27	90.0%	38	73.1%	0.069[a]
	1	1	3.3%	3	5.8%	
	2	2	6.7%	9	17.3%	
	3	0	0.0%	2	3.8%	
Varicocele degree left	0	0	0.0%	1	1.9%	1.000[a]
	1	0	0.0%	3	5.8%	
	2	13	43.3%	22	42.3%	
	3	17	56.7%	26	50.0%	
Operation side	Bilateral	3	10.0%	13	25.0%	0.099[a]
	Right	0	0.0%	1	1.9%	1.000[a]
	Left	27	90.0%	38	73.1%	0.069[a]
Postoperative complications	No	28	93.3%	49	94.2%	1.000[a]
	Yes	2	6.7%	3	5.8%	
Age at the time of operation (mean±SD)		18±1.91		35±4.83		
Postoperative analysis day (mean±SD)		143.0±46.4		143.7±52.6		0.839[b]

[a] Fisher's exact test, [b] Mann-Whitney U test.

SD: Standard Deviation

RESULTS

A total of 82 patients were included in the study, comprising 30 patients in group 1 and 52 patients in group 2. The proportion of patients presenting with scrotal pain (p<0.001) or varicose appearance (p=0.002) was significantly lower in group 2 compared to group 1. Conversely, the proportion of patients presenting with infertility was significantly higher in group 2 (p<0.001). No significant differences were observed between the groups regarding testicular atrophy complaint, laterality of varicocele, varicocele grade, surgical side, postoperative complication rates, or the timing of semen analysis (p>0.05 for all comparisons) (Table 1).

Table 2. Comparison of Groups in Terms of Pre- and Postoperative Hormone and Semen Parameters

	Group 1 (n=30)		Group 2 (n=52)		
	mean±SD	median	mean±SD	median	p value
FSH					
Preoperative	5.08±3.57	4.25	6.82±3.66	6.05	0.006[b]
Postoperative	4.90±2.97	4.23	6.70±3.15	5.92	0.002[b]
Pre/Postoperative Change	-0.19±1.08	0.07	-0.12±1.37	-0.17	0.870[b]
Intragroup p-value	0.742[c]		0.662[c]		
LH					
Preoperative	5.51±2.87	4.71	6.05±2.81	5.43	0.290[b]
Postoperative	5.25±1.78	4.94	5.75±2.37	5.15	0.476[b]
Pre/Postoperative Change	-0.27±1.68	-0.09	-0.31±1.78	-0.29	0.665[b]
Intragroup p-value	0.926[c]		0.389[c]		
Total testosterone					
Preoperative	4.46±1.52	4.37	4.07±1.80	3.66	0.147[b]
Postoperative	4.22±1.49	3.93	4.38±1.72	4.06	0.762[b]
Pre/Postoperative Change	-0.24±0.81	-0.38	0.31±1.02	0.39	0.009[b]
Intragroup p-value	0.098[c]		0.017[c]		
Concentration					
Preoperative	16.7±22.6	8.0	9.4±10.6	7.0	0.194[b]
Postoperative	32.2±27.8	20.5	31.7±26.3	26.5	0.862[b]
Pre/Postoperative Change	15.5±27.5	6.5	22.3±21.9	17.5	0.076[b]
Intragroup p-value	0.001[c]		<0.001[c]		
Motility					
Preoperative	28.8±16.0	30.0	29.3±13.8	30.0	0.735[b]
Postoperative	39.8±10.5	38.5	35.7±15.5	34.5	0.186[b]
Pre/Postoperative Change	11.0±13.7	12.5	6.4±15.1	5.0	0.128[b]
Intragroup p-value	<0.001[c]		0.008[c]		
Morphology					
Preoperative	1.23±0.77	1.00	1.21±0.46	1.00	0.531[b]
Postoperative	1.93±0.74	2.00	1.88±0.83	2.00	0.602[b]
Pre/Postoperative Change	0.70±1.02	1.00	0.67±0.79	1.00	0.510[b]
Intragroup p-value	0.002[c]		<0.001[c]		

[b] Mann-Whitney U test, [c] Wilcoxon signed-rank test.

SD: Standard Deviation

In hormonal analyses, preoperative (p=0.006) and postoperative (p=0.002) FSH levels were significantly higher in group 2 compared to group 1. However, within-group comparisons revealed no significant change in FSH or LH levels pre- and postoperatively in either age group (p>0.05). Similarly, there were no significant differences in the degree of FSH or LH change between the groups. Regarding testosterone levels, postoperative testosterone values increased significantly compared to preoperative values only in group 2 (p=0.017). Furthermore, the degree of testosterone increase was significantly greater in group 2 compared to group 1 (p=0.009) (Table 2).

Semen parameter analysis revealed that both groups demonstrated significant improvements in sperm concentration, progressive motility, and morphology after varicocelectomy (p<0.05 for all parameters within groups). However, the degree of improvement in these parameters did not differ significantly between the two groups (p>0.05) (Table 2).

DISCUSSION

In this retrospective cohort study, we aimed to evaluate the impact of varicocelectomy on hormonal and semen parameters in patients aged under 21 and over 30 years. Our findings revealed that postoperative testosterone levels increased significantly only in group 2, while FSH levels remained higher in this group compared to group 1. Notably, both age groups exhibited significant improvements in semen parameters postoperatively. These results suggest that early varicocelectomy in adolescents may not be necessary, as hormonal improvements are more pronounced in older patients. This study contributes to the ongoing debate regarding the optimal timing of varicocelectomy in adolescents, providing evidence that supports a more conservative approach in younger individuals.

Our findings align with previous studies indicating that varicocelectomy can lead to improvements in hormonal profiles, particularly testosterone levels, in older patients. For instance, a meta-analysis by Cannarella et al. demonstrated significant increases in serum testosterone levels post-varicocelectomy, with a mean difference of 82.45 ng/dL, especially in patients with baseline testosterone levels below 300 ng/dL (9). Similarly, a prospective cohort study reported that patients with FSH levels ≤10 mIU/mL experienced increased testosterone levels and improved semen quality after varicocelectomy (10).

While both age groups in our study demonstrated improvements in semen parameters, the lack of significant hormonal changes in the younger cohort raises questions about the necessity of early surgical intervention. This may be explained by the fact that in patients with varicocele, Sertoli cell dysfunction and decreased inhibin B levels lead to compensatory elevations in serum FSH levels. In this context, elevated FSH may be considered an indirect marker of germ cell damage. Additionally, patients with higher FSH levels have been shown to exhibit greater postoperative increases in testosterone following varicocelectomy (11). In our study, the absence of elevated FSH in the adolescent group may indicate that germ cell damage had not yet fully manifested in this population, thus potentially explaining the limited hormonal response. This observation is consistent with the notion that the hormonal benefits of varicocele repair may become more prominent once subclinical testicular damage has progressed. It also underscores the importance of hormonal assessment in the clinical decision-making process for varicocelectomy, particularly in younger patients (12).

Several studies have explored the outcomes of varicocelectomy in adolescents. A study by Van Batavia et al. found significant correlations between hormone levels and semen parameters in adolescents with varicocele, suggesting that hormonal evaluation can be a useful tool in assessing the severity of varicocele and the need for surgical intervention (13). Another study by Zhou et al. reported that adolescents with varicocele who underwent varicocelectomy showed improvements in semen parameters, including sperm count, motility, and morphology (14). However, the degree of improvement varied among individuals, highlighting the need for individualized assessment and treatment planning.

In contrast, some studies suggest that conservative management may be appropriate for certain adolescents with varicocele. A study by Bogaert et al. found that 85% of adolescents with uncorrected varicoceles managed with observation achieved paternity, a proportion similar to the 78% of men whose varicoceles were repaired (15). This

finding suggests that not all adolescents with varicocele require surgical intervention, and that careful monitoring may be sufficient in some cases.

Given the variability in outcomes and the potential risks associated with surgery, it is essential to consider multiple factors when deciding on the management of varicocele in adolescents. These factors include the severity of the varicocele, the presence of symptoms, testicular volume, hormone levels, and semen parameters. A comprehensive evaluation can help identify adolescents who are most likely to benefit from surgical intervention and those who may be managed conservatively. Our findings may also highlight the importance of routinely incorporating baseline FSH and testosterone assessments in the initial evaluation of adolescents with varicocele, to enhance risk stratification and guide clinical decision-making.

It is important to note that our study has certain limitations. The retrospective design may introduce selection bias, and the relatively small sample size, especially in group 1, may limit the generalizability of our findings. Additionally, the follow-up period was limited to 6-12 months postoperatively, which may not capture long-term outcomes and even future fertility rates of each group. Another notable limitation is the absence of inhibin B level analysis, which is a major determinant of Sertoli cell dysfunction and a key regulator of the hypothalamic-pituitary-gonadal axis. Future prospective studies with larger cohorts and extended follow-up periods are warranted to validate our findings and further elucidate the age-related effects of varicocelectomy on hormonal and semen parameters.

CONCLUSION

This study demonstrates that while varicocelectomy leads to significant improvements in semen parameters in both adolescents and adults, only adults showed meaningful hormonal recovery, particularly in testosterone levels. The absence of FSH elevation and hormonal response in younger patients may indicate a lack of advanced germ cell damage, suggesting that early surgical intervention may not be necessary in all adolescent cases. These findings support a more individualized and hormone-informed approach to varicocelectomy in younger patients, rather than relying solely on varicocele degree or semen parameters. Further prospective studies are needed to optimize age-specific treatment strategies.

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Conflict of Interest: The authors declare no conflicts of interest.

Informed Consent: The written informed consent was waived due to the study's retrospective design.

Ethical Approval: The study was approved by the Bağcılar Training and Research Hospital Clinical Research Ethics Committee (Approval No: 2025/07/05/050).

Author Contributions: Concept and Design: İU, YŞ, MMD; Supervision: MMD; Data Collection and Analysis: İU, İH; Analysis and Interpretation: YŞ, İH; Statistical Analysis: İH; Writing: İU, YŞ; Critical Review: MMD

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