Surgical Outcomes of Subinguinal and Retroperitoneal Approaches in Varicocelectomy: A Prospective Comparative Study

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Abstract

Background: **Varicocele, or the dilatation and tortuosity of the pampiniform plexus of veins, remains the most common surgically correctable cause of male infertility. Surgical intervention through varicocelectomy has been associated with significant improvement in semen parameters and fertility outcomes. This study compared subinguinal and retroperitoneal approaches regarding the duration of surgery, complications after the operation, and improvement in semen parameters.** ***Patients and Methods:*** **A randomized prospective study of 60 male patients aged 15-40 years with symptomatic varicocele had been performed. Patients were then randomized into two groups: Group A undergoing subinguinal varicocelectomy and Group B undergoing retroperitoneal varicocelectomy. Assessment of preoperative and postoperative operative time, complication rates, and semen analysis was performed. All data and results of both approaches had been analyzed.** ***Results:*** **Operative time was significantly shorter in the retroperitoneal approach as compared to the subinguinal approach 44.2 ± 11.5 minutes versus 50.9 ± 12.5 minutes, P = 0.037. In both groups, a statistically significant improvement in semen parameters regarding sperm count, motility, and morphology was noted. These changes did not differ statistically between the two groups. Postoperative complications like hydrocele formation and recurrence were minimal and comparable between the two groups.** ***Conclusions:*** **Subinguinal and retroperitoneal approaches are effective in improving semen parameters in patients undergoing varicocelectomy. The significant advantage of the retroperitoneal approach is shorter operative time, but similar outcomes can be achieved by the subinguinal approach.**

Keyword: Varicocele, subinguinal varicocelectomy, retroperitoneal varicocelectomy, semen parameters.

Introduction

Varicocele is the varicosity and tortuosity of the pampiniform plexus around the testis, mainly due to retrograde blood flow through the internal spermatic vein [(1)]. Anatomically, varicocele is more common on the left side because of the perpendicular drainage into the left renal vein[(1)]. This is very often combined with congenitally weak vessel walls and valvular insufficiency. It is also caused by the collateral retrograde flow via aberrant communicating veins originating from the lumbar or iliac veins [(2)].

Varicocele affects roughly 15% of the general male population, with prevalence increasing to 35% in men with primary infertility and up to 80%

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in men with secondary infertility [3]. Despite its high prevalence among asymptomatic fertile men, varicocele paradoxically remains the most common surgically correctable cause of male infertility [4]. Patients with varicocele typically present with worse seminal parameters, such as reduced total sperm counts, lower progressive motility, and increased abnormal forms, and higher DNA fragmentation compared to the general population[5].

The pathophysiological mechanisms underlying varicocele-related infertility are not yet fully elucidated. It is considered that oxidative stress is a pivotal factor, combined with scrotal hyperthermia, hypoxia, reflux of metabolites, and cadmium accumulation [6]. Many studies have documented that surgical treatment of varicocele improves semen parameters, sperm DNA integrity, and oxidative stress levels, which eventually enhance pregnancy outcomes [7,8].

Varicocelectomy is indicated for male factor subfertility in men desiring biological paternity, testicular hypotrophy with abnormal semen parameters in adolescents, and painful varicocele [9]. There are several surgical modalities available to treat varicocele, all with their specific advantages and complications. A systematic review of 56 studies showed that pregnancy rates were significantly higher for microsurgical subinguinal varicocelectomy (41%) and open retroperitoneal approaches (37%) compared with inguinal, laparoscopic, and embolization techniques (26%, 26%, and 36%, respectively) [4].

The present study will compare subinguinal and retroperitoneal varicocelectomy in subfertile men for operative time, length of stay in the hospital, postoperative complications, and semen parameter outcomes to provide insight into possibly improving clinical decision-making and patient outcomes.

Patient and method:

Study Design

This was a randomized prospective study conducted at the Department of Surgery, Suez Canal University Hospitals from April 2022 to March 2023. Ethical approval was provided by the ethics committee of this institution, with informed consent obtained from all the participants before entering the study.

Study Population

Male patients aged between 15-40 years with symptomatic varicocele were included in the study according to clinical examination and diagnostic criteria. Symptomatic varicocele was defined by the presence of varicocele-related pain or abnormal semen analysis or ipsilateral testicular atrophy.

Patients with azoospermia, recurrent or secondary varicocele, subclinical varicocele, immunological disorders of infertility, chromosomal aberrations, earlier pelvic surgery, or severe chronic diseases like hepatic or renal insufficiency were excluded from the study.

Sample Size and Randomization

Sample Size calculation determined 27 cases per group accounting for an approximate dropout rate of 10%; while final enrollment yielded 30 per arm by using convenient sampling. Thereafter, this group of randomly allocated participants will be divided,

through a Simple randomization into two groups such that Group 'A' includes the cases undergone Sub-inguinal varicocelectomy; Group 'B' includes retroperitoneal Varicocelectomy.

Pre operative evaluation

The pre-operative workup consisted of detailed history and physical examination with relevant Laboratory investigations. A history was taken from both patients concerning demographic data, marital status, fertility history, chronic illnesses, allergies, previous admissions, and surgical history. Physical examination was done concerning vital signs and a focused abdominal and genital examination. Coagulation profile, complete blood count, renal function tests, and urine analysis were requested. Baseline semen analysis was performed to determine total sperm count, ejaculate volume, sperm concentration, motility, and morphology. Varicocele grading was performed based on the Dubin and Amelar criteria[10] (table 1).

Table (1): The Dubin-Amelar grading system for varicocele

Grade	Physical exam finding
0	Non-palpable
1	Palpable with valsalva only
2	Palpable at rest
3	Visible and palpable at rest

Surgical Techniques

Surgical techniques were uniform. Subinguinal varicocelectomy was performed using the Goldstein technique with a 2- to 2.5-cm incision, followed by the identification of the spermatic cord and meticulous ligation of veins with preservation of arteries and lymphatics[11]. Retroperitoneal varicocelectomy was done by the technique of Palomo with a 3- to 4-cm transverse incision and ligation of the internal spermatic vein in the retroperitoneal space. The operative time in minutes was taken from the skin incision to its closure[12].

Postoperative Follow-ups

Postoperative outcomes including mortality, operative time, length of hospital stay, and complications were monitored. Pain levels were assessed using a visual analog scale six hours after the procedure in the recovery unit. Patients were re-evaluated at 48 hours, and again at three and six months postoperatively to detect any complications such as hydrocele formation, recurrence, testicular atrophy, persistent pain, or wound-related issues. Additionally, semen analysis was repeated at three months post-surgery to evaluate changes in sperm count, motility, and morphology compared to baseline values.

Ethical consideration:

Informed consent was obtained from all participants, with the explanation of the purpose, techniques, and potential risks of this study. All participants were assured of confidentiality of the data and their right to withdraw at any time without compromising the treatment. Contact details for the researcher were provided for further clarification; the results were given to

the patients. Consent was confirmed by signature or fingerprint.

Statistical Analysis

SPSS software, version 26, was utilized for analysis. First, the distribution of all the data was reviewed using the Kolmogorov-Smirnov test. Data are represented for continuous variables as mean ± standard deviation. Comparisons among independent samples utilized Student's t-test, while in the case of pre- vs. post-operative samples, the comparisons were by paired t-test. Categorical variables were expressed as frequencies and percentages and analyzed by chi-square or Fisher's exact test. The level of significance was set at $P < 0.05$.

Results:

This was a randomized prospective study that compared subinguinal and retroperitoneal varicocelectomy among subfertile men in terms of operative time, postoperative complications, and semen parameter outcomes. For better clarity, results are summarized into four tables:

Baseline Characteristics

Both groups were comparable in age, characteristics of varicocele, and preoperative semen analysis. The mean age for the retroperitoneal group was 24.8 ± 5.9 years and for the subinguinal group was 24.3 ± 6.7 years (P = 0.759). Most participants had left-sided varicocele, 76.7%, followed by bilateral varicocele, 21.7%, which were not significantly different between groups. Grade II varicocele showed a prevalence of 61.7%, while Grade III demonstrated 38.3%. 43.3% of the patients complained of pain, which was not statistically significantly different among groups ***(Table 2).***

Tables (2): Baseline Characteristics

	Operation		Total	P value
	retroperitoneal	subinguinal		
Age (mean±SD)	24.8 ± 5.9	24.3 ± 6.7		0.759
Varicocele side no(%) Left Right Bilateral	 21 (70%) 1 (3.3%) 8 (26.7%)	 25 (83.3%) 0 (0%) 5 (16.7%)	 46(76.7%) 1 (1.7%) 13 (21.7%)	0.360
Varicocele grade no(%) Grade II Grade III	17 (56.7%) 13 (43.3%)	20 (66.7%) 10 (33.3%)	37(66.7%) 23(33.3%)	0.596
Pain presence no (%) Yes No	16 (53.3%) 14 (46.7%)	10 (33.3%) 20 (66.7%)	26(43.3%) 34 (56.7%)	0.192

Operative Time and Postoperative Complications

The average operative time of retroperitoneal approach was distinctly shorter than that of the subinguinal approach: 44.2 ± 11.5 minutes versus 50.9 ± 12.5 minutes, P = 0.037. There were very few postoperative complications found in either group. Testicular and scrotal

oedema was recorded for 6.7% of retroperitoneal and 20% of subinguinal cases, respectively (P = 0.254). Scrotal pain occurred in 26.7% of retroperitoneal and in 31% of subinguinal cases (P = 0.779), while wound complications occurred in 3.3% of the subinguinal and none of the retroperitoneal cases (P > 0.999)**(Table 3).**

Table (3) Operative Time and Postoperative Complications			
Outcome	retroperitoneal	subinguinal	P value
operative time (minutes) (mean±SD)	44.2 ± 11.5	50.9 ± 12.5	0.037
Edema of testicle no (%)	6.7%)(2	6 (20%)	0.254
Scrotal pain no (%)	8 (26.7%)	9 (31%)	0.779
Wound complications no (%)	0 (0%)	1 (3.3%)	> 0.999

Pre- and Postoperative Semen Analysis

No significant intergroup differences were found in the preoperative semen parameters regarding volume, total sperm count, sperm concentration, motility, and morphology. In the postoperative analysis, there was a significant improvement in both groups. The concentration improved from 17.37 ± 4.51 million/ml to 30.4 ± 9.9 million/ml for the retroperitoneal group and from 18.39 ± 6.77 million/ml to 32.5 ± 10.9 million/ml for the subinguinal group (P < 0.001 for both groups). Similar trends of improvement were noticed in motility and morphology. Volume has shown an increasing trend but did not reach to statistical significance regarding the retroperitoneal approach for varicocele ligation with P = 0.098 **(Table 4).**

Table (4) Pre- and Postoperative Semen Analysis				
parameter	operation	Preoperative	Post operative	P value
Volume	Retroperitoneal	2.69±1.17	3.3 ± 1.4	0.098
	Sub inguinal	2.49± 1.07	3.3 ± 1.1	0.017
Total Sperm count	Retroperitoneal	47.07 ± 22.53	96.7 ± 45.0	<0.001
	Sub inguinal	44.56 ± 20.54	106.4 ± 52.5	<0.001
sperm concentration million/ml	Retroperitoneal	17.37 ±4.51	30.4 ± 9.9	<0.001
	Sub inguinal	18.39 ± 6.77	32.5 ± 10.9	<0.001
motility %	Retroperitoneal	27.84 ± 10.27	40.3 ± 9.8	<0.001
	Sub inguinal	25.44 ± 11.79	42.9 ±11.8	<0.001
normal morphology %	Retroperitoneal	23.13 ± 6.02	36.5 ± 4.3	<0.001
	Sub inguinal	25.09 ± 6.37	38.2 ± 5.4	<0.001

Resolution of pain

Pain resolved completely in 75% of retroperitoneal cases and in 70% of subinguinal cases (P > 0.999). Partial resolution was seen in 12.5% of retroperitoneal and 10% of subinguinal ones. No resolution was seen in 12.5% and 20% of retroperitoneal and subinguinal cases, respectively **(Table 5).**

Table (5): Resolution of pain					
		Retroperitoneal operation (n=16)	Sub inguinal operation (n=10)	Total (n=26)	P value
Resolution of pain if initially present no (%)	complete	12 (75%)	7 (70%)	19 (73.1%)	> 0.999
	partial	2 (12.5%)	1 (10%)	3 (11.5%)	
	No	2 (12.5%)	2 (20%)	4 (15.4%)	

Discussion

Chronic scrotal pain is considered one of the painful symptoms of varicocele. It has numerous multifactorial causes that include trauma, malignancy, hydrocele, spermatocele, epididymal cyst, inguinal hernia, intermittent torsion, infection, and musculoskeletal or neuropathic pain. Varicocele is well documented to be one of the major causes, making surgical intervention indicated[11].

Varicocelectomy via the retroperitoneal approach, first described by Palomo in 1949, is widely adopted and enjoys consistent results[12]. On the other hand, the subinguinal approach, although more technically challenging, enjoys several advantages in that the testicular artery, cremasteric artery, lymphatics, and internal spermatic veins are more reliably identified and preserved. This has made it the favorite technique of choice for microsurgical varicocelectomy[13].

This was a randomized controlled trial where in patients underwent either retroperitoneal or subinguinal varicocelectomy. The mean ages of the patients were 24.8 ± 5.9 years and 24.3 ± 6.7 years in the retroperitoneal and subinguinal groups, respectively, which have been consistent with those in the previously conducted study, compared the retroperitoneal and subinguinal approaches to treat varicocele. The mean age of patients was 21.5 ± 2.5 (range, 18–28) years in retroperitoneal and 21.4 ± 3.2 (range, 18–30) years in subinguinal[5]. Graded II and III varicoceles were reported in 61.7% and 38.3%, correspondingly, sharing similarities with a study conducted by Akkoç: 40% have grade II varicocele, while 43% have varicocele at grade III degree[5].

No statistical difference was observed in the semen analyses of both groups before the operation. Significant improvements in sperm count, concentration, motility, and morphology were seen in both groups postoperatively, though not significantly different from each other. These are supported by a series from Duarsa, where improvement in sperm parameters after surgery in 84% of retroperitoneal and 86% of microsurgical patients was observed[14]. Liu et al. also reported significant improvements in sperm concentration and motility after subinguinal varicocelectomy[15]. However, Sun reported that even the differences in sperm parameters

between microsurgical and retroperitoneal procedures were significant thus underlining the variability in the outcomes from study to study[16].

The mean operative time for retroperitoneal varicocelectomy was significantly shorter compared to the subinguinal approach: 44.2 ± 11.5 vs 50.9 ± 12.5 minutes, P = 0.037. In this respect, the results coincide with those of Akkoç, where retroperitoneal operations were faster than subinguinal ones[5]. This may turn out to be useful in situations requiring the shortest possible surgical time.

There were a few postoperative complications in each, with no hydrocele or recurrence. Testicular and scrotal oedema were recorded in 6.7% each of retroperitoneal and 20% subinguinal cases. Further, there was noticed scrotal pain in 26.7% and 31% in retroperitoneal and sub-inguinal groups respectively, all without any significant statistical differences. In the same line of thought, Liu, in 2023, showed low rates of edema and hydrocele events across surgical techniques[15]. In contrast, meta-analyses conducted by Cayan demonstrated a slightly higher rate of hydrocele in retroperitoneal surgery compared to microsurgery techniques[17].

About the resolution of pain, 75% in the retroperitoneal and 70% of the subinguinal had complete resolution of pain. This is in tandem with a series by Liu, in which a pain relief rate of 76.6% after subinguinal varicocelectomy has been observed[15]. Similarly, Ghanem indicated that the subinguinal varicocelectomy procedures are associated with shortening of the post-operative recovery period by taking lesser numbers of painkillers against retroperitoneal surgery[18].

This study shows that the two methods, retroperitoneal and subinguinal varicocelectomy, are efficient in treating the painful varicocele; with no differences noticed in sperm parameters improvement and pain resolution. Retroperitoneal approach was related to a highly significantly shorter operative time, making this a viable option, especially in settings lacking microsurgical equipment or expertise. However, this study has limitations of a small sample size, short follow-up, and a single center, which can affect the generalizability and long-term sustainability of the findings. Despite these limitations, the findings of this study suggest that the retroperitoneal technique is a reliable alternative to subinguinal varicocelectomy, especially in patients requiring a quicker procedure. Larger studies with greater numbers of patients and longer follow-up are necessary to confirm these findings and establish the long-term benefits of each approach.

Conclusion:

Both subinguinal and retroperitoneal approaches are effective in improving semen parameters in patients undergoing varicocelectomy. The significant advantage of the retroperitoneal approach is shorter operative time, but similar outcomes can be achieved by the subinguinal approach.

Reference

1. Zavattaro M, Ceruti C, Motta G, et al. Treating varicocele in 2018: current

knowledge and treatment options. *Journal of endocrinological investigation*. 2018;41:1365-1375.
2. Huang T, Li W, Peng B. Correlation of inflammatory mediators in prostatic secretion with chronic prostatitis and chronic pelvic pain syndrome. *Andrologia*. 2018;50(2):e12860.
3. Clavijo RI, Carrasquillo R, Ramasamy R. Varicoceles: prevalence and pathogenesis in adult men. *Fertility and sterility*. 2017;108(3):364-369.
4. Lundy SD, Sabanegh Jr ES. Varicocele management for infertility and pain: a systematic review. *Arab journal of urology*. 2018;16(1):157-170.
5. Akkoç A, Aydın C, Topaktaş R, et al. Retroperitoneal high ligation versus subinguinal varicocelectomy: Effectiveness of two different varicocelectomy techniques on the treatment of painful varicocele. *Andrologia*. 2019;51(7):e13293.
6. Su JS, Farber NJ, Vij SC. Pathophysiology and treatment options of varicocele: an overview. *Andrologia*. 2021;53(1):e13576.
7. Baazeem A, Belzile E, Ciampi A, et al. Varicocele and male factor infertility treatment: a new meta-analysis and review of the role of varicocele repair. *European urology*. 2011;60(4):796-808.
8. Abdel-Meguid TA, Al-Sayyad A, Tayib A, Farsi HM. Does varicocele repair improve male infertility? An evidence-based perspective from a randomized, controlled trial. *European urology*. 2011;59(3):455-461.
9. Cho C-L, Esteves SC, Agarwal A. Indications and outcomes of varicocele repair. *Panminerva medica*. 2019;61(2):152-163.
10. Dubin L, Amelar RD. Varicocelectomy as therapy in male infertility: a study of 504 cases. *The Journal of urology*. 1975;113(5):640-641.
11. Cho CL. Invited Commentary: Outcomes of microsurgical subinguinal varicocelectomy to treat painful recurrent varicocele. *Andrologia*. 2018;50(10):e13132.
12. Palomo A. Radical cure of varicocele by a new technique: preliminary report. *The Journal of urology*. 1949;61(3):604-607.
13. Pathak P, Chandrashekar A, Hakky TS, Pastuszak AW. Varicocele management in the era of in vitro fertilization/intracytoplasmic sperm injection. *Asian journal of andrology*. 2016;18(3):343-348.
14. Duarsa GWK, Sutanto PO, Santosa KB, et al. Comparison of sperm parameters improvement and complications between retroperitoneal and microsurgical varicocelectomy.
15. Liu H, Chen R, Wu X, et al. Microsurgical Varicocelectomy: Experience of Our Sub-Subinguinal Approach and Review of the Literature. *Andrologia*. 2023;2023(1):9937114.
16. Sun H, Liu Y, Yan M, Li Z, Gui X. Comparing three different surgical techniques used in adult bilateral varicocele. *Asian Journal of Endoscopic Surgery*. 2012;5(1):12-16.
17. Cayan S, Kadioglu TC, Tefekli A, Kadioglu A, Tellaloglu S. Comparison of results and complications of high ligation surgery and microsurgical high inguinal varicocelectomy in the treatment of varicocele. *Urology*. 2000;55(5):750-754.
18. Ghanem H, Anis T, El-Nashar A, Shamloul R. Subinguinal microvaricocelectomy versus retroperitoneal varicocelectomy: comparative study of complications and surgical outcome. *Urology*. 2004;64(5):1005-1009.