

## Six years' experience of laparoscopic varicocelectomy using bipolar electrosurgery and its effect on semen parameters

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**Purpose:** To evaluate postoperative results of laparoscopic varicocelectomy using bipolar electrosurgery and analyze semen according to the grade of varicocele after surgery.

**Materials and Methods:** In a six-year period, 416 men with clinical varicocele and impaired semen parameters or infertility underwent laparoscopic varicocelectomy using bipolar electrosurgery. All patients were assessed for hydrocele and recurrence of varicocele six months and one year after the procedure. Semen analyses were obtained before and after the surgery and were compared according to the clinical grade of varicocele.

**Results:** Seven patients (1.7%) had right side, 391 (94%) had left side and 18 (4.3%) had bilateral varicoceles. Varicocele grades I, II and III were detected in 113 (27.1%), 232 (55.7%) and 71 (17%) patients respectively. Abdominal wall emphysema and pneumoscrotum were developed in 19 (4.5%) and 11 (2.6%) cases. Recurrence rate was significantly higher in grade III varicocele ( $P < .001$ ). In patients with varicocele grades of I and II, sperm concentration, motility and morphology significantly improved six months after surgery ( $P < .05$ ). In patients with grade III varicocele, only sperm concentration improved ( $P < .05$ ). Sperm motility and morphology did not show any significant change after one year.

**Conclusion:** Laparoscopic varicocelectomy using bipolar cautery is a safe, feasible and cost-effective technique with few complications. It significantly improves sperm parameters. A follow up program for at least one year after the surgery seems reasonable to detect recurrent cases. The study shows that increase in clinical varicocele grade can cause irreversible deleterious effects on sperm motility and morphology. So, earlier treatment is recommended.

**Keywords:** varicocelectomy; bipolar cautery; varicocele; semen analysis

### INTRODUCTION

The abnormal dilatation of pampiniform venous plexus in the spermatic cord is called varicocele. Its prevalence is 12% in the general population and 25% to 40% in infertile men.<sup>(1,2)</sup> Multiple factors play role in male infertility. However, varicocele is the most common finding which is observed in 45-81% of men having secondary infertility.<sup>(3,4)</sup> The adverse effect of varicocele on male fertility is clearly manifested by testicular atrophy which is generally associated with this condition.<sup>(2)</sup> Using scrotal ultrasound, it has been demonstrated that in men with left varicocele, the left testicular volume is less than the right testicular volume.<sup>(5)</sup> Varicocele is associated with hypogonadism in some infertile men. Also, varicocelectomy significantly improves serum testosterone levels.<sup>(6)</sup> The most common abnormality in the spermiogram of individuals who are suffering from varicocele is decreased sperm motility, which can be observed in 90% of patients.<sup>(7)</sup> In addition, abnormality in the shape of sperm cells is very common in them. Currently no relationship has been found between varicocele grade, pathology of testicles and spermiogram abnormality. Whenever clinical varicocele is undetectable and three dilated veins are found in the regular scrotal ultrasound, with at least one vein more than 3 mm in diameter, the patient is known to have subclinical varicocele.<sup>(8)</sup>

Varicocele is also known as the most surgically correctable cause of male infertility. Its repair is the most commonly performed surgical procedure in order to correct male infertility.<sup>(9)</sup> The standard varicocele surgery is the microscopic sub-inguinal procedure. Sub-inguinal refers to the location of the incision.<sup>(10)</sup> Varicocelectomy is cost-effective by itself or in conjunction with in vitro fertilization when compared to other fertility techniques.<sup>(11,12)</sup> There are several approaches for varicocelectomy. They include retroperitoneal and conventional inguinal open techniques, microsurgical inguinal and subinguinal approaches, laparoscopic varicocelectomy and radiographic embolization.<sup>(13,14)</sup> The microsurgical varicocelectomy is the standard technique because it is associated with the lowest risk of complications including varicocele recurrence, hydrocele formation and testicular atrophy.<sup>(14,15)</sup> In the inguinal approach, an incision is made on the groin above and lateral to the ipsilateral pubic tubercle, extending laterally along the skin lines of the inferior abdominal wall. The external oblique fascia is sharply incised to expose the spermatic cord covered with cremasteric fibers. They are incised along with the external spermatic fascia to provide access to vascular structures within. Generally, the vas deferens should be identified and preserved along with its artery, vein and lymphatic vessels. Venous structures, including the internal spermatic, cremasteric, external spermatic, gubernacular and periarterial veins (venae comitantes) have all been described to

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**Table 1.** Late postoperative complication according to the grade of varicocele

	Grade of varicocele	No. of Recurrences	P value	Number of Hydrocele	P value
First follow up visit	Grade I	0	.03	6	.09
	Grade II	0		4	
	Grade III	2		6	
Second follow up visit	Grade I	1	.001	1	.7
	Grade II	1		1	
	Grade III	6		0	
Total	Grade I	1	<.001	7	.2
	Grade II	1		5	
	Grade III	8		6	

be part of the body of varicoceles and should be identified and dissected for ligation. Arteries and lymphatic vessels should be clearly identified and preserved to avoid complications.<sup>(16)</sup> Percutaneous embolization of the gonadal vein was originally described three decades ago. Nowadays, percutaneous embolization procedures for varicocele include the traditional retrograde occlusion and the more recently described anterograde technique.<sup>(17)</sup> The recurrence/persistence rates, the complication rates, duration of procedure, the costs and clinical outcomes on the various treatment modalities vary. Well-designed, large-scale comparative studies evaluating the results of the various varicocele treatment options remain scarce in the recent literature.<sup>(14,18)</sup> Previous studies have shown abnormalities in sperm count, motility, and morphology in varicocele patients. Still a significant improvement has been seen in these parameters after surgical correction. This study evaluated the postoperative outcomes of laparoscopic varicocelectomy during a six-year period. The results of semen analyses were also compared before and after the surgery for all patients.

## MATERIALS AND METHODS

Between March 2006 and May 2012, laparoscopic varicocelectomy was performed on 416 men diagnosed with varicocele. Patients were older than 18 years and were included in the study by consecutive sampling. Varico-

cele diagnosis was confirmed by Doppler ultrasound. Patients were infertile or had impaired semen parameters. All other patients without infertility were treated but were not enrolled in this study (**Figure 1**). Varicocele was defined on Doppler ultrasound as spermatic venous dilatation of more than 3 mm with venous reflux. Exclusion criteria were previous abdominal operation for infertility or subfertility due to other causes. In physical examination varicocele was graded according to Dubin and Ambler's classification. A basic infertility evaluation including detailed history, physical examination and semen analysis were carried out before treatment.

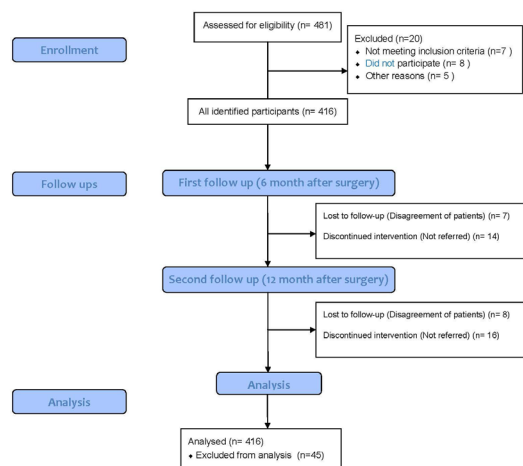
### Follow up and surgical assessment

Surgical assessment included the operation duration (from beginning of the operation until skin closure), major intraoperative complications such as vascular or bowel injury, emboli, cardiovascular complications, early and late postoperative complications including subcutaneous emphysema, pneumoscrotum, recurrence and hydrocele formation. Patients were discharged from hospital the day after surgery. They were visited one week later to check the wound and look for possible complications. Follow up program consisted of physical examination, Doppler ultrasound study in suspicious cases of recurrence and semen analysis six months and one year after surgery. Semen analysis was performed based on the latest World

**Table 2.** Sperm parameters before surgery and in the first and second follow up visits

Varicocele grade	Mean ± SD of sperm concentration (number/million)			Mean ± SD of sperm motility (%)			Mean ± SD of normal sperm morphology (%)		
	Before surgery	First follow up	Second follow up	Before surgery	First follow up	Second follow up	Before surgery	First follow up	Second follow up
Grade I	21.5 ± 4.1	40.1 ± 4.4	40.3 ± 4.8	35.8 ± 4.3	49.2 ± 4.3	51.3 ± 4.6	40.6 ± 3.6	66.3 ± 3.8	69.5 ± 3.7
		<i>P</i> = .01			<i>P</i> = .03			<i>P</i> = .01	
Grade II	20.8 ± 4.3	40.5 ± 4.7	41.3 ± 5.1	37.7 ± 4.1	58.9 ± 5.2	59.7 ± 5	40.5 ± 3.3	65.1 ± 3.7	67.9 ± 3.8
		<i>P</i> = .01			<i>P</i> = .01			<i>P</i> = .01	
Grade III	14.7 ± 5.7	37.7 ± 6.4	39.4 ± 6.8	31.2 ± 4	37.7 ± 4.2	37.9 ± 4.2	38.3 ± 3.4	41.1 ± 3.3	4.8 ± 3.4
		<i>P</i> < .01			<i>P</i> = .1			<i>P</i> = .3	

**Note:** *P*-value compares semen analysis before the surgery and at the second visit. There was no significant difference in sperm parameters between first and second follow up visits



**Figure 1.** Flow diagram of the study

Health Organization (WHO) manual for the examination and processing of human semen. Volume, pH, sperm density, morphology and motility were evaluated. Normal semen parameters according to the WHO Manual for Semen Analysis were as follows:<sup>(19)</sup> volume of semen in adult males: 1.5 mL, sperm concentration:  $15 \times 10^6$ , sperm morphology (normal forms): 4%, progressive and non-progressive motility: 40%, and progressive: 32%.

### Surgical technique

General anesthesia with endotracheal intubation was used in all patients. After placing the patient in a modest Trendelenburg position, A 10 mm Trocar was inserted using open access technique through an above umbilical incision. The abdomen was insufflated up to 12 mmHg with CO<sub>2</sub>. A zero degree laparoscope was inserted. Under laparoscopic vision, two 5 mm operating trocars were placed in the lower right and left quadrants of the abdominal wall along the lateral border of each abdominal rectus muscle. A retroperitoneal incision was made in the lateral aspect from a point 3 cm superior to the internal inguinal ring along the testicular vessels to expose them. The accompanying lymphatics and testicular artery were preserved from the spermatic veins. The veins were coagulated by a bipolar electrosurgery apparatus. Each coagulated vein was transected by endoscissors. When the procedure was completed, the intraperitoneal pressure was reduced to 5 mmHg to check the surgical site and ensure absence of bleeding. The trocars were subsequently removed. Fascia at the supraumbilical incision was sutured and the 5 mm incisions were closed by simple skin sutures.

### Statistical analysis

All data were analyzed by the statistical package for social sciences (SPSS) software version 16.0 (Chicago, IL, USA). The Kolmogorov-Smirnov test was used to determine whether the study population followed the normal distribution. All the nonparametric comparisons were performed by Chi-Square and Mann-Whitney *U* tests. The difference between pre- and post-operative seminal data was analyzed using a paired Wilcoxon signed rank test. The mean of quantitative variables

was reported with mean  $\pm$  standard deviation. *P* values less than .05 were considered statistically significant.

## RESULTS

A number of 416 men with mean age of  $24.7 \pm 9.2$  years entered the study. There were seven cases (1.7%) of right sided, 391 cases (94%) of left sided and 18 cases (4.32%) of bilateral varicocele. 32 (7.6%) men had a history of inguinal varicocelectomy and recurrence after surgery. Forty five men were infertile (10.8%). Varicocele grades I, II and III were detected in 113 (27.1%), 232 (55.7%) and 71 (17%) men, respectively. The means  $\pm$  SD of operation duration were  $25.7 \pm 16.5$  and  $37.1 \pm 27.8$  minutes for unilateral and bilateral cases, respectively. The study population had no normal distribution ( $P > .05$ ). There were no major intraoperative complications. Abdominal wall emphysema and pneumoscrotum were observed in 19 (4.5%) and 11 (2.6%) cases, respectively. At the first visit one week after the surgery, subcutaneous emphysema and pneumoscrotum resolved in all patients. However, three men (0.7%) still complained of scrotal pain and swelling. Epididymitis was diagnosed with physical examination to check for enlarged lymph nodes in the groin and an enlarged testicle on the affected side. Doppler ultrasound confirmed the diagnosis. These patients were treated by antibiotic and anti-inflammatory drugs without any further complications. The total number of hydrocele formations and recurrences after one year were 18 (4.3%) and 10 (2.4%), respectively. Six months after surgery 21 (5%) patients were lost at the first follow up visit. Hydrocele was detected in 16 patients (3.8%) and recurrence occurred in two cases (0.4%). In the second follow up visit, 24 patients (5.7%) were lost. Hydrocele and recurrence were diagnosed in two (0.4%) and eight (1.9%) patients, respectively (Table 1). Sperm concentration, motility and morphology improved six months after surgery in patients with varicocele grades of I and II. However, in grade III varicocele only sperm concentration improved while motility and morphology did not change significantly. No significant improvement was detected in sperm parameters from the first to the second follow up visits (Table 2). The increase in clinical varicocele grade caused irreversible deteriorational effects on sperm motility and morphology. At follow up visits patients were examined and Doppler ultrasound was requested to confirm varicocele in cases which were suspicious of recurrence. Both recurrent cases in the first follow up visit (six months after the surgery) had grade III varicocele preoperatively. At the second follow up visit (one year after surgery) eight cases of recurrence were detected. All these cases had preoperative grade III varicocele. Recurrence rate was higher in varicocele grade III compared to other grades ( $P < .001$ ).

## DISCUSSION

Laparoscopic varicocelectomy is equally effective as open varicocelectomy.<sup>(20)</sup> Laparoscopy has been shown to have the same intraoperative safety, shorter hospital stay and less postoperative complications.<sup>(21)</sup> It provides better magnification which is more helpful to preserve the testicular artery.<sup>(22)</sup> There are two main approaches for laparoscopic varicocelectomy. One is mass ligation of spermatic vessels and the other is just ligation of the veins and sparing lymphatics and testicular artery. Mass ligation can be a safe approach with significant-

ly lower recurrence and higher successful rates.<sup>(22)</sup> On the other hand, this technique is associated with more post-operative discomfort<sup>(23)</sup> and hydrocele formation.<sup>(24)</sup> The risk of hydrocele formation after mass ligation of spermatic vessels ranges from 3% to 25%.<sup>(22,25)</sup> As the laparoscopic approach may facilitate the identification of lymphatics, it is believed that sparing the lymphatics during the procedure may reduce the incidence of post-operative hydrocele.<sup>(26)</sup> Misseri and colleagues observed very good outcomes after lymphatic sparing varicocelectomy.<sup>(27)</sup> They compared post-operative hydrocele formation of the two techniques and reported a significantly higher rate of hydrocele formation after mass ligation. Kocvara and colleagues reported 17.9% hydrocele formation with conventional laparoscopic varicocelectomy and 1.9% after lymphatic vessel preservation.<sup>(28)</sup> In our study we performed the artery and lymphatic sparing approach and encountered 18 cases (4.3%) of hydrocele formation during one year follow up after surgery. It has been hypothesized by infertility experts that varicoceles are associated with progressive deleterious effects on testicular function.<sup>(29,30)</sup> Barry and colleagues randomized 80 patients into two groups for laparoscopic and open inguinal varicocelectomies and compared their results.<sup>(26)</sup> They found a lower rate of recurrence with the laparoscopic approach (two versus seven). They also observed that recurrence would increase progressively with the increase of varicocele grade. Among nine patients with recurrence, six had varicocele grade III, preoperatively. In our series we used bipolar cautery to coagulate spermatic veins. Standard bipolar diathermy technology may have some disadvantages in sticking and thermal spread.<sup>(31-33)</sup> Simforoosh and colleagues compared laparoscopic varicocelectomy using bipolar cautery to open high ligation approach for 100 men who were randomly allocated into two groups.<sup>(33)</sup> They observed that using bipolar cautery is a safe technique and can reduce costs compared to endoclips. Méndez-Gallart and colleagues used LigaSure technology to ligate spermatic veins for 63 men. They reported that using this system allows the surgeon to improve coagulation with minimal thermal spread to the surrounding tissues. Still, the initial cost and learning curve may be its disadvantage.<sup>(34)</sup> Semen analysis six months after surgery showed a significant improvement in concentration and quality (motility and morphology) of sperms in varicocele grades I and II. For varicocele grade III, only concentration improved and semen quality did not show any significant changes. No significant improvement was observed at the second visit in sperm concentration and quality. Kang and colleagues compared testicular artery and lymphatic preservation versus complete testicular vessel ligation in 80 patients. They found significant improvement in sperm parameters after both procedures.<sup>(35)</sup> Al-Kandari and colleagues compared postoperative results of semen analysis of 120 men who were randomized into three groups for laparoscopic, open inguinal and subinguinal microscopic varicocelectomies.<sup>(36)</sup> No significant improvement was observed in sperm morphology in any group. Our study with the advantage of one year follow up for most patients showed a significant improvement in sperm parameters after laparoscopic varicocelectomy. Testicular artery, lymphatic preserving

approach and using bipolar cautery were associated with a low rate of post-operative complications. The lack of data for pregnancy rate was a shortcoming of our study. Besides measuring testicular size, studying the rate of catch up growth can be more informative.

## CONCLUSION

Many approaches have been proposed for varicocele management. However, recent evidence supports the premise that the microsurgical technique is the standard technique. Although in a number of studies, it has been shown that microsurgical varicocelectomy is superior to non-microsurgical procedures with respect to the development of postoperative complications such as hydrocele or recurrence. In this study we showed that laparoscopic varicocelectomy using bipolar electrosurgery is a safe and feasible technique, with a low rate of postoperative complications that can be an alternative for the standard microsurgical varicocelectomy. It significantly improves sperm parameters. A follow up program for at least one year after the surgery seems reasonable to detect recurrent cases. This study reveals that increase in clinical varicocele grade can cause irreversible deleterious effects on sperm motility and morphology, leading to a higher probability of recurrence after laparoscopic varicocelectomy. Thus, earlier treatment seems reasonable when the disease has not progressed much.

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