

The use of titanium ligation clips in microsurgical subinguinal varicocelectomy

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ABSTRACT

Objective: The aim of this study is to evaluate the use of titanium ligation clips for dilated spermatic veins in microsurgical subinguinal varicocelectomy.

Material and methods: In this retrospective study, eighty-four men with clinical varicocele underwent microsurgical varicocele repair. The patients were divided into two groups according to the ligation materials used for the varicocelectomy (silk sutures vs. titanium clips). Group 1 included 43 patients; these patients underwent microsurgical subinguinal varicocelectomy with the titanium clips. The 41 patients included in Group 2 underwent microsurgical subinguinal varicocelectomy with silk sutures. Microsurgical subinguinal varicocelectomy was performed in all patients. The two study groups were compared in terms of intra-operative and postoperative parameters.

Results: The mean age of the patients was 28.6±4.6 years, and the mean follow-up was 12.3±2.7 months. The two groups exhibited comparable improvements in sperm motility and/or concentration: 79.1% and 82.9% in Group 1 and Group 2, respectively (p>0.05). The operation time in Group 1 (titanium clip) was significantly shorter than in Group 2 (silk sutures). None of the patients experienced any intra-operative complications. There were no significant differences between Group 1 and Group 2 with regard to postoperative recurrences, ligated veins, postoperative complications and hydrocele formation, hospitalization time, the requirement for postoperative analgesia or the time until the patient could return to work.

Conclusion: Titanium ligation clips can be used for the ligation of dilated vessels during microsurgical subinguinal varicocelectomy, and the operation time is significantly reduced with the use of titanium ligation clips.

Key words: Ligation; silk; surgery; therapy; varicocele.

Introduction

Varicocele is the main cause of correctable male infertility. Varicoceles are found in approximately 15% of the male population, 35% of men with primary infertility and up to 80% of men with secondary infertility.^[1] The ideal method for varicocele treatment is controversial. Several methods have been used, including open surgical ligation of the spermatic vein, retrograde or antegrade sclerotherapy, and microsurgical and laparoscopic varicocelectomy. Each technique has its own advantages and disadvantages, and conflicting results have been obtained from different studies.^[2-5] The materials used for the ligation of spermatic veins in varicocelectomy have varied Classic suture materials, including silk, propylene and vicryl, and metallic ligation clips, such as titanium

clips, have been used for the ligation of varicose veins. However, silk sutures are most commonly used for varicocelectomy. In this study, we evaluated the use of titanium clips for dilated spermatic veins during microsurgical subinguinal varicocelectomy.

Material and methods

This study was conducted retrospectively. From January 2010 to July 2012, 84 men with clinical varicocele underwent microsurgical varicocele repair at the Urology Departments of Koru Hospital and Gazi University Hospital and were included in this study.

Patients and grouping

The study included 84 patients with 148 clinically palpable varicoceles who were subjected to varicocelectomy. Varicocelectomy was per-

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formed for indications of infertility, scrotal pain or testicular atrophy. The patients were informed of the advantages and disadvantages of each technique.

For infertility patients, a ≥ 1 -year duration of infertility, defined as the failure to establish a pregnancy in 12 months with unprotected intercourse, was required for inclusion in the study. Testicular ultrasonography was performed for all patients. Testis volume was assessed by physical examination and testicular ultrasonography. Testicular atrophy was defined as any testis with a volume less than 15 cc or a testis 25% smaller (volume/volume) than its contralateral mate.^[6] Varicocele identified at scrotal examination, which was performed with the patient in the standing position using the Valsalva maneuver, was classified as grade 1 (palpable only using the Valsalva maneuver), grade 2 (palpable without the Valsalva maneuver) or grade 3 (visible without the need for palpation).^[7] Hormonal analyses including serum testosterone and follicle-stimulating hormone (FSH) and prolactin (PRL) were performed for all patients. Adolescents and patients with subclinical varicocele, congenital urogenital abnormalities, abnormal hormonal profiles, or azoospermia were excluded from the study.

The patients were divided into two groups according to the ligation materials used for the varicocelectomy (silk sutures and titanium clips). In Group 1, 43 patients underwent microsurgical subinguinal varicocelectomy with the titanium clips. In Group 2, 41 patients underwent microsurgical subinguinal varicocelectomy with the silk sutures.

Surgical procedures

The standard technique was performed under spinal or general anesthesia in all patients. With this technique, the spermatic cord was grasped with a Babcock clamp through a small transverse skin incision overlying the external inguinal ring (subinguinal area). The spermatic cord was then delivered through the incision. The gubernacular veins and external spermatic perforators were isolated and divided. An operating microscope (S88, Opmi Vario, Carl Zeiss Surgical GmbH, Oberkochen, Germany) was then brought into the operating field, and the cord was examined under 15-20X magnification. Once the internal and external spermatic fascias were incised, the underlying internal spermatic artery and external spermatic artery were identified by their subtle pulsations. The arteries were then dissected free from the underlying veins and encircled with a 2-0 silk ligature for identification. Care was taken to preserve the lymphatics to prevent the development of postoperative hydrocele and lymphocele. All internal spermatic veins, external spermatic veins and gubernacular veins, with the exception of the vassal veins, were then ligated and cut. For ligations of each vein, including the internal

spermatic, external spermatic and gubernacular veins, a small, wide titanium ligation clip ([REF] 30130, Vesocclude medical, USA, 14-LD 00003-02) was used in Group 1 (Fig. 1), and 4-0 silk sutures were used in Group 2. The operation time was considered as the time between the first incision and closure of the skin. In bilateral varicocelectomy, total operation time included the operation time for both the left and right varicocele. The operation time did not include the anesthesia time.

Follow-up

All patients were discharged 12-24 hours after surgery and underwent postoperative evaluations at 1 week to check the wound, 1 and 3 months, and every 3 months thereafter. The evaluations included a physical examination and ultrasonography of the scrotum with Doppler assistance. The recurrence of a clinical varicocele was determined from the physical examination or ultrasonography findings. The semen analysis findings and pregnancy rate were assessed for the patients with infertility.

Statistical analysis

The quantitative values of age, follow-up duration, serum hormone values, sperm concentration and motility are presented as the mean \pm standard deviation, median (min-max), and qualitative values are presented as frequency and percentage. A comparison between the two study groups regarding the preoperative and postoperative parameters was performed using the chi-squared test and the Mann-Whitney U and t tests (two related samples and paired samples). Probability values less than 0.05 were considered statistically significant.

Results

The mean age of the patients was 28.6 \pm 4.6 years, and the mean follow-up was 12.3 \pm 2.7 months. The patients' ages, characteristics and varicocele sides as well as the grades for the two study groups are given in Table 1. The major indication for varicocelectomy was infertility (83.3%) (Table 2).

The two study groups were comparable regarding the preoperative semen parameters, including sperm count, motility and volume (Table 3). A comparison between the two study groups and between the mean preoperative and postoperative semen parameters showed significant improvements in sperm concentration and motility, with no significant changes in semen volume (Table 3). The two groups had comparable improvement in sperm motility and/or concentration, which was achieved in 79.1% and 82.9% of group 1 and group 2, respectively ($p > 0.05$).

The operation time for group 1 (titanium clip) was significantly shorter than for Group 2 ($p < 0.001$). For Group 1, the



Figure 1. Titanium clips (medium size) for use in dilated spermatic veins. Microsurgical subinguinal varicocelectomy

mean operation time was 27.6 ± 3.5 minutes for patients with unilateral varicocele and 40.3 ± 5.2 minutes for patients with bilateral varicocele; for Group 2, the mean operation time was 39.8 ± 3.9 minutes for patients with left varicocele and 52.1 ± 6.5 minutes for patients with bilateral varicocele (Table 4). There were no significant difference between Group 1 and Group 2 with respect to postoperative recurrences, ligated veins, postoperative complications and hydrocele formation, hospitalization time, the requirement for postoperative analgesia or the amount of time until the patient could return to work.

All of the procedures in both groups were completed satisfactorily, with no intraoperative complications. During the postoperative period, 4 patients (2 in Group 1, 2 in Group 2) had hydrocele formation, and 3 patients (1 in Group 1, 2 in Group 2) had varicocele recurrence (detected by physical examination). There was no significant difference between the groups in terms of recurrence.

In addition, there was no significant difference between the unilateral and bilateral varicocele groups with regard to cost.

Discussion

A number of different techniques have been described to treat varicocele. In some of these techniques, dilated internal and external spermatic veins are ligated at different regions of the spermatic cord.^[8] In other techniques, these veins are embolized or obstructed with sclerosan materials.^[9,10] In techniques that involve vessel ligation, silk sutures are usually preferred, although various materials can be used for ligation. Titanium clips are also commonly used for ligation. However, the use of titanium clips has not been documented until now. We also evaluated the use of titanium clips for ligation of the dilated veins during microsurgical subinguinal varicocelectomy.

Table 1. Patient ages, characteristics, varicocele sides and grades

	Group 1	Group 2	P value
Patient (n)	43	41	-
Age	28.1 ± 4.6	29.1 ± 4.6	0.99
Varicocele (unit)	75	73	-
Varicocele side			
Left	21	23	0.51
Bilateral	27	25	0.86
Varicocele grade			
I	8	7	0.91
II	18	19	0.68
III	17	15	0.79
P<0.05 is significant			

Table 2. Indications for varicocelectomy

	Group 1	Group 2	P value
Patient	43	41	-
Infertility (%)	36 (83.7)	34 (82.9)	0.92
Scrotal pain (%)	6 (13.9)	5 (12.2)	0.81
Atrophy (%)	1 (2.4)	2 (4.9)	0.28
P<0.05 is significant			

Varicocelectomy using microscopic techniques has a more positive effect on postoperative sperm parameters and is a safer procedure.^[11] Several studies suggest that varicocele repair significantly improves postoperative sperm concentration, sperm motility, and total motile sperm count. Some studies have reported improvement as a percentage, and a number of studies have reported an increase or decrease in semen parameters from the mean value.^[12-15] Based on several studies, the rate of the postoperative improvement in sperm parameters ranges from 51 to 79%.^[2,12,16] In our study, we found that the improvement was similar in both groups. The postoperative improvement rate was 79.1% for Group 1 and 82.9% for Group 2. In this investigation of the microsurgical varicocelectomy technique, the use of titanium clips for ligation of the dilated vessel did not result in any postoperative improvements in sperm parameters, including total count and motility.

According to the EAU guideline, there are many different methods of varicocele treatment.^[13] Recently, techniques involving different methods for the ligation of dilated veins have been described, and technical improvements in laparoscopic varicocelectomy (LV) have made it a viable treatment option.^[14,15] In a

Table 3. Preoperative and postoperative semen parameters for all cases

Semen parameters	Group 1			Group 2		
	Preoperative	Postoperative	P value	Preoperative	Postoperative	P value
Sperm concentration (million/mL) <i>Median (min-max)</i>	8.0 (0.05-40.0)	22.0 (1.0-80.0)	<0.001	7.0 (0.04-32.0)	20.0 (1.1-79.0)	<0.001
Total sperm motility (%) <i>Median (min-max)</i>	20.0 (0.0-65.0)	40.0 (10.0-75.0)	<0.001	21.0 (0.0-60.0)	32.0 (10.0-75.0)	<0.001
Semen volume (mL) <i>Median (min-max)</i>	3.6 (1-7.3)	4.0 (1.5-7.0)	0.75	3.8 (1.0-7.0)	4.0 (1.3-6.9)	0.52

P<0.05 is significant

Table 4. Operative and Postoperative Outcomes

	Group 1	Group 2	P value
Operation time (minutes)			
<i>Unilateral</i>	27.6±3.5	39.8±3.9	<0.001
<i>Bilateral</i>	40.3±5.2	52.1±6.5	0.02
Ligated vein (n)	4.25±1.27	4.24±1.33	0.96
Postoperative hydrocele (%)	4.6 (2/43)	4.9 (2/41)	0.67
Postoperative recurrence (%)	2.3 (1/43)	4.9 (2/41)	0.48
Hospitalization time (hours)	17.4±4.7	18.0±4.6	0.87

P<0.05 is significant

recent study^[14] that compared conventional transperitoneal laparoscopic varicocele ligation (CTL-VL) and laparoendoscopic single-site varicocele ligation (LESS-VL) using a transumbilical home-made single port, it was revealed that LEES-VL was more effective than other methods, while the operation time was not significantly different between the two methods. In another study, the vascular clip and LigaSure (Valleylab, Boulder, Colorado) vascular sealing method was compared for the ligation of dilated veins in laparoscopic varicocelelectomy.^[17] The study showed that there was no significant difference between the two ligations methods. Thus, titanium clips can be safely used for the ligation of dilated veins.

There are certain complications associated with varicocelelectomy related to the surgical technique used. Hydrocele formation is the most commonly observed complication of varicocele repair. The cause of post-varicocelelectomy hydrocele is the ligation of the lymphatic vessels, which are colorless and are sometimes mistaken for veins. Hydrocele had been the most common complication reported after operative varicocele repair, and with the classic non-microsurgical approach, the incidence rates were approximately 7%, ranging from 3%-39%.^[18] Recently, the hydrocele formation rate has been reduced with the development of microsurgical varicocelelectomy techniques. In the meta-analysis performed by Cayan et al.^[19], the lowest hydro-

cele formation rate observed was an overall rate of 0.44% in the microsurgical series, whereas the rate was 8.24% in the Palomo technique series, 2.84% in the laparoscopic varicocelelectomy series, and 7.3% in the macroscopic inguinal (Ivanissevich) or subinguinal varicocelelectomy series. In our study, hydrocele formation was similar in both groups. The rate of hydrocele formation was 4.6% and 4.9% in Group 1 and Group 2, respectively. Therefore, we think that the use of titanium clips does not increase the likelihood of hydrocele formation. Other complications of varicocele surgery include wound inflammation, epididymal discomfort and wound ecchymosis. In this study, the rates of these complications were similar in both groups.

Varicocele may recur after the surgery. The recurrences are identified by the presence of varicocele during physical examination or the presence of reverse blood flow on Doppler ultrasonography during the postoperative period. Recurrences after varicocele repair are reported in 0-35% of cases, in accordance with the varicocelelectomy technique used. The microsurgical techniques for varicocelelectomy are associated with low recurrence rates. In the study by Marmar and Kim,^[20] among 466 cases of subinguinal microsurgical varicocelelectomy, the rate of palpable recurrence was 0.82% per procedure. In the meta-analysis by Cayan et al.^[19], the recurrence rates were 14.97% in the Palomo technique series, 1.05% with use of the microsurgical varicocelelectomy technique, 4.3% with use of the laparoscopic varicocelelectomy technique, 12.7% with the radiologic embolization approach, and 2.63% in the macroscopic inguinal (Ivanissevich) or subinguinal varicocelelectomy series, revealing a significantly lower recurrence rate in association with the use of the microsurgical varicocelelectomy technique. In our study, the recurrence rate was similar in both groups, at 2.3% and 4.9% for Group 1 and Group 2, respectively. Thus, the use of titanium clips does not increase the rate of recurrence during the postoperative period.

Microsurgical varicocelelectomy is associated with longer operation times. Notably, the preoperative arrangement, intraoperative movement and the surgeon's experience may

affect the length of the operation. In our study, the operation time was considered as the time from the first incision to the closure of the incision; the anesthesia time was excluded. In a study by Al-Kandari et al.^[15], who performed microsurgical varicocelectomy, the operation time was 64 minutes for patients with unilateral varicocele and 105 minutes for patients with bilateral varicocele. In another study, Zini et al.^[5], who performed modified microsurgical varicocelectomies, reported operation times of 50.2 and 81.7 minutes for patients with unilateral and bilateral varicocele, respectively. In this study, we performed subinguinal microsurgical varicocelectomy and report operation times of 27.6 and 39.8 minutes for unilateral and bilateral varicocele, respectively, in Group 1 (titanium clip). In Group 2 (silk sutures), operation times were 40.3 and 52.1 minutes for unilateral and bilateral varicocele, respectively.

The operation time was shorter when titanium clips as opposed to silk sutures were used for the ligation. The use of titanium clips was also more practical for the ligation of vessels.

Differences in operation duration can depend on a surgeon's capability. In this study, two surgeons performed all of the operations at two departments. Therefore, we do not think that the surgeons had any impact on operation duration in the silk suture and titanium clip groups. However, large group studies controlled by a single surgeon are needed to conclude that changes in operation duration are not artifacts caused by the surgeon.

The cost of varicocelectomy depends on the conditions in a particular country; the cost of silk sutures is generally lower than that of other ligation materials. However, the ligation material used (silk or titanium) does not strongly affect the total cost of the varicocelectomy. Various factors such as anesthetic materials, rent for the operation room, and housekeeping affect the total cost. In Group 1, the mean cost was \$1,975 and \$2,235 for patients with unilateral and bilateral varicocele, respectively. For Group 2, the mean cost was \$1,915 and \$2,157 for patients with unilateral and bilateral varicocele, respectively. In Turkey, there is no significant difference between the costs of titanium clips as opposed to silk sutures because only 4-5 titanium clips are necessary (mean number of ligated veins was 4.25 ± 1.27 for Group 1). Therefore, the use of titanium ligation materials does not change the total cost of varicocelectomy.

In conclusion, titanium ligation clips may be used for the ligation of dilated veins in microsurgical subinguinal varicocelectomy. In this study, the operation time was significantly decreased by the use of titanium clips. Additionally, titanium

clips did not have any negative effects on the rate of postoperative improvement of sperm parameters, the rate of hydrocele formation or the frequency of recurrences in comparison to the rates observed with the use of silk sutures.

Conflict of Interest: No conflict of interest was declared by the authors.

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