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Advantages of microsurgical varicocelectomy over conventional techniques

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Abstract. – OBJECTIVE: Varicocelectomy is the only effective method of treating varicocele. Nowdays, many techniques for varicocelectomy include retroperitoneal, inguinal, and subinguinal varicocele repairs with or without magnification and laparoscopic repair. The advantages of the microsurgical approach to varicocele repairs are reliable identification and preservation of the vascular structures. Thus, our aim is to compare the efficiency of microsurgery over conventional techniques of varicocele repairs.

PATIENTS AND METHODS: We have evaluated 105 man divided into three groups of 35 patients surgically treated with open varicocelectomy in the first group, microsurgical varicocelectomy in the second, and laparoscopic varicocelectomy in the third group. Sperm test improvement and complications were then compared.

RESULTS: The testicular volume shows a significant increase after all three types of surgery, the highest one being after the laparascopic varicocelectomy (14.47 ± 6.76 vs. 21.8 ± 7.52), whereas the lowest increase was recorded in open varicocelectomy (14.90 ± 6.26 vs. 17.46 ± 5.89). Regarding motility of spermatozoids, the highest postoperative increase of values is after microsurgical varicocelectomy (4.30 ± 2.19 vs. 15.88 ± 3.13).

CONCLUSIONS: Our study shows the lowest degree of postoperative complications among patients treated with microsurgical varicocelectomy, and the most frequent complications in those treated by open varicocelectomy. Sperm test outcomes after microsurgical varicocelectomy was better than those after other conventional techniques: significantly higher improvement of sperm quality, shoter postsurgical clinical treatment, and the lowest rate of postsurgical complications.

Key Words:
Varicocele, Microsurgical varicocelectomy, Laparascopic varicocelectomy, Semen analysis.

Introduction

Varicocele is the most common identifiable cause of male infertility[1], and varicocelectomy is the only effective method of treatment. Goldstein et al[2] implies that the goals of varicocele repair are pain relief in symptomatic cases and improvement in semen parameters, testicular function, and pregnancy rates in couples with male-releated infertility associated with varicocele. There are numerous surgical techniques being used in varicocele treatment, each of them having its own advantages and disadvantages, with various studies often having rather conflicting results of their outcomes[3]. Conventional techniques of varicocele repair, which includes open inguinal varicocelectomy and laparoscopic varicocelectomy, have a relatively high rate of postoperative hydrocele incidence, varicocele recurrence and testicular artery injuries[1]. Microsurgical approach of varicocele repair is reliable identification and preservation of the testicular and cremasteric arteries and lymphatic channels and reliable identification of all internal spermatic veins and gubernacular veins[2].

The aim of our study is to compare the efficiency of microsurgical varicocelectomy with conventional techniques of varicocele repair, based on semen analysis, the prevalence of postoperative complications and duration of postsurgical clinical treatment (days in hospital).

Patients and Methods

The study included 105 men aged from 18 to 26 divided into three groups according the type of surgical treatment of varicocele:

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- The first group of 35 patients underwent the open varicocelectomy by Palomo's technique
- The second group of 35 patients underwent the inguinal microsurgical varicocelectomy technique.
- The third group of 35 patients underwent laparascopic surgical method according to *baseball diamond concept* with preservation of testicular artery.

Indications for varicocelectomy were: painful varicocele, abnormal semen analysis, and/or varicocele accompanied by ipsilateral testicular atrophy. Research results for the first group were collected retrospectively, considering that these patients underwent surgery from 2000 to 2003 and the results for the other two groups were observed prospectively over 2010 and 2011. Patients' semen analysis values were determined before and 90 days after the surgery. Patients with immunological fertility disorders, as well as patients with chromosomal aberrations, were excluded from the study.

A physical examination for varicocele presence in all groups was performed according to the following criteria:

- Subclinical varicocele (Doppler reflux during Valsalva maneuver with vein dilatation for more than three mm),
- Grade 1 (palpable varicocele with Valsalva maneuver),
- Grade 2 (palpable without Valsalva maneuver, not visible),
- Grade 3 (easily visible).

Prior to beginning the surgical treatment and after five days of sexual abstinence, patients provided the sperm sample, throughout the masturbation. A subsequent sample was given 90 days after completion of the surgical treatment as to assess the effect of treatment, also respecting the five day abstinence rule used to provide the first sample. The compliance rate was 100% in every group.

Testicular Volume

The orchidometry was performed with Aloka 650 (5 MHz) ultrasonography tool (Bloomfield, CT, USA), which measured three ipsilateral testicle's dimensions. The volume of the testicle was established multiplying the dimensions with the standard coefficient of 0.51.

Sperm Analysis

After liquefaction, which averaged 20 minutes, the samples were analyzed using a Sperm Quality Analyser SQA IIC-P (made by Medical Electronic Systems Ltd., Los Angeles, CA, USA), which determined all sperm test analyses. We chose to present motility, progressive motility, sperm concentration and morphology (i.e. the percentage of abnormal forms) only, since other parameters did not show any significant outcome. The used reference values were taken from the criteria given by the Guidelines on Male Infertility 2010, provided by the European Association of Urology (EAU)). The lower reference limit (with 5th centiles and their 95% confidence intervals) of motility was 40% (38-42;) progressive motility 32% (31-34); minimum sperm concentration was 15 × 10 per ml (12-16); more than 4% (3-4) of the morphologically normal forms were above the lower reference limit.

Ethics

Each subject signed the acceptance of the study protocol, in which the Ethical Principles for Medical Research Involving Human Subjects (the Helsinki Declaration) were clearly stated.

Surgical Techniques

All patients in first group had high ligation of the dilated testicular veins by the technique described by Palomo in 1969[5].

Inguinal microsurgical approach was performed after standard pre-surgical procedure of the patients. The position of the superficial inguinal ring was marked on the skin, approximately three to five cm over the inguinal canal[6]. The incision extends around two cm from mark, following the natural lines of the skin. The spermatic cord is being exposed by hooking it with index finger under the superficial inguinal ring, and a small retractor slides into the incision along the index finger's dorsum and pulls in the opposite direction[2]. The cord is elevated and any external spermatic veins that are running parallel to the spermatic cord or perforating the floor of the inguinal canal are identified and ligated[6]. Ilioinguinal and genital branches of the of genitofemoral nerve are safely excluded. After testicle luxation, the gubernaculum is carefully examined and all the identified veins either electro-coagulated or clipsed and dissected, depending on their size. All the external spermatic perforators and gubernacular veins are also dissected. After that, the testicle is returned back to the scrotum,

spermatic cord remaining elevated to stabilize and get prepared for microscopic examination. Then we place surgical microscope in the operating field and examine the cord. The both layers of spermatic fascia are incised longitudinally, and the spermatic cord is being examined. Next, we identify the testicular artery and preserve it with 0 or 1 silk ligature, as well as all the subsequently identified arteries. All remaining inner spermatic veins, with an exception of the vassal vein, are clipped with hemoclips or ligated and dissected[2].

Laparoscopic surgical method (baseball diamond concept with preservation of the testicular artery) was performed with the patient in the supine position under general anesthesia. The urethral catheter is placed to empty the bladder, and a Veress needle for the creation of pneumoperitoneum was introduced into the abdomen through a supra - umbilical transverse skin incision. Carbon dioxide insufflation was maintained through the Veress needle at a rate of 1-2 liters per minute[7]. Three laparoscopic ports are then being placed. We identify the intraabdominal vas deferens as a structure joining the spermatic cord above the internal or deep inguinal ring. The gonadal vessels are clearly visible in the retroperitoneum, and the posterior peritoneum is excised with a cautery. Next, we mobilize the blood vessels. Then, we use the Doppler probe to facilitate the identification of the artery and its ligation. After identifying the artery, we isolate the gonadal artery using blunt dissection with atraumatic graspers. To secure the operating field, the intracorporal suturing is used to ligate the gonadal vein while sparing the testicular artery[8].

Statistical Analysis

Following the customary methods of statistical description, the Z test for proportion and the Student *t* test were applied in order to assess statistical significance. The difference of the obtained values was considered to be significant when $p < 0.05$.

Results

The occurrence of postoperative complications is presented through the parameters of spermatic artery preservation, postoperative hydrocele and varicocele recurrence. Thereby, the patients treated with microsurgical technique had the percentage of spermatic artery preservation of 100% (35 patients), none of the patients had postoperative hydrocele and one patient (2.85%) had a varicocele recurrence. Laparascopic varicocelectomy had the spermatic artery preserved in 97.1% cases (34 patients), three patients (8.5%) had the postoperative hydrocele, and five patients (14.2%) had varicocele recurrence. On the other side, open varicocelectomy achieved spermatic artery preservation in 91.4% cases (32 patients), two patients had postoperative hydrocele (5.2%), and varicocele recurrence was reported in six cases (17.14%).

The postsurgical clinical treatment of patients treated microsurgically lasted 2.4 ± 0.69 days, while with patients that had undergone laparascopic varicocelectomy it was 3.68 ± 0.71 days, and those who had undergone Palomo open varicocelectomy had the longest postoperative hospital stay 4.05 ± 0.93 days. *t*-test outcomes reveal statistically significant difference among all of the three groups (Group 1 vs. Group 2 – $p < 0.001$; Group 1 vs. Group 3 – $p < 0.05$; Group 2 vs. Group 3 – $p < 0.001$).

Table I implies that there is no statistically significant difference between postoperative results of microsurgical and laparascopic varicocelectomy regarding testicular volume and abnormal forms, unlike the values of motility, progressive motility and sperm count.

Table II shows statistically significant difference between postoperative results of laparascopic varicocelectomy and Palomo procedure in all aspects of semen analysis parameters except sperm motility.

Table III indicates that there is statistically significant difference between Palomo procedure and microsurgical varicocelectomy regarding all parameters of semen analysis.

Discussion

Our research showed the increase in testicular volume and improvement of all fertility parameters in the examinees 90 days after the surgery, with some inividual differences regarding the varicocelectomy technique applied. The testicular volume showed a significant increase after all three types of surgery, the highest one being after the laparascopic varicocelectomy (14.47 ± 6.76 vs. 21.8 ± 7.52), whereas the lowest increase was recorded in Palomo open varicocelectomy (14.90

Table I. The Mean value, standard deviations, max, min, median of the measured semen analysis parameter values before and after the microsurgical varicocelectomy. *p*-values show comparison of postoperative results of the microsurgical varicocelectomy with the laparascopic varicocelectomy (p).

Sperm analysis parameters	Microsurgical varicocelectomy								*t*-test Laparascopic
	Before surgery				After surgery				
	MV ± SD	Min	Max	Median	MV ± SD	Min	Max	Median	
Testicular volume	14.04 ± 6.51	4	28	13	20.33 ± 7.09	11.3	38.4	18.6	$p > 0.05$
Motility	4.30 ± 2.19	1.2	9.2	3.5	15.88 ± 3.13	9.5	21.4	16.4	$p > 0.001$
Progressive motility	23.39 ± 7.20	11.5	36	23.3	35.30 ± 7.41	22.1	50.5	34.6	$p > 0.03$
Sperm count (%)	8.47 ± 3.31	2.8	15	8.2	17.42 ± 3.35	10.3	23.1	18	$p > 0.001$
Abnormal forms (%)	84.35 ± 12.12	55.6	98.2	86.7	54.49 ± 14.29	29.8	81.6	55.2	$p > 0.05$

Table II. The Mean value, standard deviations, max, min, median of the measured semen analysis parameter values before and after the laparascopic varicocelectomy. *p*-values show comparation of postoperative results of the laparascopic varicocelectomy and the Palomo varicocelectomy (p)

Sperm analysis parameters	Laparascopic varicocelectomy								*t*-test Palomo
	Before surgery				After surgery				
	MV ± SD	Min	Max	Median	MV ± SD	Min	Max	Median	
Testicular volume	14.47 ± 6.76	3.6	29.3	14	21.8 ± 7.52	8.9	36.3	20.7	$p > 0.001$
Motility	3.88 ± 1.91	1.1	7.4	3.6	12.49 ± 3.75	6.4	20.1	11.5	$p > 0.05$
Progressive motility	24.27 ± 6.57	10.4	35.4	25.4	32.38 ± 7.21	16.7	45.3	32.6	$p > 0.02$
Sperm count (%)	9.41 ± 3.17	4	15.2	8.4	13.88 ± 3.35	3.6	19	14.3	$p > 0.04$
Abnormal forms (%)	84.80 ± 10.05	64.6	98.4	86.2	53.4 ± 11.31	32.1	83.6	51.6	$p > 0.001$

Table III. The Mean value, standard deviations, max, min, median of the measured semen analysis parameter values before and after the open varicocelectomy by Palomo. *p*-values show comparation of postoperative results of the Palomo varicocelectomy and the microsurgical varicocelectomy (p).

Sperm analysis parameters	Open varicocelectomy (Palomo)								*t*-test
	Before surgery				After surgery				
	MV ± SD	Min	Max	Median	MV ± SD	Min	Max	Median	Microsurgery
Testicular volume	14.90 ± 6.26	6.7	27.2	14.2	17.46 ± 5.89	8.3	29.8	16.7	$p > 0.002$
Motility	4.05 ± 2.08	1.5	10.2	3.6	13.84 ± 2.74	9.8	19	13	$p > 0.01$
Progressive motility	21.79 ± 7.62	11.6	36	21.4	28.04 ± 7.95	13	41.5	28.85	$p > 0.001$
Sperm count (%)	10.02 ± 2.54	5.3	14.2	9.7	12.62 ± 2.22	8.8	17.3	13.2	$p > 0.001$
Abnormal forms (%)	84.01 ± 9.73	63	97	84.5	61.7 ± 10.14	41	78.1	62.4	$p > 0.003$

± 6.26 vs. 17.46 ± 5.89). There was no statistically significant difference ($p > 0.05$) in postoperative improvement of testicular volume between microsurgical and laparoscopic groups of patients. The research of Chen and Chen[9] showed significant improvement in testicular volume 6 months after subinguinal microsurgical varicocelectomy (mean ± SD: 29.6 ± 5.9 vs. 23.2 ± 6.1 mL), but it did not observe its relation with laparascopic or open inguinal varicocelectomy, which our study did. However, Papanikolaou et al[10] stated that microsurgical varicocelectomy – although improving sperm count parameters in infertile subjects – did not significantly influence testicular volume increase, which was contrary to our results.

Regarding motility of spermatozoids, the highest postoperative increased of values was after microsurgical varicocelectomy (4.30 ± 2.19 vs. 15.88 ± 3.13). Progressive motility showed the highest improvement after microsurgical varicocelectomy (23.39 ± 7.20 vs. 35.30 ± 7.41), and the lowest improvement was recorded in Palomo open varicocelectomy (21.79 ± 7.62 vs. 28.04 ± 7.95) As to the sperm count, the highest postoperative improvement of this parameter was found after microsurgical varicocelectomy treatment (8.47 ± 3.31 vs. 17.42 ± 3.35), and the lowest result had the Palomo exeminees (10.02 ± 2.54 vs. 12.62 ± 2.22).

Metha and Goldstein[11] considered that, although there were other described techniques of varicocelectomy, microsurgical varicocelectomy with subinguinal and inguinal approach was recognized as a golden standard in treatment of varicocelectomy due to its high success rates and minimal postoperative complications. Our research showed that lowest degree of postoperative complications was in group of patients treated with microsurgical varicocelectomy whereas the complications were most frequent in open varicocelectomy. Al-Said et al[12], also showed that the lowest number of complications was presented in microsurgical group of patients, where none of the examinees developed postoperative hydorcele, and only 2.6% had varicocele recurrence. In addition, this research showed that prevalence of complications was higher in the laparascopic group compared to the open inguinal Palomo approach (5.4% vs. 2.8 and 11% vs. 17%), which was not the case in our research. Our study went a step further examining the degree of testicular artery preservation, which wass 100% in the microsurgical group – similar to the

study of Chan et al[13], where the frequency of accidental ligation of testicular artery in microsurgical approach was approximately 1%.

Our investigation has examined the postoperative hospital stay duration, which was important from the economic aspects of a health system, and which proved that the postoperative hospital stay was the shortest in microsurgical group (2.4 ± 0.69).

Unlike our research, the study of Sun et al[3], examined 153 patients who underwent laparascopic, open inguinal and retroperitoneal surgical approaches, and found out that the postoperative hospital stay was significantly shorter in the laparascopic group than in the other two ($p <$ 0.01).

The research that we conducted clearly showed the positive impact of varicocelectomy on sperm count parameters. At the same time it was shown that the best results were obtained applying microsurgical varicocelectomy. Pan et al[14], also pointed out significant improvement of sperm count parameters (motility and sperm concentration) 90 days after inguinal microsurgical varicocelectomy (15.47 ± 3.21) × 10 mL and (13.34 ± 5.16%), but also after 120 days (18.39 ± 4.05) × 10 ml and (17.23 ± 4.69%), where a gradual positive trend in improvement of sperm count parameters was clearly seen, which was not included in our study. Furthermore, our research examined a larger number of sperm count parameters in three surgical techniques, which was not the case in the Chinese study. The report of Cho et al[15], indicated that microsurgical varicocelectomy gives statistically significant improvement of all sperm count parameters except the morphology of spermatozoids, which did not show significant decrease of abnormal forms. This is different compared to our research, which indicated a significant postoperative reduction of abnormal spermatozoids forms, with no statistically significant differences between laparascopic and microsurgical group ($p > 0.05$).

In meta-analytical study conducted by Agarwal et al[16] the effect of microsurgical and high ligation varicocelectomy on motility and sperm concentration was observed, where a significant improvement of the given parameters was recorded after both surgical approaches, as well as a better outcome of the ligation technique compared to varicocelectomy (4.33 to 19.12 vs. 4.90 to 14.95 and 5.71 to 18.35 vs. 7.34 to 12.08). However,regarding the results presented here, significantly better outcome has been shown after microsurgical varicocelectomy compared to the Palomo ligation technique, with statistically significant differences in all semen parameters.

Comparing pre and post operative semen parameters values, Sun et al results[3] showed that there was a significant postoperative improvement in motility and the sperm count ($p < 0.01$), but no statistically significant difference in semen parameters ($p > 0.05$) comparing the three groups mutually (open inguinal, retroperitoneal and laparoscopic). This is different compared to our study which showed the best results in microsurgical group of subjects, where there was statistically significant difference compared to those of open varicocelectomy in all semen parameters, as well as compared to laparascopic group in some of semen parameters (motility – $p < 0.001$; progressive motility – $p < 0.03$; sperm count – $p < 0.001$).

Conclusions

Based on results of this study there is an undoubted rapid and positive impact in the microsurgical treatment of varicocele, more progressive than after conventional techniques of varicocele repair. The group of patients that underwent microsurgical varicocelectomy with inguinal approach have the most convenient results, with the lowest level of complications and the most obvious semen parameters improvement. The open Palomo varicocelectomy has the most of postoperative complications and the lowest semen parameters improvement among the three groups, but the improvement of all parameters compared to preoperative findings is quite certainly present in this group, too. Likewise, the postoperative hospital stay is the shortest in the microsurgical group of patients, which brings us to the conclusion that microsurgery is the future of surgical treatment of varicocele.

Conflict of Interest

The Authors declare that there are no conflicts of interest.

References

1) Pan LJ, Xia XY, Huang YF, Gao YP. Microsurgical varicocelectomy for male infertility. Zhonghua Nan Ke Xueuly 2008; 14: 640-644.

2) Goldstein M, Gilbert BR, Dicker AP, Dwosh J, Gnecco C. Microsurgical inguinal varicocelecto-

my with delivery of the testis: an artery and lymphatic sparing technique. J Urol 1992; 148: 1808-1811.

3) Sun HB, Liu Y, Yan MB, Li ZD, Gui XG. Comparing three different surgical techniques used in adult bilateral varicocele. Asian J Endosc Surg 2012; 5: 12-16.

4) Jungwirth A, Diemer T, Dohle GR, Giwercman A, Kopa Z, Krausz C, Tournaye H. Guidelines on male infertility. Eur Urol 2012; 61: 150-63 In: EAU Guidelines, edition presented at the 25th EAU Annual Congress, Barcelona 2010. ISBN 978-90-79754-70-0.

5) Palomo A. Radical cure of varicocele by a new technique: preliminary report. J Urol 1949; 61: 604-607.

6) Binsaleh S, Lo KC. Varicocelectomy: microsurgical inguinal varicocelectomy is the treatment of choice. Can Urol Assoc J 2007 ; 1: 277-278.

7) Bebars GA, Zaki A, Dawood AR, El-Gohary MA. Laparoscopic versus open high ligation of the testicular veins for the treatment of varicocele. JSLS 2000; 4: 209-213.

8) Mishra RK. Laparascopic varicocelectomy. Operative technique. In: Mishra RK, editor. Textbook of practical laparascopic surgery. 3rd edition. Jaypee Brothers Medical Publishers, 2013; pp. 458-459.

9) Chen SS, Chen LK. Predictive factors of successful varicocelectomy in infertile patients. Urol Int 2011; 86: 320-324.

10) Papanikolaou F, Chow V, Jarvi K, Fong B, Ho M, Zini A. Effect of adult microsurgical varicocelectomy on testicular volume. Urology 2000; 56: 136-139.

11) Mehta A, Goldstein M. Varicocele repair for nonobstructive azoospermia. Curr Opin Urol 2012; 22: 507-512.

12) Al-Said S, Al-Naimi A, Al-Ansari A, Younis N, Shamsodini A, A-sadiq K, Shokeir AA. Varicocelectomy for male infertility: a comparative study of open, laparoscopic and microsurgical approaches. J Urol 2008; 180: 266-270.

13) Chan PT, Wright EJ, Goldstein M. Incidence and postoperative outcomes of accidental ligation of the testicular artery during microsurgical varicocelectomy. J Urol 2005; 173: 482-484.

14) Pan LJ, Pan F, Zhang XY, Liu Y, Zhang FL. Treatment of varicocele by microsurgical varicocelectomy: report of 94 cases. Zhonghua Nan Ke Xue 2012; 18: 416-418.

15) Cho SY, Kim TB, Ku JH, Paick JS, Kim SW. Beneficial effects of microsurgical varicocelectomy on semen parameters in patients who underwent surgery for causes other than infertility. Urology 2011; 77: 1107-1110.

16) Agarwal A, Deepinder F, Cocuzza M, Agarwal R, Short RA, Sabanegh E, Marmar JL. Efficacy of varicocelectomy in improving semen parameters: new meta-analytical approach. Urology 2007; 70: 532-538.