



## Comparison of Two Methods in Surgical Treatment of Varicocele: Laparoscopic and Open Surgery

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### Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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### ABSTRACT

**Introduction and Objective:** Varicocele is the loosening of testicular veins and the pump form venous channel within the spermatic cord. There are different treatments for varicocele, as open surgery, microsurgery, laparoscopy, sclerotherapy and other techniques. The purpose of this study was to compare the outcomes of laparoscopic and open techniques in the surgical treatment of varicocele.

**Materials and Methods:** In a randomized interventional study, 96 patients referring to the private or public hospitals of Hamedan were diagnosed to have Varicocele, and after filling the informed consent they were included in the study. Patients with a confirmed diagnosis of Varicocele, were studied after filling the testimonial. Testicles size was measured by using vernier calipers in width and height and the patients underwent the analyzing of their semen fluid. The patients were randomly assigned into 2 groups (n = 48 per group).

Following-up the patients in order to assess any effects related to the treatment, such as wound infection, hydrocele, hematoma, and etc. lasted up to 1 month. Examining with regard to the recurrence or lack of examination of the form obvious clinical Varicocele was conducted, despite the treatment and related examines with infertility factors after 6 months. The assessment of the size of the testis and analysis of semen was done after 3 and 6 months. At the end of 6 months, the results were compared between the two groups. The collected data was analyzed using the indicators of

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frequency, mean, SD and in necessary cases were analyzed using t-test and paired t-test, and in cases of comparing qualitative data it was analyzed by using Chi-square test. The significance of the results were considered  $P \leq 0.05$ .

**Results:** The semen analysis after 6 months, in all patients, indicated a significant difference in favor of the improvement of these factors after the surgery, in comparison with to the state before the surgery. These evaluations were performed separately in each group and in both laparoscopic and open groups a statistically significant difference was observed in favor of improving semen analysis factors. Changes in these factors before and after the surgery were compared in both groups and no significant statistical difference was observed. This means that both groups had no differences regarding the effect on fertility factors. No varicocele recurrence was reported within 6 months. Hospital stay was had no significant differences between the two groups. Also, no significant difference was observed between the two groups, regarding the effects associated with surgery.

**Conclusions:** Open and laparoscopic varicocelectomy surgeries have approximately equal post-surgery consequences, regarding improved parameters of semen liquid and post-surgery effects. However, further research with larger sample size and longer follow-up period is required so that with greater certainty, we could judge about the advantages and disadvantages of the two methods.

*Keywords: Varicocelectomy; laparoscopy; open surgery.*

## 1. INTRODUCTION

Dilation of inner spermatic veins is called varicocele [1]. Outbreak of Varicocele in men is 15% [2]. It is rare in children and it increases markedly with age. Varicocele is a progressive lesion which is related to testicular growth and its function during the time and is the most common and modifiable infertility reason in men. Though the exact relation of Varicocele and spermatogenesis disorder is not clear, about 40 percent of men with initial infertility have Varicocele. After Varicocelectomy is done, the semen analysis parameters improved in more than 50 percent of patients [3]. Modification of this disorder leads to an increase in measurable fertility factors such as mobility, viability, and total number of sperms. The purpose of curing Varicocele is to eliminate reflux and artery blood flow return through inner spermatic veins [2]. Varicocelectomy indications include cases such as disorder in semen analysis parameters or sperm quality, hypogonadism, scrotal pain, and testicular hypertrophy especially in children and inclination of the individual who has a large Varicocele. Treatment options for Varicocele include: open surgery in different anatomical levels, robotic surgery, micro surgery, laparoscopy, sclerotherapy and vein embolization [4].

In 1991, laparoscopy was applied as a less invasive method in the treatment of Varicocele. Laparoscopy has the advantage of isolating spermatic vein in proximal, near its drainage point to left renal vein. In this layer only one or

two big veins exist and we have to close some of them, and testicular artery is not damaged and it is often separated from vein. Varicocelectomy laparoscopy is done trans-peritoneally in general, but retroperitoneal and extra peritoneal cases have been also described [5].

In a study conducted by Sangrasi, 107 patients had undergone laparoscopic varicocelectomy or open inguinal. There were 50 patients in each group. The needed painkiller in open group was  $16.3 \pm 1.58$  pills and  $11.3 \pm 2.23$  pills in laparoscopic group. The pain level in laparoscopic group was significantly lower after the surgery. Significant statistical improvement in sperm numbers and also sperm mobility was seen in both groups regardless of their surgery process [6].

In Moreira-Pinto study, in a retrospective way, 33 teenagers who had undergone varicocelectomy in a Portuguese children hospital were evaluated. There were 24 patients in laparoscopic varicocelectomy group and 9 patients in open varicocelectomy group. Average age in both groups was 12 years. Significant difference was not seen between the two groups regarding hydrosol happening. Relapse was not seen in laparoscopy group, whereas there were three cases in the open group ( $P=0.015$ ).

It can be concluded that laparoscopy is more efficient than open technique in treating Varicocele in teenagers, in order to have more valid and reliable results, the study must be done with larger sample [7].

The present study is done with the aim of comparing the two techniques of laparoscopy and open in treating Varicocele surgery.

## 2. METHODS AND INSTRUMENTS

In a randomized interventional study, 96 patients (48 patients in each group) referring to private or state health centers of Hamadan with symptomatic unilateral or bilateral and clear Varicoceles with regard to the clinical study had been examined by a surgeon and were candidate to one of the treatment options, participated in the study after being justified about the project and filling out the consent form. The criteria to choose patients to do the surgery were the attendance of the patient in the clinical examination, and no para-clinical methods were used to choose patients.

Using the caliper vernie, the testis size was checked in length and width in each patient and the semen liquid was analyzed in each person; the questionnaire was filled out and the patients were assigned into two groups randomly. 100 envelopes which were numbered from 1 to 100 were given to the evaluating doctor. Inside the envelopes, there was a paper with A or B relating to the kind of surgery. The letter A or B which was placed inside the envelopes was determined by random numbers' table. When the first patient referred, the doctor opened the first envelope and the patient was assigned into the group that the paper in the envelope specified. Accordingly during the study, any patient with the appropriate criteria to enter the study was assigned in the mentioned group after the special envelope for that number was opened. Therefore, the patients were randomly assigned into two groups and invasive factors were eliminated. Then, the patients were treated according to the specified surgery for them.

In laparoscopy method 3 trocars, one under umbilicus and 2 down on left and right side were used to enter the abdomen. The posterior lateral peritoneal or spermatic anterior cord was opened, the peritoneal was set aside and after getting and separating the spermatic veins, the veins were closed. Dram 29 used in the open surgery method means that transverse incision is used in inside and down the anterior superior iliac spines and is expanded inside; the outside muscle fascia is cut. The internal muscle is set aside so that the spermatic veins about the inner rings can be identified. The identified spermatic veins are closed and separated.

The patients were evaluated by the surgeon after the surgery. The follow-up assessments of the patients included any treatment related with complications like lesion infection, hydrosol, hematoma, etc, which was till 1 month and after 6 months. Examining the relapse or treatment failure in the form of clear clinical Varicoceles, regardless of treatment and infertility factors related to the infertility factors was done after 6 months. The first assessment concerning the size of testis was conducted after 6 months and the comparison of results before and after the treatment was done after 6 months. The surgery time for each patient was calculated. The treatment cost was calculated for each patient by the end of 6 months and included all the treatment costs excluding the health insurance. The hospitalization time was measured. All the assessment on the patients was performed by the surgeon. The results are mentioned in the project questionnaire. The results of the two groups were compared at the end of month 6.

### 2.1 Statistical Procedures

The data was analyzed using SPSS software, version 17. The collected data was analyzed by frequency, mean, standard deviation, and in necessary cases by using T-test and paired T-test. Concerning the qualitative data, chi-square was utilized to analyze the data. Significance level was considered as  $P \leq 0.05$  in this study.

## 3. FINDINGS

The average age of the patients studied was  $30.29 \pm 7.36$ . Average age of patients in case group was  $29.58 \pm 7.44$ , and in control group it was  $31.00 \pm 7.30$ , where using significant using statistical test did not show significant difference between the two groups ( $P = 0.541$ ).

In comparing the two groups before the surgery: average testis size in patients taking the laparoscopic surgery was  $41.18 \pm 2.64 \times 22.64 \pm 1.29$  mm and in open surgery group it was  $22.06 \pm 1.85 \times 40.28 \pm 3.09$  mm. The average length ( $P = 0.1$ ) and width ( $P = 0.07$ ) of testis did not have significant difference in two groups before the surgery. The average sperm number in laparoscopic and open surgery groups was respectively  $50.36 \pm 32.49$  and  $45.08 \pm 32.73$  mill/ml ( $P = 0.43$ ) concerning the normal morphology of sperm in laparoscopy group the average was  $50.76 \pm 22.27\%$  and it was  $49.62 \pm 24.89\%$  in open surgery group ( $P = 0.81$ ). Normal motility mean in laparoscopic group was

36.30±18.06% and it was 38.08±14.63% in open surgery group (P=0.54).

Comparison of the fertility related parameters in patients who underwent laparoscopic varicoselectomy, is displayed in Table 1, the fertility parameters of open varicoselectomy patients are displayed in Table 2 and the comparison of fertility related parameters of both groups are displayed in Table 3.

6 months after surgery, the mean testis size in laparoscopy group has become 41.21±2.61 x 22.56±1.28 mm and 40.27±2.82 x 22.06±1.62 mm in open surgery group. There was not a significant statistical difference in average testis length (P=0.067) and width (P=0.85) in two groups before the surgery. The sperm number in laparoscopy and open surgery group was calculated 73.58±29.41 mill/ml and 68.27±30.82 mill/ml respectively (P=0.39).

Normal morphological percentage was 65.44±19.35% in laparoscopic group and 63.41±20.61% in open surgery group (P=0.62).

The mean percentage of normal motility of sperm in laparoscopy group was 50.36±20.77% and 48.62±18.74% in open surgery group (P=0.67).

In this study 14 cases of fertility was reported after the Varicocele treatment on patients with infertility experience during 6 months of follow-up where 8 cases were in open surgery group and 6 cases were in the laparoscopy group. These results were not statistically evaluated.

The mean duration of surgery in laparoscopy group was 29.68±7.47 minutes and 33.12±6.57 minutes in open surgery group (P=0.019). The average hospitalization days in laparoscopy group was about 1.12±0.61 days and it was 1.02±0.14 days for the open surgery group (P=0.25).

In the first week after surgery in the laparoscopic group, from among 48 patients, 4 patients stated to have slight pain in the umbilicus at the surgical site (8.33%). One of the patient complained of nausea and pain in the shoulder in the early days (2.08%) and 3 of the patients cited pain in

**Table 1. Comparison of the parameters associated with fertility in patients who underwent laparoscopic varicolectomy surgery**

	Before treatment	After treatment	P value
Testis size (length in mm)	41/18±2/46	41/20±2/61	0/89
Testis size (width in mm)	22/64±1/30	22/56±1/28	0/52
Sperm count (million per milliliter)	50/35±32/49	73/58±23/41	<0/001
Percentage of normal sperm morphology.	51/12±23/68	61/97±21/14	<0/001
Percentage of normal sperm motility	36/03±18/06	50/36±20/77	<0/001

**Table 2. Comparison of the parameters associated with fertility in patients undergoing open varicolectomy surgery**

	Before treatment	After treatment	P value
Testis size (length in mm)	40/25±31/10	40/27±2/82	0/9
Testis size (width in mm)	22/06±1/82	22/06±1/63	1
Sperm count (million per milliliter)	45/08±32/73	68/27±30/82	<0/001
Percentage of normal sperm morphology.	50/78±25/99	60/54±22/32	<0/001
Percentage of normal sperm motility	38/03±14/63	48/61±18/75	<0/001

**Table 3. Comparing the changes associated with pregnancy-related parameters in patients undergoing laparoscopic varicolectomy surgery through open surgery**

	Laparoscopic group	Open group	Probability
Mean change of the sperm number (million per milliliter)	32.32±28.73	23.18±23.25	0.991
Mean change of the percentage of normal sperm morphology	10.58±20.84	9.57±26.07	0.814
Mean change of the percentage of normal sperm motility	14.32±15.30	10.33±13.13	0.192

testis (6.25%). One of the patients had iliac artery injury during laparoscopic surgery that the artery was repaired (2.08%) and the patient was discharged after 6 days with a general health condition. In the closed surgical group, from among 48 patients, 8 cases reported pain at the surgical site (16.66%), that in 2 patients, the pain has been mild. 4 of the patients reported pain (8.33%). 2 of the patients complained of pain in Testis (4.16%). Pain at the surgical site ( $P=0.22$ ), headache ( $P=0.12$ ) and testicular pain ( $P=1$ ) were not significantly different between the two groups.

After 6 months, the symptoms had been disappeared in patients, but in 2 patients, one in the laparoscopic group and one in the open surgery group that had referred with the initial complaint of discomfort in Testis, the discomfort was still existing after 6 months of treatment. Regarding the Varicocele recurrence, no recurrence was observed in both groups after 6 months. Average total cost without considering the insurance was estimated as  $444/62 \pm 45/80$  Tomans in laparoscopic treatment, and was estimated as  $409/58 \pm 12/83$  Tomans in the open group ( $P=0.01$ ).

#### 4. DISCUSSION

Male infertility treatment is one of the fastest growing branches of urology. In recent years, vast improvements have been done in fertilization technologies in men with severe infertility and have remarkably increased our knowledge about the benefits and effects of any of these methods [8].

Average testis size, average sperm count, normal morphology of sperm and average amount of normal motility in the laparoscopic group, and in the open surgery group, indicated no significant difference before the study, which indicates proper conformity of the studied groups. Testis size in this study before and after the surgery in both groups had no significant changes and raised the issue that manipulation of the spermatic cord has not led to atrophy and changes in testis size in any of the groups.

In this study, during 6 months follow-up of the patients, 14 cases of fertility was reported in patients with an infertility background after varicocele treatment from among which 8 cases were in the open surgery group and 6 patients were in the laparoscopic group. Due to the short duration of follow-up period, these statistics are

not extensible in terms of creating fertility and this study was not evaluating it, but reflects the success of varicocele treatment in improving fertility. The study conducted by Shamsa, indicated significant differences between pregnancy rates in microsurgery method with open surgery, in favor of microsurgery, but no difference was observed in comparing the microsurgery method with laparoscopy and laparoscopic method with open surgery method [9]. In a study conducted by Shareef, from among 4 infertile patients treated with laparoscopic varicocele, there was an improvement in semen analysis in 3 cases and one fertility occurred [10].

In the group treated with laparoscopy, the number of sperm before the treatment, was  $05.53 \pm 32.49$  and after treatment was  $37.85 \pm 23.41$ , The percentage of sperm with normal morphology before treatment, was  $15.21 \pm 23.68$  and after treatment was  $16.79 \pm 21.14$  and the percentage of normal sperm motility before and after treatment, were respectively as  $63.30 \pm 18.06$  and  $05.63 \pm 2.77$ . Using statistical test indicated significant differences between the mentioned parameters before and after treatment, in other words laparoscopic varicolectomy, significantly improved parameters associated with fertility.

In analyzing the parameter associated with fertility in patients undergoing varicolectomy through open surgery, the number of sperm before the treatment was  $54.80 \pm 32.73$  and after the treatment was  $86.72 \pm 30.82$ , the percentage of normal morphology of sperm before treatment was  $05.87 \pm 25.99$  and after the treatment was  $06.45 \pm 22.32$ . The percentage of normal sperm motility before and after treatment was respectively  $83.30 \pm 14.63$  and  $84.16 \pm 18.75$ . Using statistical test indicated significant differences between the mentioned criteria before and after the treatment, in other words, open surgery has had a significant impact on improving the mentioned parameters.

In the present study; in the laparoscopic group, the average changes in sperm number (million per milliliter) was  $32.32 \pm 28.73$ , changes in the percentage of normal sperm morphology was  $01.58 \pm 20.84$ , and the average changes in percentage of normal sperm motility was  $41.23 \pm 15.30$ . The values of these parameters in the open surgery group, were respectively as  $32.81 \pm 23.25$ ,  $9.57 \pm 26.07$  and  $01.33 \pm 13.13$ , where the difference between the values of any

of the studied parameters in patients treated with laparoscopic and open surgery were not statistically significant, and it indicated that there is no significant difference in the improvement of factors associated with fertility in the studied groups, in other words, although both procedures of laparoscopic and open surgery improve the parameters associated with fertility, none of these seem to have significant preference. Similar to this study, in Ding's study, there was no significant difference between open varicocele surgery and laparoscopic surgery in terms of improving fertility parameters [11]. Generally, based on the results, some other similar studies, both methods have equal outcomes after surgery, in terms of the rate of improvement of semen parameters [12].

In the present study, the average duration of surgery in the laparoscopic group was  $92.86 \pm 7.47$  minutes and in the open surgery group it was  $33.21 \pm 6.57$  minutes, using statistical test indicated a significant difference between the two groups, which represent a significant shorter time compared to open surgery in the laparoscopic group. The mean duration of surgery, in the study by Sangrasi, in the laparoscopic group was,  $34.8 \pm 8.95$  minutes, which is substantially higher than the present study, and in the open surgery group was  $43.8 \pm 7.89$  minutes, which is in the range of the present study. The difference in the duration of surgery in the present study has been significant, which indicates that, unlike the present study, open surgery allocates significantly shorter time to itself [6].

The mean duration of hospital stay in the laparoscopic group was  $1.21 \pm 0.61$  and in the open group was obtained as  $1.20 \pm 0.14$ , where the lack of statistically significant difference between the two groups, indicates that with longer duration of hospitalization in the laparoscopic group, this time is not so remarkable.

In the present study, no cases of varicocele recurrence were observed within 6 months of the evaluation in any of the patients. In a study that analyzed 36 studies, from January 1980 to April 2008, the overall rate of recurrence in the open surgery was 14.97% and in the laparoscopic method it was 4.3% which was higher than of our study in both cases [13]. In a study conducted by Moreira, as in the present study, no varicocele recurrence was observed in the laparoscopic group, whereas, unlike the present study, in the open group, three cases of recurrences were

reported, which indicated that recurrence rate in the open groups in this study is significantly higher than the laparoscopic surgery group [7].

In the present study, in none of the groups, cases of hydrocele were reported. Unlike the present study, in a study conducted by Moreira<sup>7</sup>, Hydrocele was reported in 25% of patients in the laparoscopic group and 22% of the patients in the open group. But similar to this study, no significant difference was observed between the two groups in terms of hydrocele. In the study conducted by Cavan, hydrocele formation was 8.24% in the surgical group and 2.84% in the laparoscopic group [13].

## 5. CONCLUSION

Based on the results of the present study, open varicocele surgery and laparoscopic varicocele surgery have equal outcomes after the surgery, in terms of improvement in semen parameters and side effects after the surgery. The duration of surgery was shorter in the laparoscopic method. In general, the open surgery method can be used as an effective method where regarding the limitation in access to the equipment required for laparoscopic and experienced medical team and the costs. However, further research with larger sample size and longer follow-up period is required in future, so that the two methods are judged with greater certainty about the advantages and disadvantages of these methods.

## ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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