Comparative study between loupe-assisted and conventional subinguinal varicocelectomy

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Introduction In this prospective randomized study, the outcome and the complication rates of loupe-assisted subinguinal varicocelectomy (LASV) are compared with conventional subinguinal varicocelectomy.

Patients and methods Between December 2014 and June 2017, 66 patients aged from 20 to 38 years old were enrolled in this study in Al-Azhar University Hospital, New Damietta, and Al-Zahraa University Hospital, Cairo. The patients were randomly subdivided into two groups: group A included 33 patients who underwent LASV using surgical loupes with three times magnification, group B included 33 patients who underwent conventional open subinguinal varicocelectomy. Postoperative complications along with preoperative and postoperative (3 months) seminal parameters were compared between the two groups. Moreover, the number of identified internal spermatic arteries was also compared between the two groups.

Results The hydrocele formation was significantly lesser in group A treated by LASV [none of the patients (0%)] than group B treated by conventional subinguinal varicocelectomy (three patients; 9.09%). The recurrence rate was better in group A (one patient; 3.03%) than group B (two patients; 6.06%), but the result was nonsignificant regarding recurrence rate. Testicular hypertrophy does not occur in both groups. The average number of preserved arteries was more in group A than group B (0.95±0.51 in group A vs. 0.88±0.47 in group B).
Semen parameters including semen concentration, sperm motility, and percentage of abnormal forms were improved in both groups, but the improvement was nonsignificantly better in group A than group B, so the improvement was nonsignificantly between the two groups, but it was significant between the preoperative and postoperative results within each group.

Conclusion LASV is better than conventional open subinguinal varicocelectomy as loupe allows clear visualization of the testicular artery, lymphatics, and small venous channels, resulting in decrease in the incidence of complications, including hydrocele formation, testicular artery injury, and varicocele recurrence.

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Introduction

Varicocele is defined as an abnormal dilatation and/or tortuosity of the venous plexus that drains the testicle (pampiniform plexus of veins). Although the incidence of varicocele has been estimated to be between 15 and 20% in the general population, this value increases to 35–40% among men who present with primary infertility [1].

The pathophysiology of testicular damage in varicocele is not completely understood, and there are several hypotheses that attempt to explain the correlation between varicoceles and subfertility. The most commonly acknowledged mechanism is that of testicular hyperthermia. Impaired temperature regulation and reactive oxygen species production may lead to DNA damage and progressive apoptosis of testicular cells [1,2].

Reactive oxygen species are chemically reactive chemical species containing oxygen. Examples include peroxides, superoxide, hydroxyl radical, and singlet oxygen [3].

Varicocele is the most identifiable cause of male infertility, and varicocelectomy is the only effective method of treatment. The goals of varicocele repair are pain relief in symptomatic cases and improvement in semen parameters and testicular function in cases of male infertility associated with varicocele [4].

Regarding surgical technique, there have been different approaches used including retroperitoneal, inguinal, subinguinal, and scrotal approaches. Regarding surgical technique, conventional open surgery, loupe-assisted technique, microsurgical technique, laparoscopic surgery, radiographic embolization, and sclerotherapy have been introduced over several decades [5].

The benefits of varicocele repair must be balanced by the risk associated with the procedure itself as such it is important to select the procedure with the highest success and lowest complication rate [6].

Whatever the approach, some degree of optical magnification provided by either surgical loupes or an operating microscope is needed and will be very useful in preserving arteries and lymphatics and properly ligating veins. This will be reflected on the outcome of the operation by reducing the recurrence rate and avoiding the complications like atrophic testis, hydrocele formation, and secondary hematoma [7,8].

Injection of vital drops like methylene blue into the tunica vaginalis space may aid in identification of lymphatics to be accessibly preserved [9].

The aim of this prospective randomized study is to evaluate the advantages of loupe-assisted subinguinal varicocelectomy (LASV) over conventional open subinguinal technique in terms of highest success achieved and lowest complications occurred in treatment of infertile and/or symptomatic cases.

Patients and methods

Between December 2014 and February 2016, 66 patients aged from 20 to 38 years were enrolled in this study in Al-Azhar University Hospital, New Damietta. The patients were randomly subdivided into two groups:

Group A: it included 33 patients who underwent LASV using surgical loupes three times magnification.
Group B: it included 33 patients who underwent conventional open subinguinal varicocelectomy.

Inclusion criteria for surgical treatment were patients presenting with grade 2 or grade 3 varicocele with scrotal pain, abnormal semen analysis, or ipsilateral testicular atrophy, patients presented with infertility for at least 1 year with abnormal semen parameters and after exclusion of the wife as a cause of infertility.

Exclusion criteria include recurrent varicocele, testicular or retroperitoneal tumors, renal cell carcinoma, immunological fertility disorders as well as chromosomal aberrations or azoospermia.

All patients underwent thorough history taking, complete physical examination (both general and local), routine preoperative investigations, scrotal Doppler ultrasound, and semen analysis (two times, one time before the operation and the second time 3 months after the operation) after 3 days of sexual abstinence before providing the sperm samples.

Verbal and written consent was obtained from each patient, and randomization was done by making odd numbered patients for group A and even numbered patients for group B.

Surgical techniques

Loupe-assisted technique

After spinal or general anesthesia and preparation of the patients, a transverse subinguinal incision of 2–3 cm is done over the external inguinal ring (the location of the external inguinal ring is identified by gently invaginating the scrotal skin with an index finger parallel to the spermatic cord as it passes over the pubic tubercle). Camper's and Scarpa's fasciae are then divided with electrocautery. The incision is deepened with blunt dissection and by retracting the edge of the wound until the level of the spermatic cord is reached (external inguinal ring is not opened). The cord is most easily identified as it passes over the pubic tubercle. Once identified, the cord is encircled with the use of the index finger and the thumb or by the use of a Babcock instrument. After loosening of the spermatic cord by moving it medially and laterally, the cord could be looped and then easily externalized on a vascular tape without tension. The tissues external to the spermatic cord are examined first for any engorged veins, and if present, they are ligated accordingly. The external and internal spermatic fascias are incised. After the internal spermatic fascia of the spermatic cord is opened, the dissection is continued with the aid of surgical loupes three times magnification. To protect the vas deference and its vessels from potential injury during cord dissection, we first create a small window between the internal spermatic vessels and the external spermatic fascia and its associated structures (vas deference and its vessels, cremasteric fibers, and external spermatic vessels). A second vascular tape is then introduced between the internal spermatic vessels and the external spermatic fascia and its associated structures.

First, dissection of the contents of internal spermatic fascia is done. The artery (or arteries) is easily identified by its pulsation, and once identified, the artery is dissected free of all surrounding veins. Care is taken to identify a number of lymphatics (usually 2–5 channels). Lymphatics are characterized by their crystal clear intravascular contents. All the remaining internal spermatic veins are dissected carefully with mosquito clamps. Manipulating the mosquito clamps

under the target vessel by a gentle up-and-down movement helps to differentiate a vein from an artery or a lymphatic vessel. The veins are then ligated with 3/0 Vicryl ties (double ties) and then divided.

Second, dissection of the contents of the external spermatic fascia is done gently. The vas deference and its associated vessels are clearly identified and preserved. Any cremasteric artery is also preserved. The remaining cremasteric fibers and veins are ligated and divided.

The cord can be placed back to its normal position. The Scarpa's and Camper's fascias were simultaneously closed with interrupted sutures using 3/0 Vicryl sutures (DemeCRYL, DemeTECH, USA), and the skin is closed with 3/0 or 4/0 Proline sutures, and a dry sterile dressing is applied.

Conventional open technique

It was done by the same previously described technique but without the aid of the magnifying loupe.

Statistical analysis was performed using SPSS (Statistical Package for the Social Sciences) version 17. The Mann–Whitney *U*-test was used for comparison of medians. Student's *t*-test was used for normally distributed data, with equal variance between the two groups.

Results

The hydrocele formation was significantly lower in group A (0%) than in group B (9.09%). Moreover, the recurrence rate was lower (3.03%) in group A treated by LASV than group B (6.06%) treated by conventional subinguinal varicocelectomy.

The difference was significant in case of hydrocele formation ($P<0.05$), whereas it was nonsignificant in case of recurrence rate ($P>0.05$) (Table 1).

Semen analysis parameters, including semen concentration, sperm motility, and percentage of abnormal forms, were improved in both groups, but the improvements were nonsignificantly better in group A than group B, so the improvement was nonsignificant between the two groups, but it was significant between the preoperative and postoperative results within each group.

There were nonsignificant differences in the number of identified and preserved internal spermatic arteries between the two groups, but the average number of preserved arteries was more in group A (0.95±0.51 in group A vs. 0.88±0.47 in group B) (Table 2).

Table 1 Postoperative complications and recurrence rate

Complications	Group A (*N*=33) [*n* (%)]	Group A (*N*=33) [*n* (%)]	*P* value
Hydrocele	0	3 (9.09)	$P<0.05$ (significant)
Recurrence	1 (3.03)	2 (6.06)	$P>0.05$ (NS)
Testicular atrophy	0	0	–

Discussion

Hydrocele formation is the most commonly seen complication of varicocele repair. Etiology of postoperative varicocelectomy hydrocele is ligation of the lymphatic vessels, which are colorless and sometimes are mistaken for veins. Between the various surgical options, the subinguinal approaches seem to offer the best outcome in terms of hydrocele formation and recurrence [10].

Cayan *et al*. [11] prospectively reviewed the long-term results of varicocele repair and compared the complications rates of varicocelectomy techniques according to optical magnification. They found that the recurrence rate was 0% in cases managed by microscopic varicocelectomy, 2.9% in those where loupe magnification was used, and 8.8% in those where no magnification was used.

In the year 2012, Almaramhy and Ali performed a study on magnified and nonmagnified subinguinal varicocelectomy, and the results in nonmagnified varicocelectomies showed increased incidence of postoperative hydrocele (12.1%) and recurrence rate (10.6%) in comparison with 0% (no postoperative hydrocele) and 3% recurrence rate in magnified technique. The *P* value was significant regarding postoperative hydrocele formation ($P<0.001$) and recurrence rate ($P<0.03$). Postoperative semen analysis in both groups was equally improved [6].

Almaramhy and Ali concluded that magnified subinguinal varicocelectomy allows for clear visualization of the testicular artery, lymphatics and small venous channels, resulting in a significant decrease in the incidence of complications including hydrocele formation, testicular artery injury, and/or varicocele recurrence. Microsurgical subinguinal

Table 2 Number of identified and preserved internal spermatic arteries

	Group A	Group B	*P* value
Number of identified and preserved internal spermatic arteries	0.95±0.51	0.88±0.47	$P>0.05$

varicocelectomy is considered a safe, effective, and less morbid method for varicocelectomy, and it offers the best outcome and should be the preferred varicocelectomy technique [6].

In the year 2017, Vyas *et al*. [12] found that LASV has significantly better efficacy (improvement of semen quality) and lesser complications rates (including postoperative hydrocele formation and injury to the testicular artery) when compared with open subinguinal varicocelectomy. The hydrocele formation and recurrence rate were 10 and 13.3%, respectively, in group A treated with open subinguinal varicocelectomy and 0% for both hydrocele formation and recurrence rate in group B treated with LASV.

In our study, the results were similar to the aforementioned three studies (similar to Cayan and colleagues and Almaramhy and Ali regarding hydrocele formation and recurrence rate but similar to Vyas and colleagues regarding hydrocele formation only but not the recurrence rate**).** The complication rate was lower in group A patients, who were treated with LASV, than group B patients, who were treated with conventional open subinguinal varicocelectomy.

The hydrocele formation was significantly lower in group A (0%) than in group B (9.09%), whereas the recurrence rate was lower (3.03%) in group A than group B (6.06%). The difference was significant in case of hydrocele formation, whereas it was nonsignificant in case of recurrence rate.

Regarding the semen parameters, our study results were similar to the results of Almaramhy and Ali : semen concentration, sperm motility, and percentage of abnormal forms were improved in both groups (the improvement was nonsignificantly between the two groups, but it was significant between the preoperative and postoperative results within each group).

On the contrary, our study was somewhat different from that by Vyas *et al.* [12], in which they reported that the improvement was significant either between the preoperative and postoperative results within each group or between the results of the two groups.

The results of our study were also in agreement with the results of Kim *et al*. [13], Carbone and Merhoff [14], and Grober *et al*. [15] in that microsurgical subinguinal varicocelectomy is superior to nonmicrosurgical technique with respect to the development of postoperative complications such as hydrocele or recurrence.

The recommendations of American urologicalassociation is that varicocelectomy should be done byoptical magnification as safe, effective and less morbid method for varicocelectomy [16,17].

Liu *et al*. [18] found that microsurgical varicocelectomy could preserve more internal spermatic arteries and lymphatics and ligate more veins, which may interpret the superiority of microsurgical varicocele repair over macroscopic approach. There were significant differences in the average number of internal spermatic arteries identified (1.67 vs. 0.91).

Zhang *et al*. [19] found that loupe magnification is very useful in open varicocele repair. However, microscopic varicocelectomy can preserve more internal spermatic arteries and lymphatics and ligate more veins than the loupe-assisted procedure. There were significant differences in the average number of internal spermatic arteries identified (1.51 vs. 0.97).

The aforementioned two studies show that despite microscopic varicocelectomy being better than loupe-assisted procedure in preserving more internal spermatic arteries and lymphatics and ligating more veins, loupe-assisted procedure is better than conventional open technique without magnification.

Our study agreed with the results of the aforementioned two studies, as it showed that LASV could preserve more internal spermatic arteries than conventional subinguinal technique, but the difference in the average number of internal spermatic arteries identified was nonsignificant (0.95 vs. 0.88).

Our study also agreed with the studies of many investigators who used both clinical and histological analyses and have documented the presence of multiple arterial branches within the inguinal spermatic cord as far proximally as the internal ring [20–22]. Jarow and colleagues, examined the spermatic cords using loupe magnification for 12 men who underwent inguinal varicocelectomy and reported 1–3 (mean of 2) testicular arteries within the inguinal spermatic cord [23].

The mean of testicular arteries found in the inguinal canal in the study of Jarow and colleagues (which was two) will be at least the same (two also) if not more in case of subinginal approach which is more distal.

Abdle-Maguid and Othman [24] in a prospective randomized study including 162 patients compared microsurgical subinguinal varicocelectomy with non-magnified subinguinal varicocelectomy and concluded

that sperm count and motility improved significantly in both groups, and results were better in the microsurgical group.

Hsiao *et al*. [25] retrospectively reviewed the records of 272 men who underwent microsurgical subinguinal varicocelectomy and found that it resulted in significant increases in sperm concentration, total sperm count, and testosterone in all age groups.

Aggarwal and Thomas [26] in meta-analysis reported that the sperm concentration, motility, increased after both microsurgery and high ligation varicocelectomy.

The microsurgical low inguinal or subinguinal approach was reported in the adult infertility literature as the method with the highest success rate (99%) and lowest morbidity (no hydrocele) [27].

Watanabe *et al*. [28] found that microscopic subinguinal varicocelectomy is extremely useful in preserving arteries and lymph canals and in ligating not only internal spermatic but also external spermatic and vassal veins, resulting in a higher efficacy and fewer complications and recurrences.

The results of our study were similar to the results of the aforementioned studies regarding the efficacy of magnification on the outcome of subinguinal varicocelectomy.

Conclusion

LASV is better than conventional open subinguinal varicocelectomy as loupe allows clear visualization of the testicular artery, lymphatics, and small venous channels, resulting in decrease in the incidence of complications, including hydrocele formation, testicular artery injury, and varicocele recurrence.

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Conflicts of interest

There are no conflicts of interest.

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