

## Laparoscopic -2port Varicocelectomy with Scarless Periumbilical Mini-Incision: Initial Experience in Approach and Outcomes

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**Purpose:** As with other areas, there have been many efforts for minimally invasive surgery in varicocelectomy. We present our initial experience with laparoscopic varicocelectomy with a two-port scarless periumbilical mini-incision.

**Materials and Methods:** The study enrolled 18 patients who underwent laparoscopic varicocelectomy with a two-port scarless periumbilical mini-incision from February 2012 to April 2013. The laparoscopic varicocelectomy was performed using two 5-mm ports at periumbilical sites in skin creases. Here, the surgical procedure is introduced and the outcomes of the case series are summarized. We reviewed other laparoscopic techniques and compared them with our technique.

**Results:** The mean patient age was 34.8 years. Of the 18 patients, 15 had grade 3 varicoceles. The mean operating time was 62.5 minutes. Postoperatively, the scrotal pain level decreased immediately from a mean VAS score of 6.3 to 4.4 and then to 1.7 by 24 hours postoperatively. The mean hospital stay was 2.8 days. Complications included one hydrocele and two recurrent varicoceles. The operating time decreased as the surgeon's experience increased.

**Conclusion:** Laparoscopic varicocelectomy with a two-port scarless periumbilical mini-incision is a feasible technique that can be mastered relatively easily. Prospective and comparative studies are required to validate this new technique.

**Keywords:** Laparoscopy; Minimal invasive surgery; Scar; Umbilicus; Varicocele.

## INTRODUCTION

Surgical approaches for varicocele treatment include open, microscopic, laparoscopic varicocelectomy, and sclerotherapy techniques. Recent reports suggest that microscopic varicocelectomy has superior outcomes.<sup>(1,2)</sup> However, advanced techniques and instruments have enabled laparoscopic varicocelectomy, which has many advantages over other approaches, including a more rapid recovery than open varicocelectomy and shorter operating times. Laparoscopic varicocelectomy is easy to learn and costs less than microscopic varicocelectomy.<sup>(3-7)</sup> Consequently, laparoscopic varicocelectomy has become a reasonable approach for varicocele treatment.

Many ways to decrease the postoperative pain and visible scars in laparoscopic surgery have been proposed. These include reducing the diameter and number of trocars.<sup>(8,9)</sup> For varicocele treatment, the introduction of natural orifice transluminal endoscopic surgery and laparoendoscopic single-site surgery have helped to achieve minimal invasiveness with surgical results comparable to those of other approaches.<sup>(10,11)</sup> Although a small incision can be used in open or microscopic varicocelectomy, there is a trend to minimize the invasiveness of surgical varicocele treatment using laparo-

scopic approaches.<sup>(12,13)</sup> Link et al. reported their initial experience with two-port laparoscopic varicocelectomy in a small number of patients and obtained outcomes comparable with traditional open surgical approaches.<sup>(13)</sup> They used only two 5-mm trocars to minimize the size and number of ports and reported good convalescence and cosmetic results. However, the placement of the second 5-mm port in the abdominal wall results in a small scar. Here, we review our initial experience with laparoscopic two-port varicocelectomy with a scarless periumbilical mini-incision procedure for clinically significant varicoceles.

## MATERIALS AND METHODS

This study enrolled 18 consecutive patients who underwent laparoscopic varicocelectomy with a two-port scarless periumbilical mini-incision from February 2012 to April 2013. Patients older than 18 years of age with clinically palpable varicoceles (grade 2 or 3) were eligible to enroll in this study. Those with a secondary varicocele due to non-scrotal causes were excluded. The major indication for surgery was scrotal pain with a diagnosis of varicocele based on a physical examination and scrotal ultrasound. A concomitant hydrocelectomy and epididymal cyst excision was performed in four and

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Received February 2017 & Accepted November 2017

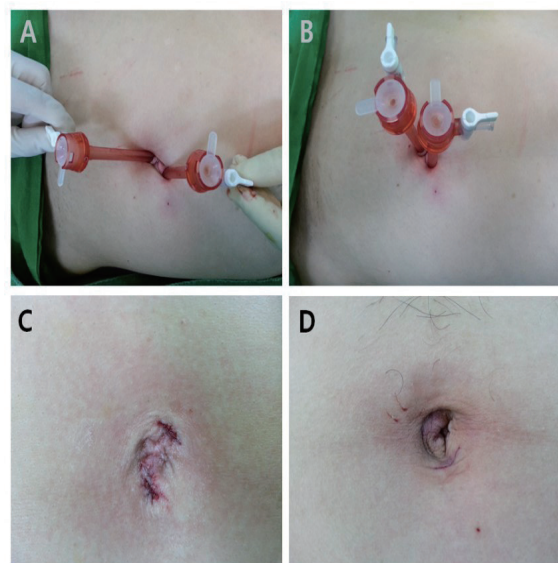
**Table 1.** Baseline characteristics of patients who underwent laparoscopic two-port varicocelectomy with scarless periumbilical mini-incision

|  |                 |
|--|-----------------|
| Age (years, mean $\pm$ SD)   | 34.8 $\pm$ 17.9 |
| Height (cm, mean $\pm$ SD)   | 174.6 $\pm$ 8.3 |
| Weight (kg, mean $\pm$ SD)   | 72.3 $\pm$ 15.2 |
| Body Mass Index (kg/m <sup>2</sup> , mean $\pm$ SD)                | 23.6 $\pm$ 4.2  |
| Varicocele grade   |                 |
| 2  | 3               |
| 3  | 15              |
| Number of ligated veins  |                 |
| $\leq$ 2   | 13              |
| $\geq$ 3   | 5               |
| Operation time (minute, mean $\pm$ SD)                             | 62.5 $\pm$ 15.6 |
| Estimated blood loss (cc, mean $\pm$ SD)                           | 20.3 $\pm$ 10.2 |
| Preoperative pain by visual analogue scale (score, mean $\pm$ SD)  | 6.3 $\pm$ 1.2   |
| Postoperative pain by visual analogue scale (score, mean $\pm$ SD) |                 |
| Immediate postoperative  | 4.4 $\pm$ 1.5   |
| 6-h after operation  | 3.1 $\pm$ 1.4   |
| 24-h after operation   | 1.7 $\pm$ 1.1   |
| Hospital stay (days, mean $\pm$ SD)                                | 2.8 $\pm$ 1.9   |
| Concomitant procedure(number of cases)                             |                 |
| Hydrocelectomy   | 4               |
| Circumcision   | 1               |
| Epididymal cyst excision   | 2               |
| Complications(number of cases)                                     |                 |
| Recurrence   | 2               |
| Hydrocele  | 1               |
| Testicular atrophy   | 0               |

two patients, respectively. One patient also underwent circumcision.

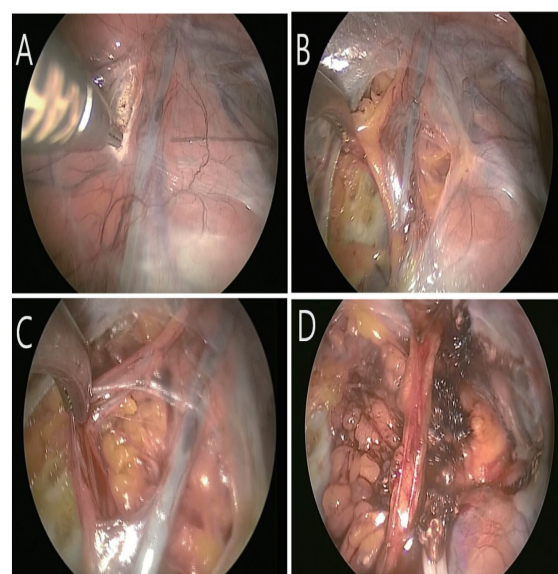
All surgeries were performed by a single surgeon (C.K.O.) who had experience with conventional two-port laparoscopic varicocelectomy. For the surgical procedure, the patient was placed in a supine position. Surgery was performed via a transperitoneal approach and two 5-mm-long incisions were made in periumbilical skin creases at between 12 and 1 o'clock for the 0-degree laparoscope and 6 and 7 o'clock for the working port (**Figure 1**). Pneumoperitoneum was established using a Veress needle and a non-threaded 5-mm trocar was inserted. The CO<sub>2</sub> pressure was maintained at 20 mmHg and was decreased to 12 to 15 mmHg after inserting the second trocar. After identifying the course of the spermatic vessel bundle, a longitudinal peritoneal incision was made along the lateral border of the spermatic vessels (**Figure 2, A**). The peritoneal incision was widened using a dissector, and then a vertical T-shaped peritoneal incision was made beginning from the spermatic vessels. The testicular artery was dissected carefully and separated from the spermatic veins in all patients (**Figure 2, B and C**). Further dissection was performed to identify additional branches of the spermatic veins around the spermatic artery. All spermatic veins were clamped using Hem-o-lok<sup>®</sup> non-absorbable polymer locking clips of medium size (5mm applied) and divided (**Figure 2, D**). The peritoneum incision site was packed with SURGICEL<sup>®</sup> and left unsutured.

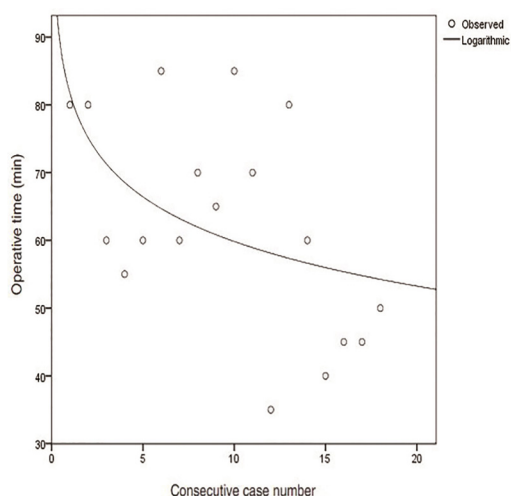
The prospectively collected data on the enrolled patients included patient age, height, weight, body mass index, bilaterality and grade of varicocele, number of ligated veins, operating time, estimated blood loss, visual analog scale (VAS) score for perioperative pain, length of hospital stay, concomitant procedures, and postoperative complications, including recurrence. When there was a concomitant operation such as hydrocelectomy, circumcision, or epididymal cyst excision, we defined the operating time as the actual surgery time for the varicocelectomy. The patients underwent postoperative evaluations at 1 week to check the wound site and at 4

**Figure 1.** Ports site of laparoscopic 2-port varicocelectomy with scarless periumbilical mini-incision.

weeks and 3 months to check the resolution of pain and postoperative complications.

To measure perioperative scrotal pain, a VAS scoring system was used that ranged from 0 (no pain) to 10 (worst pain imaginable). Variables for baseline characteristics of patients were analyzed by descriptive analysis using mean value and standard deviation. To analyze the learning curve of the operation, the distributions of variables were evaluated using the Kolmogorov-Smirnov test and logarithmic transformation was used to normalize the distribution using the real values of the operating time as reference values for the logarithmic values. A statistical analysis was performed using SPSS 20.0.0.2 (IBM Corp., Armonk, NY, USA). This study was performed in accordance with applica-

**Figure 2.** Procedures of laparoscopic 2-port varicocelectomy with scarless periumbilical mini-incision.



**Figure 3.** Operation time for laparoscopic 2-port varicocelectomy with scarless periumbilical mini-incision as surgeon experience.

ble laws and regulations, good clinical practices, and ethical principles as described in the Declaration of Helsinki. The Institutional Review Board of Haeundae Paik Hospital approved the study protocol and all patients provided informed consent before participating in this study.

## RESULTS

**Table 1** summarizes the basic characteristics of the enrolled patients. The mean age was 34.8 years. In total, 3 patients had grade 2 and 15 patients had grade 3 varicoceles. The mean operating time was 62.5 minutes and the mean estimated blood loss was 20.3 mL. Patients gave the scrotal pain a mean VAS score of 6.3 preoperatively. Postoperatively, the pain decreased to a mean VAS score of 4.4 immediately and the mean pain VAS score was 1.7 by 24 hours postoperatively. The mean hospital stay was 2.8 days.

**Table 2** summarizes the cases that underwent laparo-

scopic varicocelectomy with a two-port scarless periumbilical mini-incision. All patients experienced pain relief after surgery. One patient had a scrotal hydrocele after the operation, but it was small and did not require excision. Two patients had recurrent varicoceles postoperatively, but both recurrences were subclinical and did not cause pain or significant symptoms. Although not listed in the table, there were no such problems as omphalitis due to stress on umbilical tissue during procedure.

The Kolmogorov-Smirnov test and logarithmic transformation showed that the operating time decreased as the surgeon's experience increased (**Figure 3**).

## DISCUSSION

Varicoceles are diagnosed clinically in 8–16% of adolescents. Similar prevalence rates are reported in adults, likely because varicoceles do not resolve spontaneously.<sup>(14–16)</sup> A varicocele can cause male infertility; 21–39% of infertile men have varicoceles.<sup>(17,18)</sup> The other chief complaints of varicoceles are scrotal pain or discomfort and a palpable mass in the scrotum.<sup>(19,20)</sup> In our case series, all of the patients were adults and they presented mainly with scrotal pain and not fertility problems. The patients had grade 2 or 3 varicoceles as confirmed by a physical examination. Sperm analysis was not performed when not desired by the patient. This paper focuses on the technical aspects of the surgical procedure, degree of pain relief, and short-term complications. The results of ultrasonography or testicle size are not reported here.

With the success of modern laparoscopic surgery, there have been many technical improvements.<sup>(21)</sup> In varicocelectomy, laparoscopic surgery also has advantages over open surgery. Several comparative studies have shown that the advantages of laparoscopic varicocelectomy include a shorter operating time, less required training, and lower costs.<sup>(22,23)</sup> Some studies indicate that microscopic varicocelectomy has favorable results compared with a laparoscopic approach in terms of the low incidence of recurrence and hydrocele formation.<sup>(1,2)</sup> Some authors criticize laparoscopic varicocelectomy because of the longer operating times and no difference in long-term complications compared with open surgery.<sup>(24)</sup> Consequently, there is no standard surgical

**Table 2.** Operation results of laparoscopic two-port varicocelectomy with a scarless periumbilical mini-incision

| Case Number | Age (yr) | BMI (kg/m <sup>2</sup> ) | Varicocele Grade | Operation Time (min) | Visual Analogue Scale   |     |      |               | Resolution of pain | Complications |
|-------------|----------|--------------------------|------------------|----------------------|-------------------------|-----|------|---------------|--------------------|---------------|
|             |          |                          |                  |                      | immediate postoperative | 6-h | 24-h | Hospital Stay |                    |               |
| 1           | 46       | 28.9                     | 3                | 80                   | 3                       | 3   | 1    | 2             | Yes                | No            |
| 2           | 20       | 20.99                    | 3                | 80                   | 8                       | 6   | 3    | 3             | Yes                | No            |
| 3           | 26       | 25.15                    | 3                | 60                   | 4                       | 3   | 2    | 2             | Yes                | Recurrence    |
| 4           | 82       | 22.64                    | 2                | 55                   | 4                       | 3   | 2    | 4             | Yes                | No            |
| 5           | 23       | 16.86                    | 3                | 60                   | 4                       | 3   | 2    | 5             | Yes                | Recurrence    |
| 6           | 24       | 18.4                     | 3                | 85                   | 7                       | 3   | 4    | 9             | Yes                | No            |
| 7           | 24       | 23.23                    | 3                | 60                   | 4                       | 2   | 1    | 3             | Yes                | No            |
| 8           | 24       | 23.5                     | 3                | 70                   | 4                       | 3   | 0    | 2             | Yes                | No            |
| 9           | 22       | 21.71                    | 2                | 65                   | 4                       | 3   | 3    | 2             | Yes                | No            |
| 10          | 32       | 32.57                    | 3                | 85                   | 4                       | 2   | 2    | 2             | Yes                | No            |
| 11          | 41       | 25.89                    | 3                | 70                   | 4                       | 4   | 1    | 2             | Yes                | No            |
| 12          | 24       | 18.83                    | 3                | 35                   | 6                       | 3   | 1    | 1             | Yes                | No            |
| 13          | 57       | 31.08                    | 3                | 80                   | 4                       | 3   | 3    | 3             | Yes                | Hydrocele     |
| 14          | 21       | 19.88                    | 3                | 60                   | 3                       | 7   | 1    | 1             | Yes                | No            |
| 15          | 68       | 23.95                    | 2                | 40                   | 4                       | 1   | 1    | 2             | Yes                | No            |
| 16          | 34       | 21.22                    | 3                | 45                   | 3                       | 2   | 1    | 1             | Yes                | No            |
| 17          | 37       | 25.71                    | 3                | 45                   | 3                       | 2   | 1    | 1             | Yes                | No            |
| 18          | 22       | 24.88                    | 3                | 50                   | 7                       | 3   | 2    | 5             | Yes                | No            |



treatment for varicocele. Surgical techniques that maximize the advantages of laparoscopic varicocelectomy, especially its minimal invasiveness with comparable effectiveness, have been studied.

A conventional laparoscopic varicocelectomy uses three ports. So, some patients prefer open surgery because there are only one or two scars and the scars were nearly covered by pubic hair or faded with skin crease. In an attempt to decrease the number of port sites and improve the cosmetic outcome, a single-site laparoscopic approach was developed.<sup>(25)</sup> Several studies have reported the effectiveness, feasibility, and improved cosmetic outcome of single-incision laparoscopic varicocelectomy.<sup>(11,12,26)</sup> A recent randomized study compared single-incision transumbilical laparoscopic varicocelectomy (SIL-V) with the conventional laparoscopic technique in 80 patients. The authors reported the advantages of SIL-V in terms of postoperative pain, rapid return to normal activity, and high patient satisfaction with the cosmetic outcome.<sup>(25)</sup> Two other randomized studies reported similar outcomes in terms of cosmetic results, pain relief, and return to normal activity.<sup>(12,27)</sup>

In a systematic review and meta-analysis that compared single-site laparoscopic varicocelectomy with the conventional laparoscopic technique, Zhang et al. reported that single-site laparoscopic varicocelectomy had advantages in terms of recovery time and pain.<sup>(28)</sup> While the clinical effects and incidence of hydrocele and varicocele recurrence did not differ significantly between the two groups. Although we cannot evaluate the degree of patient satisfaction and our patients had different characteristics from previous series, the results are similar in terms of perioperative pain.

For the vein ligation method, some authors mentioned using bipolar energy device is superior to open ligation method<sup>(29)</sup>. Although the use of bipolar energies is expected to shorten the operation time, the authors thought that the number of laparoscopic instruments used was not very different and there would not be a huge cost benefit. Other studies will be needed to determine whether there is a difference in the results between ligation methods in laparoscopic varicocelectomy.

For single-site laparoscopic varicocelectomy, a transverse 2-cm skin incision is used and one 10-mm and two 5-mm cannulas are introduced through a single-incision laparoscopic surgery port or surgical glove.<sup>(25)</sup> In this background, two-port mini-incision techniques have been attempted for fewer ports. We made two 5-mm periumbilical incisions along skin creases, which achieved good cosmetic results 1 week postoperatively. Figure 1 shows a healed scarless wound. Our method is not a single-port technique, but it has promising outcomes in terms of pain and the cosmetic results (Table 1). In our series, one 57-year-old patient developed a hydrocele and the varicoceles recurred in two other patients. The scrotal pain resolved in all 18 patients. The varicocele recurrences required no additional treatment because both were subclinical varicoceles (Table 2).

The primary concern with a laparoscopic approach to varicocelectomy has been the high associated costs and expertise required.<sup>(28)</sup> The operating time is a basic indicator of the surgeon's skill level. We found that the operating times were comparable despite an initial lack of experience, ranging from 35 to 80 (mean  $62.5 \pm 15.6$ ) minutes. Analyzing the learning curve, with each subse-

quent case the operating time decreased (Figure 3). We expect that the operating time will decrease further as the surgeon's experience increases. A two-port system may help to reduce the operating time over a three-port system because there is one less port to place and close. The reduced number of trocars also decreases equipment costs. In our series, we did not find it necessary to place a third port for additional hands to obtain hemostasis, but we were prepared to do so if needed.

In summary, our technique and SIL-V have similar advantages. Compared with SIL-V, we expect better cosmetic outcomes and cost-effectiveness than SIL-V. For surgeons with experience in laparoscopic surgery, our technique should be feasible, safe, and easy to learn.

Nevertheless, our study has several limitations. First, it enrolled only adult patients who were not concerned about infertility, so the results of sperm analysis and ultrasonographic testis size were not reported. Therefore, we did not fully evaluate the effectiveness of varicocele treatment. However, we expect similar effectiveness based on the reported outcomes of laparoscopic techniques because the procedures are the same, other than the ports. Second, the degree of patient satisfaction was not evaluated. More objective evidence is needed regarding the improved cosmetic results (e.g., a questionnaire). Third, this study was not a comparative study; a comparison with other laparoscopic techniques and open varicocelectomy is required to obtain additional evidence regarding the effectiveness, safety, patient satisfaction, and cost advantages of our method. Fourth, hospital days of present study were relatively long compared to other studies. This part was difficult to compare with other studies. This may be due to differences of admission system for surgery in our institutions. Basically, it is based on 2 nights and 3 days. In addition, patients with long hospital stays were more likely to tolerate patients' personal circumstances.

## CONCLUSIONS

This study introduced another laparoscopic varicocelectomy technique to minimize invasiveness and maximize cosmetic outcomes. Two-port laparoscopic varicocelectomy with a scarless periumbilical mini-incision appears to be comparable with traditional open surgical approaches in terms of recurrence and complication rates. It may also have similar advantages to single-incision laparoscopic varicocelectomy. It is easily mastered if the surgeon has experience with laparoscopic surgery without a requirement for microsurgical skills. Nevertheless, prospective and comparative studies are required before there is popular acceptance of our laparoscopic technique. We hope it will become an acceptable alternative for varicocele treatment.

## ACKNOWLEDGMENTS

This work was supported by Grant from Inje University, 2011

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