SCIENTIFIC PAPER

# Single-Port Transumbilical Laparoscopic-Assisted Adnexal Surgery

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## ABSTRACT

**Objectives:** To evaluate the efficiency and feasibility of single-port access transumbilical laparoscopic-assisted surgery in patients with large (>8cm) adnexal tumors and to present our initial experience.

**Methods:** Twenty-two patients with presumably benign adnexal tumors who have undergone single-port access transumbilical laparoscopic-assisted surgery were enrolled. The procedure was performed using the method of exteriorization and extracorporeal surgery of adnexal tumors outside the abdominal cavity under laparoscopic guidance with preservation of as much ovarian tissue as possible. In each case, a homemade single-port device was inserted into the abdomen through a 2-cm umbilical incision. The clinical characteristics and operative outcomes of these patients were reviewed.

**Results:** Twenty of 22 cases were completed successfully. The one failed case required an additional trocar for adequate adhesiolysis, and the other case needed intraperitoneal drainage. The median operating time was 50 minutes (range, 35 to 120), and the estimated blood loss was 38mL (range, 10 to 300). Cyst rupture occurred in 2 cases, but there were no major postoperative complications.

**Conclusion:** Single-port access transumbilical laparoscopic-assisted surgery for benign and relatively large adnexal tumors is feasible and could be an alternative to convention open laparotomy or laparoscopic surgery.


**Key Words:** Single-port access laparoscopy, Ovarian tumor, Cystectomy.

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DOI: 10.4293/108680811X13071180406510



## INTRODUCTION

Laparoscopic surgery has gained general acceptance in gynecologic surgical procedures for adnexal tumors, because it offers many advantages including minimal skin incision, shorter hospital stay, less pain, more rapid postoperative recovery, and better cosmesis compared with traditional laparotomy. In recent years, to decrease the number of trocars and reduce abdominal wall injury, a 1-trocar technique has been implemented by some investigators in gastrointestinal and gynecologic surgery, using a transumbilical approach.[1–3] However, in patients with a relatively large ovarian tumor, it may be difficult to do a cystectomy using laparoscopy and to preserve normal ovarian tissues as much as possible while controlling bleeding on the inner surface. Also, particularly when the size of an ovarian tumor extends nearly to the umbilicus, laparoscopic surgery has some technical limitations: the relatively limited working space, the removal technique of the surgical specimen, and the risk of rupture.[4]

In this article, we describe the single-port access transumbilical laparoscopic-assisted adnexal surgery (SPATULAAS) as a surgical alternative to conventional laparoscopy for the management of large ovarian tumors that were clinically diagnosed as benign in nature. The aim of the present study was to report on our technique, and the results of SPATULAAS.

## MATERIALS AND METHODS

We retrospectively reviewed the medical records of the first 22 patients who underwent SPATULAAS with a "homemade" single-port device for ovarian tumors at Cheil General Hospital and Women's Healthcare Center (Seoul, Korea) between March 2009 and June 2010. Our retrospective review was approved by the institutional review board. All procedures were performed by a single laparoscopic surgeon (YSK).

The tumor was first evaluated by physical examination and ultrasonography. Images were obtained by computed tomography (CT) or magnetic resonance imaging (MRI) for further evaluation of tumor characteristics. The serum values of tumor markers including CA-125 were measured to assist the diagnosis.

Our procedure, SPATULAAS, needs the flexibility to retract the ovarian tumor to the umbilicus. The feasible criteria for SPATULAAS include easy mobility of large (>8cm in the largest diameter on preoperative imaging studies) ovarian tumors. No patients with a suspected malignancy or with severe pelvic adhesions on physical examination were candidates for this technique. Patients with obvious malignant tumor diagnosed by ultrasonography and CT/MRI were excluded from this study. So, the patients with presumably benign tumors were treated by SPATULAAS. In cases with suspicion of peritoneal implants and papillary projections or cell proliferation on the outer surface of the cyst during laparoscopy, the procedures were converted to conventional laparoscopy or laparotomy following the principles of classic oncology surgery, and these patients were also excluded.

Before the procedure, all patients were fully informed of the characteristics of SPATULAAS and the possibility of requiring conversion to an open procedure or conventional laparoscopic surgery.

### Homemade Single-Port Device

We constructed a "homemade" single-port device by use of a Levin tube and a surgical glove. An 18French catheter scale (FR) Levin tube was substituted for the wound retractor. After cutting a Levin tube to about 13cm to 15cm in length, we connected the cut piece end-to-end, producing a wound retractor. To allow for stretching of the fascial incision, this wound retractor was placed, rolled up onto the wrist portion of a surgical glove, and then inserted in the umbilical incision site **(Figure 1)**.

**Figure 1.** Homemade single-port device consisting of the wound retractor and a surgical glove.

### Surgical Technique

After standard preoperative preparations, patients were administrated general anesthesia and placed in the dorsal lithotomy position. A 2-cm vertical incision was made within the umbilicus with the open Hasson technique at the beginning of the operation to open the abdominal cavity. The single-port device was inserted transumbilically into the wound opening. After insertion of the single-port device, three 5-mm trocars and one 10-mm trocar were inserted through the cut-fingertip of the surgical glove and tied with 7-0 silk ligatures to prevent carbon dioxide ($CO_2$) leakage. The pneumoperitoneum was maintained at the level of 12mm Hg to 15mm Hg. The pelvic visualization was obtained with a 5-mm 0-degree laparoscope (Panoview; Richard Wolf GmbH, Knittlingen, Germany) inserted through the 5-mm port. Once the ovarian tumor was identified, it was grasped by conventional laparoscopic atraumatic grasping forceps, and the mobility of the adnexal mass and the extensibility of adnexal ligaments for delivery through the umbilical incision were evaluated. If the adnexal mass was readily mobile, it was pulled through the umbilical incision. In cases of mild adhesion, the adhesiolysis was performed by conventional laparoscopic instruments through the single-port channel before mobilization of ovarian mass. Through this incision, the ovarian cyst was punctured with a monopolar curved Metzenbaum scissors, and its contents were aspirated rapidly and completely under laparoscopic guidance using a suction irrigation apparatus. To avoid cyst spillage, the puncture site on the cyst was held and pushed up against the abdominal wall with forceps. Then, the deflated cyst was delivered through the umbilical incision and onto the abdominal wall, and then $CO_2$ insufflation was stopped, and the single-port device was removed from the umbilical wound. The ovarian cystectomy was performed using the standard manner outside the abdominal cavity **(Figure 2)**. In the case of fatty material of cyst contents (mature cystic teratoma), the cyst was held and pulled toward the umbilicus by using atraumatic laparoscopic forceps, the single-port device was removed simultaneously after stopping insufflations of $CO_2$, and the cyst was elevated by 2 Allis clamps to the umbilical opening. Then, 0.3-cm incision was made through the cyst wall, and the cyst contents were aspirated extraperitoneally with a laparoscopic suction irrigator to allow a portion of the cyst to be brought out through the umbilical incision. The hole was controlled with clamps, the cyst then delivered. A moist towel was placed about the wound to prevent any contents from flowing back into the peritoneal cavity. The ovary was reintegrated into the abdominal cavity, the single-port

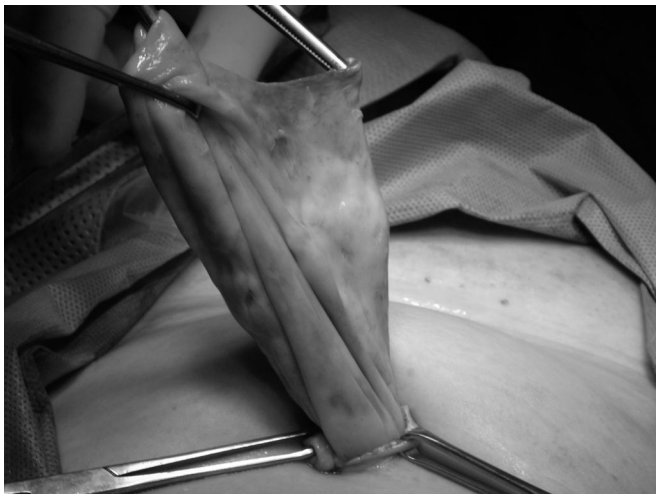

**Figure 2.** Transumbilical exteriorization of the ovarian cyst for cystectomy.

device and laparoscope were reinserted, and the pneumoperitoneum was reestablished for a final inspection, checking for possible bleeding. After extensive washing with saline solution for washing out possible spillage and blood clots, the abdominal cavity was finally inspected for hemostasis and adjacent organ injury including tearing of adnexal ligaments or tubes. The fascia was closed with 2-0 Vicryl and the skin with 4-0 Vicryl sutures. At the end of the procedure, blood loss during the operation was estimated by measuring the volume of intraoperative suction then subtracting the volume of liquid used for intraperitoneal washing.

Occurrence of immediate postoperative complications was carefully monitored. Patients were discharged when they were fully ambulatory and fever free. A simple dressing was sufficient to restore the natural appearance of the umbilicus, and no other procedures or materials were needed.

## RESULTS

SPATULAAS was successfully completed in 20 of 22 patients. The 1 of 2 failed cases required an additional trocar in the suprapubic area for adequate adhesiolysis, and the other needed the intraperitoneal drainage insertion through the right lower quadrant of the abdomen in 1 ruptured case during the procedure. Twenty-two patients with 25 cysts constituted the study population. Patient demographics are shown in **Table 1**. Four of 22 patients had prior abdominal surgery, including 1 cesarean delivery, 2 appendectomies, and in 1 patient, there was a history of more than 1 previous surgery (myomectomy and contralateral ovarian cystectomy). CA-125 values were available for 20 patients. Two patients had values >35U/mL. One had a value of 50.8U/mL, and pathologic diagnosis demonstrated mucinous cystadenoma. The other had 62.1U/mL and an endometriotic cyst. The operative outcomes are described in **Table 2**. Adhesion between a previous abdominal wall surgical scar and omentum was noted in 3 patients, and cyst wall and pelvic peritoneum in 2 patients with endometrioma. In 4 of 5 patients, laparoscopic adhesiolysis through a single-port channel was successfully performed, but in 1 patient (mucinous cystadenoma), who had prior myomectomy and contralateral ovarian cystectomy, an additional trocar insertion was required due to a severe pelvic adhesions. Adhesions requiring laparotomy were not encountered in this series.

The cysts that ruptured intraperitoneally resulting in peritoneal contamination were endometrioma (n=1) and ma-

**Table 1.**
Patient Demographics of Study Population (n=17)

| Patient Demographics | Number |
|---|---|
| Age (year; median [range]) | 29.5 (21–41) |
| Body Mass Index (kg/m$^2$; median [range]) | 22 (17–30) |
| Previous Abdominal Surgery | |
| None | 18 |
| Cesarean delivery | 1 |
| Gynecologic surgery[a] | |
| Myomectomy | 1 |
| Adnexal surgery | 1 |
| Nongynecologic surgery | |
| Appendectomy | 2 |
| CA-125 (U/mL; median [range]) (n=15)[b] | 18.3 (11.6–62.1) |
| <35 | 18 |
| >35 | 2 |
| Size (n=20) (cm; median [range]) [c] | 11.9 (8.2–20) |
| 8–12.0 | 11 |
| 12.1–16.0 | 10 |
| 16.1–20.0 | 4 |

[a]One patient had a history of more than 1 previous surgery (myomectomy and contralateral ovarian cystectomy).

[b]CA-125 values were available for 20 patients. Two patients had values >35U/mL. One had value of 50.8U/mL, and pathologic diagnosis demonstrated mucinous cystadenoma. The other had 62.1U/mL, and endometriotic cyst.

[c]Twenty-two patients with 25 cysts constituted the study population. Unilateral ovarian cysts in 19 patients and bilateral ovarian cysts in 3 patients.

**Table 2.**
Operative Results

| | |
|---|---|
| Operative Time (minutes; median [range]) | 50 (35–120) |
| Estimated Blood Loss (mL; median [range]) | 38 (10–300) |
| Hospital stay (days; median [range]) | 2 (1–4) |
| Pelvic Adhesions During Operation | 5 (29.4%) |
| Ancillary Trocar Insertion[a] | 1 (4.5%) |
| Procedures[b] | |
| Unilateral cystectomies | 19 |
| Bilateral cystectomies | 3 |
| Pathologic Features | |
| Endomterioma[c] | 2 |
| Mature cystic teratoma | 3 |
| Serous cystadenoma | 10 |
| Mucinous cystadenoma | 6 |
| Mucinous borderline tumor | 1 |
| Surgical Complication | |
| Postoperative fever | 2 |
| Transfusion | 0 |
| Subcutaneous Hematoma | 0 |

[a]In this case, the operative time was 45 min, estimated blood loss was 10mL, and hospital stay was 2 days.

[b]Unilateral ovarian cystectmy was performed in 14 patients, and bilateral cystectomy was done in 3 (endomterioma, 1 case; mature cystic teratoma, 1 case; mucinous cystadenoma, 1 case).

[c]For these 2 patients, no other postoperative complications or abdominal wall recurrences were observed during their follow-up of 11 months and 12 months, respectively.

ture cystic teratoma (n=1). All other cysts were either delivered through the incision before excision or successfully drained and delivered in a controlled fashion. In ruptured cases, after copious washing with saline solution, the abdominal cavity was inspected for residual contents of the cysts. The intraperitoneal drainage was inserted through the right lower quadrant of the abdomen in 1 ruptured case (mature cystic teratoma). We also excluded this case from the analysis.

The median postoperative hospital stay was 2 days (range, 1 to 4). The majority of the patients (n=17) were discharged on postoperative day 2, because of our hospital's routine postoperative discharge policy for all laparoscopic adnexal surgeries. Two patients were discharged on postoperative day 1, because of their personal choices after an uneventful meal and passing of gas. Extension of hospitalization (>2 days) was required in 2 patients. In 1 patient, it was her personal choice (day 3). The other was discharged on postoperative day 4, because of delayed alleviation of fever, in a case of rupture of a mature cystic teratoma.

Pathologic diagnoses of the excised tumors are also shown in **Table 2**. In a case of mucinous borderline ovarian tumor (n=1), no evidence was present of peritoneal implants and cell proliferation on the outer surface of the cyst during laparoscopy. Cytologic study of peritoneal washing was negative. Additional surgery was not performed according to the request of a patient and family, and there has not been any recurrence during a follow-up period of 12 months.

There was never any tearing of the adnexal ligaments during their mobilization or extraction. No case of conversion to open laparotomy was necessary. Bowel movements were restored within 24 hours of the operation in all patients. No wound infections or periumbilical hematomas occurred. No other postoperative complications were observed during a median follow-up of 5 months (range, 3 to 12).

## DISCUSSION

Even after laparoscopic ovarian cystectomy has become the ideal method of managing benign ovarian cysts, large ovarian cysts have always been a technical challenge for gynecologists. Some investigators reported their experiences with large ovarian tumor treatments, but they performed mostly oophorectomies.[5] If cystectomy was performed, the cyst was drained preoperatively by suprapubic catheter or under ultrasonographic guidance.[4,6] Another group[7] reported treatment of a giant ovarian cyst in an adolescent patient, and those authors chose aspiration under laparoscopic visualization, because it allows assessment of the pelvic cavity and ovarian cyst before cyst puncture, thus, limiting the risk of spillage that cannot be avoided by aspiration under ultrasonographic guidance. However, they extracted the cyst through a 2-cm suprapubic incision.

Previously reported 1-trocar approaches combine the advantages of laparoscopic surgery with those of open surgery,[1–3,8,9] but we think these procedures have some limitations. In fact, in patients with dense adhesions, it may be frequently necessary to use more than one trocar or a minilaparotomy (ie, suprapubic or McBurney) to extract the specimen and treat it outside the abdomen. Further, in adnexal tumors of adult patients, it is difficult to evaluate the surfaces of ovarian tumors and pelvic peritoneum thoroughly and manipulate the ovarian tumors just with 1

trocar and 1 instrument. Instead, we applied the transumbilical single-port channel to the extracorporeal cystectomies for ovarian tumors for making more complicated surgical interventions possible.

The definition of "large" adnexal tumors varies with reports of several authors (5cm to 20cm).[5,10,11] However, other authors define large[12] or extremely large[13] ovarian cysts as those reaching above the level of the umbilicus. Because the level of the umbilicus might vary among women, using a definite measurement is more reproducible and reflective of the actual size of the ovarian cyst.[11] We defined "large" adnexal tumors as those with the diameter >8cm on preoperative imaging studies. This definition is similar to that adopted by some authors.[14,15]

The results of our study could support the technical feasibility of using this procedure, because all procedures were completed successfully without major complications, except 2 cases that required an ancillary port for adhesiolysis of a severe pelvic adhesion and intraperitoneal drainage. Furthermore, the specimen can be effectively removed through the larger umbilical wound incision in SPATULAAS than in the 0.5-cm or 1.2-cm ports of conventional laparoscopy. The operative times and complication rates were well within the acceptable range. There was no case of conversion to laparotomy.

By applying the single-port channel to the procedure, laparoscopic intervention for ovarian tumor handling was made easier and safer, because laparoscopic adhesiolysis is possible in cases of adhesion, and continuous laparoscopic observation can detect the accidental spillage of cyst contents. Furthermore, the degree of size reduction of the cyst, while aspiration of the contents is assessed by laparoscopic observation, enables the surgeon to judge the timing of extracorporeal extraction of the deflated cyst.

Although 1 case of mucinous borderline tumor with no apparent peritoneal implants under laparoscopic observation was noted in the present study, there has not been any recurrence of this tumor to date without additional treatment. But the role of SPATULAAS in treating adnexal tumors with malignant potential is not clearly interpreted yet. Further investigations should be evaluated.

There were still some disadvantages in performing SPATULAAS in this study. With the parallel placement of instruments through a single-port channel and with all instruments closely packed together, the operator's movement was restricted by external crowding and clashing of the instruments and both hands. This limitation interferes with not only allowing for a good operative visual field but also hampers procedure accuracy, which could result in a longer operative time and unnecessary rupture of the cyst, especially when adhesiolysis of a severe pelvic adhesion is performed. Therefore, careful case selection is paramount so that this procedure can be explored safely and effectively. In addition, although we did not experience injuries to adnexal ligaments or tubes, this remains a risk of this approach, and we understand this is an important issue when performing this procedure. So, additional study of SPATULAAS with mobilization of adnexal tumors to analyze this risk should be warranted.

Two patients with endometriosis were enrolled in our study. Although the holes were controlled with clamps, the cysts then delivered, and moist towels placed about the wound to prevent any contents from flowing back into the peritoneal cavity, we understand the abdominal wall should be protected whenever possible to avoid complications, such as abdominal wall endometriomas. Even though no other postoperative complications or abdominal wall recurrences were observed during the follow-up period (11 and 12 months, respectively), our follow-up was too short to allow a conclusion. So, the role of SPATULLAS in treating adnexal tumors, such as endometriosis, should be evaluated thoroughly.

We think the SPATULAAS technique may offer several advantages, such as simplicity, avoidance of potential complications of multiple punctures, improved cosmetic results, and the flexibility to convert to conventional multiport laparoscopy or laparotomy if necessary. In addition, we think performing a cystectomy with preserving normal ovarian tissues is an important issue to a young patient with a large ovarian tumor, who wants to preserve her fertility. However, we hope that a laparoscopic surgeon should not hesitate to introduce ancillary trocars or change to laparotomy if necessary.

We understand that the study population was small and limited in size, the study was retrospective in nature, and there was an absence of a control population. Also, this study did not provide significant comparisons between similar laparoscopic cases performed by conventional multi-port laparoscopic surgery. Additional study of single-port access transumbilical surgery to analyze this procedure is warranted.

## CONCLUSION

We report our initial experiences with single-port access transumbilical laparoscopic-assisted surgery using a

homemade single-port device for ovarian tumors in 22 patients. In select cases, we hope that this technique could be considered an alternative to conventional laparoscopy or laparotomy for management of women with large, benign ovarian tumors, who wish to obtain laparoscopic advantages, especially cosmesis.

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