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Single-port vs. conventional multi-port access laparoscopy-assisted vaginal hysterectomy: comparison of surgical outcomes and complications

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ABSTRACT

Objective: To compare surgical outcomes and complications between single-port access (SPA) and multi-port access (MPA) laparoscopy-assisted vaginal hysterectomy (LAVH).
Study design: A retrospective review of medical records was performed in patients who underwent LAVH for non-malignant gynaecological diseases at Eun Hospital between April 2010 and April 2012. One hundred and twenty women underwent SPA LAVH using a transumbilical three-channel single-port system and 130 women underwent conventional MPA LAVH. Surgical outcomes and complications were compared between the two groups.
Results: The outcomes of the SPA-LAVH group vs. the conventional MPA-LAVH group were as follows: mean ± standard deviation total operative time (73.1 ± 24.3 vs. 70.3 ± 22.1 min, $p = 0.349$), largest dimension of uterus (10.7 ± 2.3 vs. 10.8 ± 2.8 cm, $p = 0.847$), weight of extirpated uterus (311 ± 185 vs. 339 ± 234 g, $p = 0.298$) and change in haemoglobin (1.7 ± 0.8 vs. 2.0 ± 0.9 g/dl, $p = 0.025$). The incidence of complications was similar in each group (20 vs. 16 patients, $p = 0.327$). Unplanned intra-operative laparotomy was not necessary in either group, and there were no cases of bowel injury or main vessel injury in either group. In total, there were three bladder injuries: one in the SPA-LAVH group and two in the MPA-LAVH group. The postoperative course was uneventful in most patients, but six patients had a transient paralytic ileus (four in the SPA-LAVH group and two in the MPA-LAVH group) and 10 patients had a pelvic haematoma (five in each group), all of whom recovered following conservative management. Port-related complications were rare, but one patient in the SPA-LAVH group had a port-site umbilical hernia.
Conclusion: Use of SPA and MPA LAVH has similar results in terms of surgical outcomes and complications.

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1. Introduction

One of the great innovations in surgery was the shift from laparotomy to operative laparoscopy, and efforts and advances in minimally invasive surgery are ongoing. To optimize the benefits of minimally invasive surgery, surgeons have attempted to reduce abdominal wall incisions by decreasing the size and number of ports.

Single-port operative laparoscopy may appear to be a novel technique, but a single-incision approach to gynaecological procedures is not a new idea. Historically, laparoscopy originated as a single-access technique, first for diagnostic procedures and subsequently for minor operations. Wheeless and Thompson first described the technique in 1969 in a study on laparoscopic tubal ligation with single-trocar laparoscopy [1–3], and in 1991, Pelosi and Pelosi reported total abdominal hysterectomy with bilateral salpingo-oophorectomy (BSO) using a single incision [4].

Transumbilical single-port surgery enhances cosmetic benefits because the surgical incision is hidden in the umbilicus, and postoperative pain is reduced [5–8]. Despite the benefits, however, the use of single-incision operative laparoscopy did not spread rapidly due to technical difficulties. Nowadays, surgical skills and instruments have been greatly advanced, and many surgeons are now able to perform single-port laparoscopy [9–12].

This study compared surgical outcomes and complications between single-port access laparoscopy-assisted vaginal hysterectomy (SPA LAVH) and conventional multi-port LAVH (MPA LAVH).

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2. Materials and methods

2.1. Statistical analysis

The medical records of patients who underwent LAVH for benign gynaecological diseases at Eun Hospital between April 2010 and April 2012 were reviewed retrospectively. The study was limited to patients with benign gynaecological diseases, because the essential outcomes of malignant diseases should be determined using specific parameters such as recurrence and survival rate. Therefore, malignant diseases were excluded, and 250 women were enrolled in this study.

During the study period, 120 women underwent SPA LAVH using a transumbilical three-channel single-port system and 130 women underwent conventional MPA LAVH. The procedures were performed by six surgeons. Surgical techniques were chosen based on the surgeon's skill, preference and clinical situation.

Surgical outcomes and complications were compared between the two groups. Past abdominopelvic surgery, body mass index (BMI) and uterine size were not considered as exclusion criteria.

Data on age, parity, BMI, abdominopelvic surgical history, indication for surgery (from the pathology report), total operative time (from incision to final umbilical closure), largest dimension of the uterus (from pre-operative ultrasonography measurements), weight of the extirpated uterus (from the pathology report), change in haemoglobin (from before surgery to first postoperative day), and peri-operative and postoperative complications were gathered.

Differences in the proportions of categorical variables were evaluated using the Chi-squared test or Fisher's exact test when the expected cell values were <5. Student's t-test was used to analyse the differences in the mean values of continuous variables between the groups.

2.2. Operative procedures

Operative techniques were similar in both groups, except for port number, trocar placement points and induction of pneumoperitoneum. A uterine manipulator was applied vaginally in both groups. All surgical procedures were similar to the standard LAVH (with or without BSO) technique using conventional non-articulated rigid laparoscopic instruments and the LigaSure™ system (Valleylab, Boulder, CO, USA). In this series, ligation of uterine vessels, cardinal and uterosacral ligaments, extirpation of uterus and vaginal stump closure were performed through the vagina.

2.2.1. SPA LAVH

A three-channel single-port system was made using the Alexis® wound retractor (Applied Medical, Rancho Santa Margarita, CA, USA), a surgical glove, two 10-mm trocars and one 5-mm trocar.

After partial eversion of the umbilicus, a curved C-shaped skin incision was performed at the lateral surface of the umbilical crater. Subsequently, a rectus fasciotomy and peritoneal incision were performed by direct cut-down technique. The fascial edges were tagged with suture for traction prior to installation of the port system; this was useful for fascial closure at the end of the procedure.

The distal ring of the Alexis wound retractor was loaded within the intraperitoneal space, and tightly turned inside out of the proximal ring. Once fixed in the opening site, the connecting sleeve of the Alexis wound retractor was used to retract the sides of the opening laterally. This made the small incision wider and rounder, and formed an air-tight seal. Subsequently, a sterile surgical glove was fixed over the proximal ring, and three trocars were inserted through the surgical glove with cut edges of the distal fingertips and tied with elastic string.

After installation of the three-channel single-port system, carbon dioxide pneumoperitoneum was achieved directly through the single-port system.

2.2.2. MPA LAVH

After partial eversion of the umbilicus, a curved transverse skin incision was made at the inferior surface of the umbilical crater near the base. Carbon dioxide pneumoperitoneum was achieved through a Verres needle, a 10-mm trocar was placed through the umbilicus and the camera was inserted. Further, two 5-mm trocars were placed in the left iliac and lumbar regions. Accessory right and suprapubic trocars were not necessary.

3. Results

Table 1 shows the demographic characteristics of the patients, including history of abdominopelvic surgery and pathological

Table 1
Demographic characteristics of both group (SPA-LAVH vs. MPA-LAVH, $N = 250$).

	SPA-LAVH ($n = 120$) mean ± SD (range)	MPA-LAVH ($n = 130$) mean ± SD (range)	P-value*
Age (years)	48.9 ± 5.7 (36–75)	48.6 ± 6.5 (34–70)	0.760
Body mass index (Kg/m^2)	24.6 ± 2.9 (19.1–34.5)	23.5 ± 2.5 (18.7–32.9)	0.001
Parity	2.3 ± 0.9 (0–5)	2.4 ± 1.0 (0–6)	0.599
Previous abdomino-pelvic surgery	34	29	0.273
Caesarean section	6	8	
Repeat Caesarean sections	6	8	
Three times Caesarean sections	5	4	
Myomectomy	0	2	
Tubal ligation	9	1	
Appendectomy	4	1	
Adnexal surgery	3	4	
Others	1	1	
Indication of hysterectomy			0.729
Leiomyoma	31	40	
Adenomyosis	24	29	
Adenomyosis coexisting leiomyoma	50	43	
Preinvasive lesion of uterine cervix coexisting adenomyosis or leiomyoma	7	9	
Adnexal disease	5	3	
Endometrial hyperplasia	2	4	
Others	1	2	

* Chi-square or Fisher's exact test.

Table 2
Surgical outcomes and complications of both group (SPA-LAVH vs. MPA-LAVH, $N = 250$).

	SPA-LAVH ($N = 120$) mean ± SD (range)	MPA-LAVH ($N = 130$) mean ± SD (range)	P-value [**]
Total operative time (min)	73.1 ± 24.3 (35–180)	70.3 ± 22.1 (35–150)	0.349
Largest dimension of uterus (cm)	10.7 ± 2.3 (6–15)	10.8 ± 2.8 (5–16)	0.847
Weight of extirpated uterus (gram)	311 ± 185 (90–1007)	339 ± 234 (33–1380)	0.298
Haemoglobin drop (g/dL)	1.7 ± 0.8 (0.2–4.4)	2.0 ± 0.9 (0.3–5)	0.025
Intraoperative complications	10	9	0.674
Conversion to laparotomy	0	0	
Ancillary puncture	0	0	
Great vessel injury	0	0	
Bowel injury	0	0	
Bladder injury	1	2	
Ureter injury	0	0	
Blood transfusion	9	7	
Postoperative complications	10	7	0.355
Haemorrhage	5	5	
Paralytic ileus	4	2	
Sepsis	0	0	
Thromboembolic events	0	0	
Return to operating room	0	0	
Port-related umbilical hernia	1	0	

[**] Student's t-test.

diagnosis of the uterus after hysterectomy. The demographic data of the SPA-LAVH group vs. the conventional MPA-LAVH group were as follows: mean ± standard deviation (SD) age (48.9 ± 5.7 vs. 48.6 ± 6.5 years, $p = 0.760$), BMI (24.6 ± 2.9 vs. 23.5 ± 2.5 kg/m^2, $p = 0.001$) and parity (2.3 ± 0.9 vs. 2.4 ± 1.0, $p = 0.599$). Furthermore, 34 vs. 29 patients ($p = 0.273$) had a history of abdominopelvic surgery. There were no significant differences between the groups with regard to patient demographics.

As shown in Table 2, the outcomes of the SPA-LAVH group vs. the conventional MPA-LAVH group were as follows: mean ± SD total operative time (73.1 ± 24.3 vs. 70.3 ± 22.1 min, $p = 0.349$), largest dimension of uterus (from pre-operative ultrasound measurement, 10.7 ± 2.3 vs. 10.8 ± 2.8 cm, $p = 0.847$), weight of extirpated uterus (from pathology report, 311 ± 185 vs. 339 ± 234 g, $p = 0.298$) and change in haemoglobin (from before surgery to first postoperative day, 1.7 ± 0.8 vs. 2.0 ± 0.9 g/dl, $p = 0.025$).

The operative data did not differ significantly between the two groups, but the total operative time was greater in the SPA-LAVH group; this may reflect the time needed for installation of the single-port system. As shown in Table 2, the incidence of complications in both groups was similar (20 vs. 16 patients, $p = 0.327$).

Unplanned intra-operative laparotomy was not necessary in either of the groups, and extra-umbilical puncture or conversion to conventional MPA LAVH was not required in the SPA-LAVH group.

There were no cases of bowel injury or main vessel injury in either group. Three bladder injuries (one patient from the SPA-LAVH group and two patients from the MPA-LAVH group) occurred during surgery. These were treated with intra-operative laparoscopic sutures, and Foley catheters were maintained for 1–2 weeks. All three patients recovered fully.

In the MPA-LAVH group, one patient experienced injury of the ureter. This was treated intra-operatively by laparoscopy, and a double-J catheter was maintained for 3 weeks. Furthermore, a transfusion of 2–3 units of packed red cells was needed in nine vs. seven patients (SPA-LAVH vs. MPA-LAVH group) due to chronic anaemia and intra-operative haemorrhage.

The postoperative course was uneventful in most patients, but six patients (four in the SPA-LAVH group vs. two in the MPA-LAVH group) had a transient paralytic ileus and 10 patients (five in each group) had a pelvic haematoma; all these patients recovered with conservative management. Port-related complications were rare, but one patient had a port-site umbilical hernia one week postoperatively and some port-site haematoma; however, external drainage was not needed in patients in the SPA-LAVH group.

4. Comments

LAVH seems to be well suited for single-port surgery, because the vagina can be considered as an additional route and uterine manipulators can be applied through the vagina. Unlike uterine repair following myomectomy, reconstruction via laparoscopy can be skipped in LAVH, because the vaginal stump can be repaired through the vagina. As such, skilful surgeons can learn SPA LAVH over a short period of time because a considerable proportion of the procedure can be performed through the vagina [13–18].

The homemade single-port system used in this study has several functions and advantages. It can be easily converted to an MPA procedure if necessary. Also, the wound retractor prevents subcutaneous emphysema, and conventional rigid instruments can be used, which is cost-effective [19,20].

In this series, one patient had port-site umbilical herniation one week postoperatively. This patient had a thin abdominal wall (BMI 19.9 kg/m^2). In previous reports, trocar-site herniation and infection were considered to be related to fascia >10 mm in size and incomplete closure [20]. Therefore, it is important to repair the rectus fascia completely in order to prevent port-site herniation. In this series, rectus fascial edges were tagged with suture for traction prior to port-system installation; this was useful for complete fascial closure at the end of the procedure.

A major principle of laparoscopic surgery is the concept of triangulation. Triangulation enables facilitation of instrumental angular motion and leverage effect, thus assisting in dissection and reconstruction [8,15]. However, angular motion and leverage effect are considerably limited in single-port surgery due to its nature. These act as hurdles for single-port surgery, especially for operative procedures such as reconstructive surgery. Surgeons need to better optimize the to-and-fro motion instead of angular motion in single-port surgery.

Although SPA LAVH has hurdles to overcome, and more time and effort are required for surgeons to acquire the skills, this procedure has advantages over MPA LAVH.

Conflict of interest statement

None declared.

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