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# Total laparoscopic hysterectomy via suture and ligation technique

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**Objective**
The term 'total laparoscopic hysterectomy (TLH) with classical suture method' refers to a surgical procedure performed using only sutures and ligations with intracorporeal or extracorporeal ties, without using any laser or electronic cauterization devices during laparoscopic surgery as in total abdominal hysterectomy. However, the method is not as widely used as electric coagulation equipment for TLH because further advances in technology and surgical technique are required and operative time can take longer. In the current study, we evaluated the benefits of the classical suture method for TLH.

**Methods**
This study retrospectively reviewed patients who received TLH using the classical suture method from August 2005 to April 2014. The patients' baseline characteristics were analyzed, including age, parity, cause of operation, medical and surgical history. Surgical outcomes analyzed included the weight of the uterus, operative time, complications, changes in hemoglobin level, blood transfusion requirements, and postoperative hospital stay.

**Results**
Of 746 patients who underwent TLH with the classical suture method, mean operation time was 96.9 minutes. Mean average decline in hemoglobin was 1.6 g/dL and transfusion rate was 6.2%. Urinary tract injuries were reported in 8 patients. Urinary tract injuries comprised 6 cases of bladder injury and 3 cases of ureter injury. There were no cases of vaginal stump infection, hematoma, bowel injury or abdominal wound complication. All cases involving complications occurred before 2010.

**Conclusion**
The classical suture method for TLH presents tolerable levels of complications and blood loss. Advanced surgical skill is expected to decrease operation time and complications.

**Keywords:** Classical suture; Hysterectomy; Laparoscopy

## Introduction

Hysterectomy is one major surgery in the field of gynecology with various indications. Advances in surgical technique and materials have allowed hysterectomy to be less invasive and have reduced the number of complications. Currently, total laparoscopic hysterectomy (TLH) is widely performed in gynecologic surgery following its introduction by Reich et al. in 1989 [1]. Compared with abdominal hysterectomy, laparoscopic hysterectomy has many benefits including cosmetic effect, low infection rate, low pain, short postoperative hospital stay and a low postoperative adhesion rate [1-5].

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Hysterectomy using laparoscope was classified into 9 different methods in 1992 by the American Association of Gynecologic Laparoscopists [2,3]. Laparoscopic-assisted vaginal hysterectomy was a popular method in the early years of hysterectomy using laparoscopes. TLH was performed more frequently with advances in laparoscope equipment and the introduction of the uterine manipulator with colpotomizer and pneumooccluder balloon (RUMI). In addition, laparoscopic radical hysterectomy and lymphadenectomy are frequently performed for gynecologic malignancy. Recently, single port assisted and robotic assisted TLH have also been performed for the advantages of cosmetics and improved surgeon dexterity and surgical precision, respectively.

The laparoscope is widely used in gynecology. Conventional bipolar electrocautery is commonly used because of its convenience, time savings and decreased blood loss, but thermal injury can occur in the surrounding tissue. The term 'TLH with classical suture method' refers to a surgical procedure performed using only sutures and ligations with intracorporeal or extracorporeal ties, without using any laser or electronic cauterization devices during laparoscopic surgery as in total abdominal hysterectomy. However, the classical suture method for TLH is not as widely used as electric coagulation equipment because further advances in technology and surgical technique are required and operative time can take longer. In the current study, we evaluated the benefits of the classical suture method for TLH.

## Materials and methods

This study retrospectively reviewed TLH by the classical suture method performed at the Gangdong Sacred Heart Hospital, Hallym University, Seoul, Korea. Between August 2005 and April 2014, 746 patients who underwent TLH by the classical suture method were analyzed. All patients were operated upon by the same surgeon. Inclusion criteria included all benign uterine diseases and early stage malignancy.

The patients' baseline characteristics were analyzed, including age, parity, cause of operation, medical and surgical history. Weight of the uterus, operative time, complications, changes in hemoglobin level, blood transfusion requirements and postoperative hospital stay were recorded and analyzed. The decline in hemoglobin level was determined by the difference between the preoperative and postoperative day 1 hemoglobin levels. Blood transfusions were performed in cases of symptomatic patients and in asymptomatic patients with hemoglobin level less than 7 g/dL. Patient follow-up visits occurred 4 weeks after surgery.

Operations were performed on patients under general anesthesia. All patients were positioned in the lithotomy position and draped in a sterile fashion. The RUMI was inserted for visibility during surgery, as well as protection of the bladder and ureter. The first 10-mm port was placed through the umbilicus, and a second 5-mm port was placed in the left lower quadrant site. Two 5-mm ports were placed in the suprapubic and right lower quadrant sites. Depending on whether the ovary was removed, round ligament and ovarian ligament or

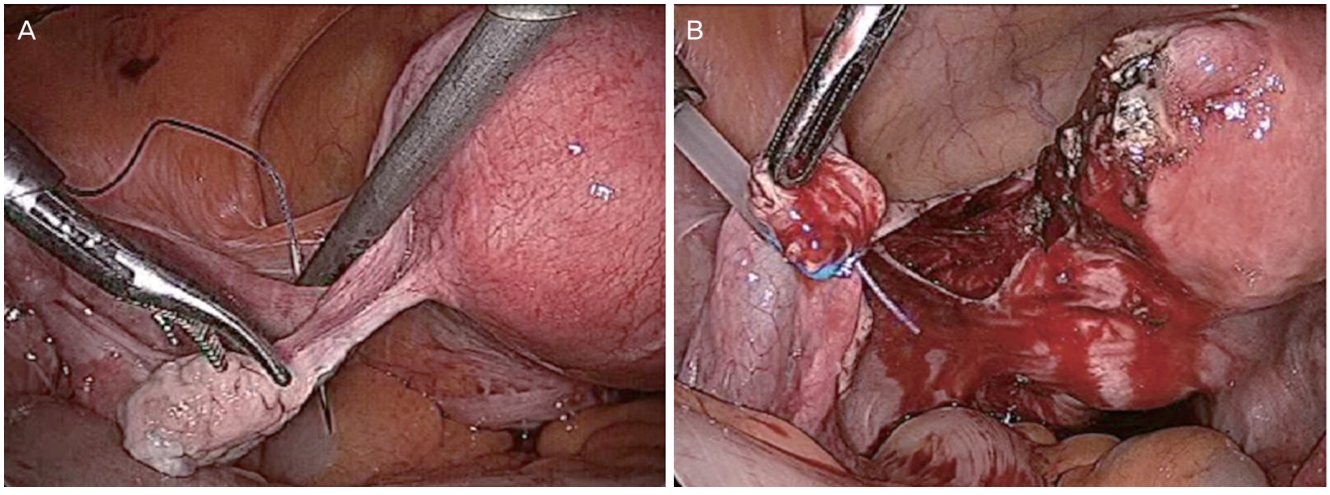


**Fig. 1.** Round ligament and ovarian ligament were sutured by the laparoscopic extracorporal technique (A). The proximal site was cut, and the distal site was reinforced by loop (B).

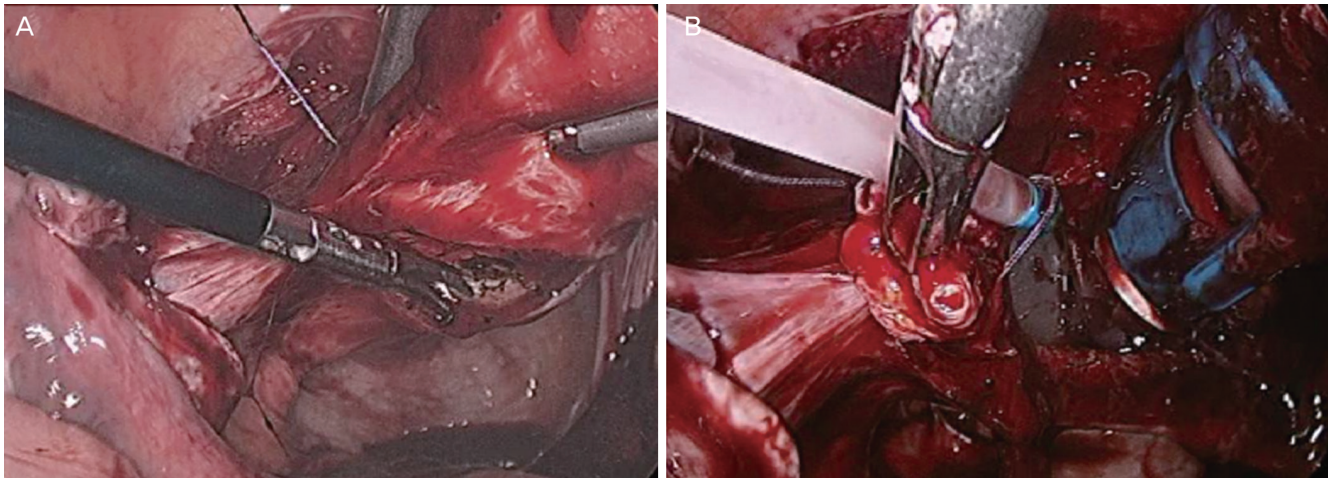


**Fig. 2.** The uterine vessel and cardinal ligament were sutured by the laparoscopic extracorporal technique (A). The proximal site was cut, and the distal site was reinforced by loop (B).

infundibulopelvic ligament were sutured by the laparoscopic extracorporal technique using delayed absorbable polyglactin 1-0 suture (Laploop, Sejong Medical, Paju, Korea) (Fig. 1A). The proximal site was cut by laparoscopic endoscissor, and the distal site was reinforced by delayed absorbable polyglactin 1-0 round loop (Fig. 1B). The front and back of the broad ligament were carefully peeled off using endoscissors. After the uterovesical peritoneum had been cut by the endoscissors, the bladder was separated from the uterus. After moving the uterus using the RUMI, the circumferential culdotomy was performed along the protrusion sites using a monopolar cutter. The uterine vessel and cardinal ligament on both sides were sutured by the laparoscopic extracorporal technique using delayed absorbable polyglactin 1-0 suture (Fig. 2A). The proximal site was cut by laparoscopic endoscissors, and the distal site was reinforced by delayed absorbable polyglactin 1-0 round loop (Fig. 2B). A tenaculum was placed through the vagina and the uterus was grasped, pulled into the vagina, and removed. The exposed vaginal stump was closed four times using a figure-of-eight suture by the laparoscopic intracorporal technique using four delayed absorbable polyglactin 1-0 sutures. At this time, each uterosacral ligament and vaginal edge pair were sutured together from both sides to avoid uterine prolapse. To complete the reconstruction of the pelvis, the peritoneum of pelvic floor and bladder side were sutured by the laparoscopic extracorporal technique using delayed absorbable polyglactin 1-0 suture. To confirm urinary tract injury, we identified the peristalsis of both ureters. In addition, if a patient was suspected of having a urinary tract injury, indigocarmin dye 5 mL and furosemide 10 mg (Lasix 20 mg/2 mL) were injected intravenously to determine whether there was spillage into the abdominal cavity. Intravenous pyelography was checked at 1 day post-hospital. After irrigation and hemostasis, the peritoneum was closed.

**Table 1.** Patients' characteristics (n=746)

| Patients' characteristics | Value |
|---|---|
| Age (yr) | 46.3 (37–62) |
| Parity | 1.9 (0–5) |
| Past operation history | 284 (38) |
| Cesarean section | 132 (18) |
| Appendectomy | 54 (7) |
| Salpingectomy | 52 (7) |
| Oophorectomy | 45 (6) |
| Myomectomy | 43 (6) |
| Others | 24 (3) |

Data are given as median (range) or number (%).

## Results

Table 1 shows the characteristics of the patients who underwent TLH by the classical suture method. Of 746 total patients, the mean age was 46.3 years with range of 37 to 62 years, and median parity was 1.9 times with range of 0 to 5 times. Of the patients, 284 had undergone prior abdominal surgery and the most common operation was cesarean section followed by appendectomy, salpingectomy, oophorec-

**Table 2.** Indications for hysterectomy (n=746)

| Indication | Value |
|---|---|
| Adenomyosis | 564 (75.6) |
| Myoma | 484 (64.9) |
| Carcinoma *in situ* | 61 (8.2) |
| Tubo-ovarian abscess | 51 (6.8) |
| Early stage endometrial cancer | 25 (3.4) |
| Early stage ovarian cancer | 9 (1.2) |
| Microinvasive cervical cancer | 7 (0.9) |

Data are given as number (%).

**Table 3.** Surgical outcomes (n=746)

| Surgical outcome | Value |
|---|---|
| Uterus weight (g) | 325 (80–520) |
| Operation time (min) | 96.9 (55–170) |
| Hemoglobin changes (g/dL) | 1.6 (0.3–3.7) |
| No. of patients received transfusion | 46 (6.2) |
| Post-op hospital stay (day) | 4.1 (3–9) |
| Total complications | 11 (1.5) |
| Bladder injury | 6 (0.8) |
| Ureter injury | 3 (0.4) |
| Vaginal injury | 1 (0.1) |
| Pulmonary embolism | 1 (0.1) |
| Neuropathy | 1 (0.1) |

Data are given as median (range) or number (%).

tomy, and myomectomy.

As shown in Table 2, the most common indications for TLH were adenomyosis (n=564) and uterine leiomyoma (n=484). The other indications included carcinoma *in situ* of the cervix (n=61), tubo-ovarian abscess (n=51), and early stage gynecologic cancer (n=41).

Table 3 shows the surgical outcome of the patients who underwent TLH with the classical suture method. The mean weight of the uterus was 325 g with range of 80 to 520 g. Mean operation time was 96.9 minutes with a range of 55 to 170 minutes. Mean average decline in hemoglobin was 1.6 g/dL (range, 0.3 to 3.7) and transfusion rate was 6.2% (n=46). The inserted hemovac was removed at 2 days after surgery, and the mean hospital stay was 4.1 days.

Total complication included 11 of 746 cases (1.5%). Urinary tract injuries were reported in 8 patients (1.1%). Urinary tract injuries included 6 cases of bladder injury (0.8%) and 3 cases of ureter injury (0.4%). Of these, one patient had both bladder and ureter damage. Only one patient was readmitted for pulmonary thromboembolism management. There were no cases of vaginal stump infection, hematoma, bowel injury or abdominal wound complication.

**Table 4.** Postoperative complications

| Postoperative complication | Before 2010[a] (n=359) | After 2010[b] (n=387) |
|---|---|---|
| Total complications | 11 (3.1) | 0 |
| Bladder injury | 6 (1.7) | 0 |
| Ureter injury | 3 (0.8) | 0 |
| Vaginal injury | 1 (0.3) | 0 |
| Pulmonary embolism | 1 (0.3) | 0 |
| Neuropathy | 1 (0.3) | 0 |

Data are given as number (%).
[a]From August 2005 to December 2009; [b]From January 2010 to April 2014.

Table 4 shows the incidence of complications by comparing instances before and after the year 2010. All cases involving complications occurred before 2010.

## Discussion

In the current study, ligations of round, ovarian, infundibulopelvic ligament and uterine arteries were performed with the classical suture method and this method for TLH was found to produce tolerable complications. A recent review article reported the rate of urinary tract injury for TLH was 0.56% to 1.24%. The rate of bladder injury for TLH was 0.38% to 1.04% and the rate of ureter injury for TLH was 0.15% to 0.53% [6]. In our study, urinary tract injuries included 8 of 746 cases (1.1%) and comprised 6 bladder injuries (0.8%) and 3 ureter injuries (0.4%). There were no cases of vaginal stump infection, hematoma, bowel injury or abdominal wound complication. Furthermore, all complication that we reported occurred before 2010; no complications have occurred since 2010.

A history of cesarean delivery, prior abdominal surgery and/or laparotomy, endometriosis, adhesions, broad ligament fibroids, and low-volume surgeons are among the most commonly cited risk factors for urinary tract injuries [7]. In our cases that had urinary tract injury, there was tubo-ovarian abscess, severe endometriosis, or previous multiple cesarean

delivery history.

Delayed thermal injury may be induced using electric coagulation equipment, ant this is a contributing factor to reoperation rates that may be responsible, in part, for fistula formation [7]. The classical suture method for TLH does not induce thermal injury because electronic equipment is not used. In several comparative studies between bipolar and ultrasonic devices, large vessel size is associated with increased thermal injury. Thermal damage of bipolar coagulation spreads up to 3.2 mm in 6–7 mm vessels, suggesting a 5-mm safe margin between instrument application and the surrounding tissue. Bipolar coagulation is widely used because of convenience, time savings, and decreased blood loss, but it requires caution when used for ligation of a large vessel [6,8]. Although the classical suture method causes no thermal injury, it can induce urinary tract injury. Apart from prior operation history or pelvic adhesion, suture of excessive tissue during uterine artery and vaginal cuff ligation induces inordinate tension, resulting in ureteral obstruction by kinking. In suspicious cases for urinary tract injury, we identified the peristalsis of both ureters. In addition, indigocarmin dye 5 mL and furosemide 10 mg (Lasix 20 mg/2 mL) were injected intravenously to determine spillage into the abdominal cavity. Intravenous pyelography was checked at 1 day post-hospital.

The classical suture in the current study showed tolerable blood loss, with 1.6 g/dL change in mean hemoglobin and 6.2% (46 of 746 patients) transfusion rate. In the previous studies, hemoglobin changes were reported to range from 1.5 to 1.8 g/dL in TLH [9-12]. The. hysterectomy procedure includes major blood vessels such as ovarian, infundibulopelvic ligament and uterine arteries, and patients consequently have a risk of bleeding. Although bipolar coagulation and ultrasonic devices feature convenience and easy vessel coagulation in the laparoscopic procedure, the classical suture method also showed good vessel ligation, resulting in comparable hemoglobin change compared to electric equipment. We propose two reasons why our clinic has a high transfusion rate. Firstly, our study had patients who have received transfusion due to symptoms such as dizziness, regardless of hemoglobin level. Secondly, our criteria for surgery are very strict, only patients with a severe condition such as huge myoma who are likely to need a transfusion were accepted.

In many studies, the suture ligation method in TLH may involve a prolonged surgical time because it requires a learning curve. The skill of an advanced surgeon compensates for the suture method and operation time of TLH [13-15]. In this study, the mean operation time was 96.9 minutes. As time passed, the operation time shortened. Furthermore, all complications we reported occurred before 2010; no complications have occurred since 2010. Advanced surgical skill and a well-trained assisting team are expected to decrease operation time and complications.

Limitations of this study were the retrospective case review structure and that a single surgeon performed TLH, although a large case volume was included. The classical suture method is strongly dependent on surgeon skill, so surgical outcome may vary depending on surgeon.

In conclusion, the classical suture method for TLH presents tolerable complication and blood loss. Also, advanced surgical skill is expected to decrease operation time and complications.

## Conflict of interest

No potential conflict of interest relevant to this article was reported.

## Acknowledgments

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