Hysterectomy and ovarian cystectomy using natural orifice transluminal endoscopic surgery: An initial experience at Tzu Chi General Hospital

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INTRODUCTION

Natural orifice transluminal endoscopic surgery (NOTES) has been used for a decade [1]. NOTES is performed through natural orifices as the surgical channels for endoscopy. It avoids abdominal entry and could be the next trend in minimally invasive surgery. However, there is still limited experience in gynecologic surgery [2-5]. To perform NOTES, doctors could be hampered by experience with a single-port lack of suitable instruments and energy source for electrocauterization. Familiarity with pelvic anatomy from upside down through the vagina is essential.

Vaginal hysterectomy has been used for hundreds of years [6], but poor visualization and limited space for manipulation are limiting factors. Although vaginal hysterectomy is the route of choice [7], its use has decreased with the increasing use of abdominal laparoscopic hysterectomy since the 1990s [8,9].

Our surgical team has a lot of experience in performing laparoendoscopic single-site surgery (LESS), so we are very familiar with single-port surgery [10-14].

METHODS AND MATERIALS

The study was conducted in accordance with the Declaration of Helsinki and was approved by the local ethics committee of the institute. Informed written consent was waived because the study was a retrospective data analysis. Four patients with uterine myoma, adenomyosis, or carcinoma in situ (CIS) of the cervix and two patients with ovarian teratoma applicable for laparoscopic surgery were recruited to undergo NOTES in our hospital (Buddhist Tzu Chi General Hospital). The patients were not virgins and did not have pelvic inflammation or obliteration of the cul-de-sac. All patients receiving surgical management gave their written informed consents. The first author performed all the operations.

RESULTS

Transvaginal NOTES was performed smoothly in six patients, two patients (mean age 35 years, mean body mass index [BMI] 25) received an ovarian cystectomy (OC) and four patients (mean age 49 years, mean BMI 27) underwent a hysterectomy. One patient with a hysterectomy had a postoperative fever with 38°C last for 2 days. Pain scores were 0 at 48 h postoperatively in both groups.

CONCLUSION

Transvaginal NOTES is a feasible and safe technique for hysterectomy and OC in our patients and those in previous reports. This procedure was minimally invasive with no scars on the abdomen as well as little pain.

KEYWORDS: Hysterectomy, Laparoscopy, Natural orifice transluminal endoscopic surgery, Ovarian cystectomy, Single port

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surgeries. Prophylactic parenteral cefazolin was administered 1 h preoperatively.

**Surgical techniques**

The patients received general anesthesia with endotracheal intubation. They were placed in the Trendelenburg position with their legs supported in stirrups. Urine was drained by an indwelling 12Fr Foley catheter. The surgical procedures were carried out as follows:

**Hysterectomy**

Indications for hysterectomy included myoma, adenomyosis, and CIS of the cervix.

The cervix was circumcised using a cold knife. Both anterior and posterior colpotomy were then performed, as in conventional vaginal surgery. After exposing the extraperitoneal space along with broad, cervical, and uterosacral ligaments, a bipolar vessel sealer (Ligasure, Covidien, Boulder, CO, USA) was used to clamp and divide. Then, we established the vaginal channel for endoscopy by applying an Alexis wound retractor (Applied Medical Resources Corp., Rancho Santa Margarita, CA, USA) in the vaginal cavity [Figure 1a]. One 10 mm and two or three 5 mm cannulas were inserted through the fingers of a surgical glove [Figure 1b]. A 5 mm, 30° endoscope (Karl Storz, Tuttlingen, Germany) and a 5 mm bipolar Ligasure system (Covidien) were used for the surgery. After adequate pneumoperitoneum, the endoscope was inserted and then the bilateral broad ligament and uterine vessels were identified, followed by coagulation and cutting. Then, using one grasper, we grabbed the cervix [Figure 1c], cut the left side uterine vessels [Figure 1d], broad ligament [Figure 1d], ovarian ligaments [Figure 1e], and fallopian tube sequentially [Figure 1f]. Then, the procedures were repeated on the right side. After cutting all the pedicles, the uterus was removed through the vagina.

**Ovarian cystectomy**

The indication for ovarian cystectomy (OC) was ovarian teratoma. The mass diameter of the teratomas was 4.8 and 5.0 cm.

The procedures at the beginning of the operation were a little different from those for the hysterectomy. Only a posterior colpotomy was performed. Then, an Alexis wound retractor with a glove insertion of one 10 mm and two or three 5 mm trocars was inserted into the cul-de-sac. After establishing an adequate pneumoperitoneum, a 30° endoscope and two conventional 5 mm laparoscopic instruments were inserted into the pelvic cavity. The uterus and bilateral adnexa were then inspected. During enucleation of the ovarian cyst, we first used scissors to cut the ovarian surface [Figure 2a]. Then, we used one grasper to grab the surface epithelium and cut the inner surface of ovarian epithelium with scissors to enucleate the ovarian tumor [Figure 2b]. The specimens were removed by detaching the surgical glove through the colpotomy wound. The surgical glove was reattached to the wound retractor to check for bleeding. The colpotomy wound was then closed using 1-0 vicryl (Ethicon, Somerville, NJ, USA).

Visual analog scale (VAS) pain scores were measured at 2, 24, and 48 h postoperatively. Nonsteroidal anti-inflammatory drugs were prescribed for 24 h routinely. Vaginal intercourse was prohibited for 1 month. Patients returned to the clinic at 1 week, 1 month, and 6 months after surgery for follow-up.

**Statistical analysis**

Continuous variables are presented as the means ± standard deviation. Descriptive statistics were calculated by SPSS software (version 20, IBM-SPSS, Inc., Chicago, IL, USA).

**Results**

From September to December 2016, six patients undergoing transvaginal NOTES were enrolled in this study. Tables 1 and 2 list the patient data, surgical outcomes, and pain scores of the patients who underwent OC and hysterectomy, respectively. Their mean ages were 35 and 49 years and body mass indexes

Figure 1: Natural orifice transluminal endoscopic surgery operative images in a hysterectomy. (a) Transvaginal natural orifice transluminal endoscopic surgery portal. The anterior and posterior colpotomy was protected by an Alexis wound retractor. (b) A surgical glove with four cannulas attached was draped into the retractor. (c) Exploring the uterine cervical region. (d and e) Exploring the left parametrial space and cutting the uterine artery. (f) Exploring the right parametrial space and cutting the right ovarian pedicle.

Figure 2: Natural orifice transluminal endoscopic surgery operative images in an ovarian cystectomy. (a) Dissecting the ovarian surface epithelium out of the ovarian teratoma. (b) Complete dissection of the ovarian cyst.
were 25 and 27 in the OC and hysterectomy groups, respectively. One patient who had an OC was nulliparous, and one who had a hysterectomy was multiparous without a history of vaginal delivery. One patient in the hysterectomy group had a previous cesarean section and one had a previous vaginal delivery. The surgical times were 70 and 90 min in these cases. No patient who had an OC was multiparous without a history of vaginal delivery. In this study, we performed NOTES in one patient who had an OC and another who had a hysterectomy.

Table 1: Data of patients who had natural orifice transluminal endoscopic surgery for ovarian cystectomy

| Patient | 1 | 2 |
|---------|---|---|
| Age (year) | 46 | 24 |
| BMI | 20.3 | 29.9 |
| Mass diameter (cm) | 4.6 | 5 |
| Parity | 1 | 0 |
| Surgery | OC | OC |
| Pathology | Teratoma | Teratoma |
| Blood loss (mL) | 50 | 50 |
| Fever | No | No |
| Operative time* (min) | 58 | 90 |
| Hospital stay* (days) | 4 | 3 |
| VAS pain score (2 h) | 4 | 6 |
| VAS pain score (24 h) | 2 | 2 |
| VAS pain score (48 h) | 0 | 0 |

BMI: Body mass index, VAS: Visual analog scale, OC: Ovarian cystectomy

Table 2: Data of patients who had natural orifice transluminal endoscopic surgery for hysterectomy

| Patient | 1 | 2 | 3 | 4 | Means±SD |
|---------|---|---|---|---|---------|
| Age (years) | 59 | 61 | 46 | 30 | 49±14.3 |
| BMI | 27.3 | 28.9 | 23.3 | 32.1 | 27.9±3.7 |
| Mass diameter (cm) | 6 | 6 | 10 | 8 | 7.5±1.9 |
| Parity | 3 | 3 | 2 | 2 | 2.5±0.6 |
| Surgery | VH | VH | VH | VH |
| Pathology | CIS of cervix | Myoma | Myoma | Adenomyosis |

| Additional surgery | Blood loss (mL) | 50 | 50 | 150 | 100 | 87.5±47.9 |
|---|---|---|---|---|---|---------|
| Fever | No | No | No | Yes |
| Operative time (min) | 100 | 60 | 70 | 70 | 75±17.3 |
| Hospital stay (days) | 4 | 4 | 4 | 4 | 4±0.0 |
| VAS pain score (2 h) | 4 | 2 | 2 | 2 | 2.5±1.0 |
| VAS pain score (24 h) | 3 | 0 | 2 | 2 | 1.75±1.3 |
| VAS pain score (48 h) | 0 | 0 | 0 | 0 | 0±0.0 |

SD: Standard deviation, BMI: Body mass index, VAS: Visual analog scale, VH: Vaginal hysterectomy

NOTES hysterectomy or OC is feasible for women with benign uterine or ovarian tumors needing surgery. It has advantages that conventional vaginal hysterectomy does not offer, such as an endoscopic view and laparoscopic instruments.

The feasibility and safety of NOTES in gynecological hysterectomy and OC have been reported [2-5,15,16]. Tables 3 and 4 list previous studies of NOTES OC and hysterectomy and compare them with the present study.

Lee et al. reported that one patient with an OC among five patients who had NOTES adnexal surgery had an operative time of 64 min and blood loss of 20 mL [15] [Table 3]. Later, they reported that four patients with OC among ten patients receiving NOTES adnexal surgery had operative times of 64–162 min and blood loss of <50 mL [5]. Wang et al. compared 34 patients receiving NOTES OC with 243 women receiving laparoscopic ovarian cystectomy (LOC) [3]. They found operative times and hospital stays were shorter in NOTES ovarian cystectomy than LOC. Blood loss was <50 mL in both groups, similar to that in our patients. The operative times in our two patients were 58 and 90 min and the hospital stays were 3 and 4 days.

Lee et al. reported their initial experience with NOTES hysterectomy in 16 patients [16]; the mean operative time was 122.7 min and mean blood loss was 379 mL [Table 4]. They further reported their experience with NOTES hysterectomy in 137 patients; the operative time was shortened to 88.2 min and blood loss decreased to 257 mL [4]. In our study, the mean operative time was 74.7 min and mean blood loss was 75 mL. The blood loss was less than in other reports. The size and weight of the uterus may affect the degree of blood loss and length of surgery. The mean uterine size (the longer diameter) in our study was 7.5 cm. However, we did not measure the uterine weight. Therefore, comparison of these two parameters with other studies would not be possible.

NOTES is not contraindicated in patients without a history of vaginal delivery. In this study, we performed NOTES in one nulliparous woman and one woman without a history of vaginal delivery. The surgical times were 70 and 90 min in these cases. The absence of vaginal delivery does not seem to increase surgical time. NOTES, nevertheless, may carry a risk of infection, visceral organ injury, dyspareunia, and spread of tumor contents [5,17]. None of our six patients had infections or dyspareunia, similar to a previous report [18]. These risks can be compensated for by the good cosmetic outcomes with NOTES [5,17].

Severe adhesions in the cul-de-sac could be a contraindication to NOTES because of the potential for rectal injury when entering the cul-de-sac [15]. A pelvic examination should be performed before surgery to prevent rectal injury. Moreover, abdominal computed tomography (CT) also can also be used for preoperative evaluation. CT can demonstrate if intestines adhere to the uterus and there is obliteration of the cul-de-sac.

Single-port laparoscopy has become popular recently as shown in several reports by Kim et al. [10-14,19,20]. Their results showed superior cosmetic outcomes compared with conventional laparoscopy. Yang et al. noted shorter operative
times and hospital stays with NOTES compared with single-port laparoscopy [21]. NOTES also resulted in much better cosmetic outcomes than single-port surgery. The scarless abdominal wall is an advantage of NOTES.

The advantages of single-port laparoscopy include less postoperative pain, and thus less pain control is needed than with conventional multiport laparoscopy [14,22]. Hong et al. reported VAS pain scores of 5.6, 3.7, and 2.2 at 1, 24, and 48 h, respectively, in LESS hysterectomy [14]. In our present study, the pain scores with NOTES were much lower, at 3.3, 1.8, and 0 at 2, 24, and 48 h, respectively. Lack of an abdominal wound with NOTES may explain the lower pain scores compared with LESS.

In addition to hysterectomy and OC, NOTES may also be applied to myomectomy and staging surgery [23,24]. However, only three cases of each surgery have been reported. Large trials are needed to prove the value of NOTES in these types of surgery.

One limitation of this study was the small case number. However, this case series was the initial experience in our hospital. We hope to collect more cases in the future.

**CONCLUSION**

NOTES surgery can be feasibly and safely performed in gynecologic patients with benign pathology of the ovary and uterus. As the approach from the vagina cavity is difficult in ovarian surgery, NOTES surgery could have advantages compared with pure vaginal surgery. Less pain and better cosmetic outcomes were noted in NOTES surgery. Nulliparous patients and those with no history of a vaginal delivery can receive NOTES. Obliteration of the cul-de-sac can hamper the procedure. A prospective controlled and randomized clinical trial is needed to elucidate the feasibility and safety of NOTES [25,26].

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**Conflicts of interest**

There are no conflicts of interest.

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