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Review article

Review of transvaginal natural orifice transluminal endoscopic surgery in gynecology



Naoyuki Yoshiki*

Comprehensive Reproductive Medicine, Systemic Organ Regulation, Graduate School of Medical and Dental Sciences, Tokyo Medical and Dental University, Tokyo, Japan

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ABSTRACT

Recent technologic advances in endoscopic instrumentation and optics have allowed the development of a less invasive alternative to conventional laparoscopic surgery. During the past decade, natural orifice transluminal endoscopic surgery (NOTES) flourished in the field of general surgery, and it has emerged as a new concept of minimally invasive surgery. NOTES yields access to the abdominal cavity without any incisions on the abdominal wall (scarless surgery), and the natural orifices of the body surface, such as the mouth and the vagina, serve as the gateway to the peritoneal cavity. In gynecology, the vagina of a woman can be considered as an additional route for surgery. Recently, clinical application of transvaginal NOTES has broadened significantly in gynecology. Using transvaginal NOTES by applying the method of single-incision laparoscopic surgery via the vaginal route, not only adnexal surgery and hysterectomy, but also myomectomy and oncologic surgery could be performed safely and effectively in selected patients. In future, further studies should be conducted to evaluate the true clinical feasibility and safety of transvaginal NOTES.

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Introduction

Recent technologic advances in endoscopic instrumentation and optics have allowed the development of a less invasive alternative to conventional laparoscopic surgery. By aiming to reduce surgical morbidity, the evolution from laparotomy to laparoscopy has now broadened to include even less invasive techniques, such as single-incision laparoscopic surgery (SILS), also known as laparoendoscopic single-site surgery, and natural orifice transluminal endoscopic surgery (NOTES). Minimally invasive surgery not only improves cosmetic outcome, but also reduces surgical injury. SILS achieves access through an abdominal approach using a transumbilical single incision. Many studies have described its feasibility, safety, and surgical outcome. By contrast, NOTES uses the natural orifices of the body surface, such as the mouth and the

vagina, as surgical channels of endoscopy to avoid incision scars on the abdominal wall.

During the past decade, NOTES flourished in the field of general surgery, and it has emerged as a new concept of minimally invasive surgery. The first published experience was transvaginal endoscopic cholecystectomy performed by Zorron et al¹ at University Hospital of Teresopolis, Brazil. Afterward, Bessler et al² at Columbia University Medical Center, New York, USA, and Marescaux et al³ at University Louis Pasteur, Paris, France, reported similar procedures. Together with robotic surgery, NOTES is considered to be the next-generation minimally invasive surgical procedure; thus, numerous efforts in this area are being made in many countries. Recently, transvaginal NOTES has been performed in cholecystectomy, appendectomy,^{4,5} nephrectomy,⁶ and gynecologic diseases. NOTES can be performed via a variety of approaches, including that through the stomach,^{7–9} but the majority of NOTES procedures have been performed transvaginally. The vagina can be easily decontaminated, and it provides direct access. Culdotomy has been used widely for several surgical procedures (not only by gynecologists, but also by general surgeons for extraction of large specimens), and it has been approved as safe and easy to close. With regard to closure of the perforation site within the natural orifices

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* Corresponding author. Comprehensive Reproductive Medicine, Systemic Organ Regulation, Graduate School of Medical and Dental Sciences, Tokyo Medical and Dental University, 1-5-45, Yushima, Bunkyo-ku, Tokyo 113-8519, Japan.

E-mail address: n.yoshiki.crm@tmd.ac.jp.

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except the vagina, an acceptable closure method is not yet present. Currently, to select the transvaginal port is the most reliable for human application of NOTES.

In gynecology, the vagina of a woman can be considered as an additional route for surgery. The concept of transvaginal endoscopy was originally called “culdoscopy.” In recent times, clinical application of transvaginal NOTES has broadened significantly; in the initial days, NOTES was used only for diagnostic purposes¹⁰ or performed with transabdominal assistance,^{11,12} but now it is being used to accomplish complex procedures. Different gynecologic procedures have been effectively performed by means of pure transvaginal NOTES. These procedures seem to be feasible and safe. Reduced pain and improved cosmesis are supposed to be the potential advantages of transvaginal NOTES. The objective of this article is to review the published literature on transvaginal NOTES in gynecology.

Transvaginal NOTES in gynecology

As NOTES is relatively new, the current literature on the use of this technique in gynecology is somewhat limited. As a result of a MEDLINE/PubMed literature search of all publications in English language using the search term “natural orifice transluminal endoscopic surgery,” as well as a review of all references to summarize the existing clinical experience on NOTES in gynecology, a total of 17 articles were found to include gynecologic procedures (Table 1).^{13–29}

Review of published literature of transvaginal NOTES in benign gynecology

Although NOTES is a relatively new field, a variety of NOTES procedures with use of modern laparoscopic instrumentation and optics evolved into transvaginal NOTES have been reported in gynecology.

Adnexal surgery

Lee et al¹³ reported the first case series of pure transvaginal NOTES for adnexal diseases in 2012. Ten consecutive patients underwent transvaginal NOTES, including tubal sterilization in three, salpingectomy because of ectopic pregnancy in three, and ovarian tumor enucleation in four. The NOTES procedure failed in one patient because a misdiagnosed peritoneal mucinous tumor was located in front of the uterus and was inaccessible using the transvaginal approach, leading to subsequent conversion to conventional laparoscopy. They found that transvaginal NOTES, compared with transumbilical SILS, offered a larger space and a decreased incidence of instrument clashing during handling because of the large colpotomy wound. They also found several technical drawbacks to transvaginal NOTES. In comparison with transumbilical SILS, transvaginal NOTES was performed in an anatomically reverse direction, which might initially cause disorientation for surgeons; however, operators were quickly able to adapt to the new orientation because gynecologists were familiar with vaginal surgical procedures. They concluded that their method of combining the concepts of culdoscopy using the vaginal approach and SILS with the wound retractor represented a new way to perform transvaginal NOTES. Ahn et al¹⁴ and Kim¹⁵ described their initial experience in 10 women with benign adnexal diseases that were treated successfully with transvaginal NOTES using a single port. Procedures consisted of oophorectomy in three patients, salpingostomy and salpingectomy in two each, and ovarian cystectomy, paratubal cystectomy, and ovarian wedge resection in one each. They concluded that the selection of

appropriate patients could be important for successful surgical outcomes because of the requirement of secure colpotomy. Yang et al¹⁶ also described the initial clinical experience of transvaginal NOTES using a wound retractor and a surgical glove performed in seven women with adnexal masses. Main procedures consisted of unilateral salpingo-oophorectomy in three patients, unilateral oophorectomy in three patients, and paraovarian cystectomy in one patient. Transvaginal NOTES was successfully and safely completed in all cases. They concluded that transvaginal NOTES was a feasible and effective surgical technique in properly selected female patients with adnexal masses.

Xu et al¹⁷ were the first to report a prospective randomized study of transvaginal NOTES for tubal ectopic pregnancy. They prospectively enrolled 40 patients, each of whom had been scheduled for salpingectomy, and randomized them into the two groups: transvaginal endoscopic surgery ($n = 18$) and laparoscopic surgery ($n = 20$). Transvaginal endoscopic salpingectomy was performed using a double-channel endoscope through a vaginal puncture, and pure NOTES was performed in 17 cases except the first case in which hybrid NOTES was performed. The duration of time for transvaginal endoscopic surgery was slightly longer than that for laparoscopic surgery, however, there was no statistically significant difference between the two groups. Transvaginal NOTES was associated with lower pain scores at 4 hours after surgery. The group that underwent transvaginal endoscopic surgery was more satisfied with the absence of external scars than the group that underwent laparoscopic surgery, which left scars. They concluded that the safety and efficacy of transvaginal endoscopic salpingectomy for tubal ectopic pregnancy were equivalent to those of laparoscopic salpingectomy, and that lesser postoperative pain and more satisfactory cosmetic outcome would make it the preferred approach and superior to laparoscopic surgery in simple cases.

Wang et al¹⁸ recently published a study comparing surgical outcomes between NOTES-assisted ovarian cystectomy (NAOC) and laparoscopic ovarian cystectomy (LOC). A total of 277 patients were recruited in the study (34 in the NAOC group and 243 in the LOC group). The mean operative time and postoperative hospital stay were significantly less for the NAOC group than for the LOC group. Although the mean amount of blood loss was significantly less for the LOC group than for the NAOC group, it was <50 mL in the two groups. They compared a propensity score matched sample of 68 LOC patients with 34 NAOC patients using a “nearest-neighbor” approach. In this approach, each NAOC patient was matched to two LOC patients with the closest propensity scores. They found that there was a linear correlation between operative time and mass size, and between estimated blood loss and mass size in the LOC group, but that similar results were not seen in the NAOC group. They concluded that performing ovarian cystectomy by combining NOTES technique with conventional vaginal surgery for benign and large ovarian tumors was possible in well-selected patients, and that NAOC offered superior operative efficiency compared with conventional LOC.

Hysterectomy

Su et al¹⁹ reported the first case series of transvaginal NOTES for performing hysterectomy in 2012. Sixteen patients with benign uterine diseases underwent hysterectomy using transvaginal NOTES, which was performed by applying the techniques of SILS via the vaginal route. Transvaginal NOTES was completed in each patient without conversion to conventional laparoscopy or even laparotomy. They concluded that hysterectomy could be feasibly performed using transvaginal NOTES, which not only overcame limitations, but also broadened the indications for vaginal hysterectomy. Lee et al²⁰ evaluated the feasibility and safety of hysterectomy using transvaginal NOTES in benign uterine

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