Taiwanese Journal of Obstetrics & Gynecology 54 (2015) 761–765

Contents lists available at ScienceDirect

Taiwanese Journal of Obstetrics & Gynecology

journal homepage: www.tjog-online.com

Original Article

Robot-assisted natural orifice transluminal endoscopic surgery for hysterectomy

Chyi-Long Lee*, [1], Kai-Yun Wu [1], Hsuan Su, Chien-Min Han, Chen-Ying Huang, Chih-Feng Yen

Division of Endoscopy, Department of Obstetrics and Gynecology, Chang Gung Memorial Hospital at Linkou, Chang Gung University School of Medicine, Tao-Yuan, Taiwan

ARTICLE INFO

Article history:
Accepted 26 August 2015

Keywords:
robot
NOTES
hysterectomy

ABSTRACT

Objective: To describe the surgical procedures of robot-assisted natural orifice transluminal endoscopic surgery (NOTES) for hysterectomy and to evaluate its feasibility.
Materials and methods: From December 2014 to February 2015, four patients with benign diseases who were eligible for robot-assisted NOTES at Chang Gung Memorial Hospital were recruited to this study. Intraoperative and postoperative surgical outcomes were evaluated.
Results: Robot-assisted NOTES hysterectomy was successfully performed in all these patients. None of the patients had vaginal delivery, with two being nulliparous. The mean ± standard error of the mean uterine weight was 365.5 ± 69.2 g, the mean operative time was 198.8 ± 39.0 minutes, the mean docking time was 38.3 ± 2.4 minutes, the mean blood loss was 180.0 ± 56.1 mL, and the mean postoperative hospital stay was 2.5 ± 0.3 days. The final pathologic diagnoses were adenomyosis and/or leiomyomas.
Conclusion: The novel robot-assisted NOTES technology created scarless skin wounds. More importantly, the device allows the surgeon to reach deeper places to achieve hemostasis, and perform surgery on larger tumors using the curved cannulae-wristed instrument. However, its implementation is limited by the lack of appropriate instrumentation, which requires further development and break through. At this stage, robot-assisted NOTES is only useful for limited applications in highly selected patients.

Introduction

Natural orifice transluminal endoscopic surgery (NOTES) is a novel revolutionary surgical technique developed in the field of minimally invasive surgery [1,2]. NOTES uses the natural orifices of the body as the surgical channels for endoscopy, such as the urethra, the mouth, the anus, and the vagina to prevent visible scars on the abdominal wall [3,4]. NOTES also prevents complications of trocar wound, and achieves better cosmetic outcomes [2]. NOTES has been applied in general surgery and its safety and feasibility have already been proven [3,5]. Although various approaches had been developed for its utilization, transvaginal access is the most frequently used approach [6,7]. NOTES offers several benefits including scarless intervention, faster recovery, a shorter hospital stay, lower anesthesia requirements, and less pain compared with conventional open and laparoscopic procedures [1].

In recent times, the clinical application of transvaginal NOTES has broadened significantly; in the initial days, NOTES was used only for diagnostic purposes or to perform simple surgeries, but now it is also being used to accomplish complex procedures [3]. Lee et al [8] performed transvaginal NOTES by applying the method of laparoendoscopic single-site surgery using the wound-retractor-and-glove system via the vaginal route. Using this method, the authors of that study demonstrated that not only myomectomy and adnexal procedures but also hysterectomies and oncologic surgery could be performed safely and effectively in selected patients [9,10]. Besides, it was also reported that performing transvaginal NOTES to treat benign gynecologic disease is a feasible and attractive option [2,4,7].

In addition to NOTES surgery, application of a robotic platform is also a new revolution in performing minimally invasive surgery.

* Corresponding author. Division of Endoscopy, Department of Obstetrics and Gynecology, Chang Gung Memorial Hospital at Linkou, Chang Gung University School of Medicine, 5, Fu-Hsing Street, Kwei-Shan, Tao-Yuan 33305, Taiwan.
E-mail address: chyilong@ms21.hinet.net (C.-L. Lee).
[1] C.-L.L. and K.-Y.W. equally contributed to this article.

http://dx.doi.org/10.1016/j.tjog.2015.08.023

The Food and Drug Administration approved the use of robotic platforms in gynecologic surgery in 2005 [11]. Robotic technology possesses several potential benefits over the existing methods, such as offering three-dimensional visualization, instruments' greater range of motion, precision, scaling, enhanced stability of the operative image and instrumentation, and better ergonomics [12,13]. Several publications have described the safety and feasibility of this new approach [11,14–19]. In addition, it overcomes the existing limitations and difficulties, which are commonly associated with traditional gynecologic surgeries.

Robot-assisted laparoscopic surgery has allowed more surgeries to be performed by adopting the minimally invasive route because it is easier to learn than traditional laparoscopic surgery owing to its advantages [11,18]. According to some reports, robotic surgery offers several advantages including decreased estimated blood loss, faster recovery, and reductions in major complications [20].

Furthermore, robot-assisted surgical approaches have been used progressively in the setting of risk-reducing uterine and adnexal surgery, and for the treatment of adnexal masses, cervical cancer, endometrial cancer, and ovarian cancer [16].

The current advancements in NOTES instrumentation has motivated the development of flexible robotic endoscopic devices, which possess a number of benefits over existing rigid endoscopes that are used in NOTES hysterectomy. Therefore, in this study, we decided to fully utilize the potential of robotic endoscopic devices and NOTES to perform hysterectomy. This combined technique will eliminate the need for surgical incision (NOTES) and improve depth perception (long robotic instrument). We herein present our experience in performing robot-assisted NOTES hysterectomy, and to the best of our knowledge, this is the first report published in the literature in this regard.

Materials and methods

Robot-assisted NOTES is a type of vaginal single-port surgery, which is routinely performed at our hospital. Institutional Review Board approval was not needed for this study. All patients undergoing surgery gave their written informed consent.

Patients

Patients scheduled for laparoscopic hysterectomy and willing to undergo robot-assisted surgery between December 2014 and February 2015 at Chang Gung Memorial Hospital were selected to receive robot-assisted NOTES. The procedure was not considered contraindicated in patients with obesity [body mass index (BMI) > 30 kg/m^2], those who never had vaginal deliveries, those in whom concomitant adnexal surgery was necessary, and those with a history of cesarean delivery or abdominal surgery. However, patients with virginity, suspected severe pelvic adhesions from previous abdominal surgery, tubo-ovarian abscesses, or endometriosis were excluded.

Surgical procedures

In brief, the surgical procedures are as follows: under general anesthesia with endotracheal intubation, patients were placed in the Trendelenburg position with their legs bandaged and supported in the stirrups. A 12-F Foley catheter was inserted. The operation began as in conventional vaginal surgery, with resection of the vaginal wall around the cervix. Anterior and posterior colpotomy was performed and the uterosacral ligaments were dissected. The uterine vessels were sealed and cut up to the level of the isthmus, with either suture–ligation or the LigaSure system (Valleylab Inc., Boulder, CO, USA).

The vaginal working channel was established by inserting a single-site multi-instrument silicon port (Intuitive Surgical, Sunnyvale, CA, USA). The patient-side cart of the da Vinci Surgical System was then driven between the patient's legs, and each responsible port was docked onto the assigned robotic arms (Figure 1). A zero-degree endoscope was used for the entire procedure. We used an EndoWrist plasma-kinetic bipolar grasper in the left robotic hand and EndoWrist monopolar curved scissors in the right hand (Intuitive Surgical Inc.).

Robot-assisted NOTES hysterectomy was performed after achieving adequate pneumoperitoneum. The remaining structures upward from the isthmic level including the broad ligaments, round ligaments, ovarian ligaments, and fallopian tubes or infundibulopelvic ligaments (for salpingo-oophorectomy) were then sealed and cut (Figures 2 and 3). After hemostasis was achieved, the patient-side cart was removed. The uterus was morcellated through the vagina. The surgery ended after closure of the vaginal cuff and routine check-up of cystoscopy.

Data analysis

Patient demographics, intraoperative findings, postoperative outcomes, and pathologic reports were all prospectively recorded as patients enrolled in the study. Surgical procedures and outcomes, including operative time, docking time, estimated blood loss, length of hospital stay, and intraoperative and postoperative complications were also recorded. “Operative time” is calculated as the time from docking to the end of surgery. “Docking time” is the time taken to set up the robotic instrument with curved cannulae before surgery.

Treatment protocol

Prophylactic antibiotic therapy was administered preoperatively using a single dose of parenteral cefazolin, and postoperatively using cefazolin and gentamicin for 24 hours. The Foley catheter was left in place overnight. According to the regulations of our national insurance scheme, patients could not be discharged until they were afebrile for at least 24 hours, had good wound healing, had full recovery of urinary and gastrointestinal functions, and there was no evidence of surgical complications. Vaginal intercourse was prohibited for 2 months after the operation. Patients were followed up in our outpatient clinic at 1 week and 6 weeks after the surgery. Three months later, patients were evaluated for general well-being and sexual function, including dyspareunia or postcoital bleeding.

Results

From December 2014 to February 2015, four patients who had preoperative benign disease requiring hysterectomy were recruited to this study. Patient demographic data are presented in Table 1. None of these patients had vaginal delivery, including two being nulliparous. Mean [standard error of the mean (SEM)] age of the study population was 45.5 ± 2.5 years, median parity was 1.0 ± 0.60, and mean BMI was 25.5 ± 1.2 kg/m^2. Robot-assisted NOTES hysterectomy was successfully completed in all patients. Among the four patients, concomitant pelvic surgical procedures including one salpingectomy, one salpingo-oophorectomy, and three extensive adhesiolysis were also performed. Mean (SEM) uterine weight was 365.5 ± 69.2 g (range 218–513 g). Mean operative time was 198.8 ± 39.0 minutes. Mean docking time was 38.3 ± 2.4 minutes. Mean blood loss was 180.0 ± 56.1 mL, mean decrease in hemoglobin concentration from before the operation to postoperative Day 1 was 1.6 ± 0.2 g/dL. Mean postoperative hospital stay was 2.5 ± 0.3 days. The final pathologic diagnoses were adenomyosis and/or leiomyomas.