Article

Not peer-reviewed version

Transvaginal Natural Orifice Transluminal Endoscopic Surgery (vNOTES) for Early-Stage Ovarian Cancer and Borderline Ovarian Tumors: A Case Series

Gaétan Kellerhals , James Nef , Yannick Hurni * , Daniela Emanuela Huber *

Posted Date: 14 October 2024

doi: 10.20944/preprints202410.0987.v1

Keywords: early-stage ovarian cancer; borderline ovarian tumors; vNOTES; natural orifice transluminal endoscopic surgery; minimally invasive surgery; fertility-sparing surgery; tubal cancer; adnexal malignancies; surgical staging; ovarian cancer treatment

Article

Transvaginal Natural Orifice Transluminal Endoscopic Surgery (vNOTES) for Early-Stage Ovarian Cancer and Borderline Ovarian Tumors: A Case Series

Gaétan Kellerhals [1], James Nef [2], Yannick Hurni [2] and Daniela Huber [2,3,*]

[1] Faculty of Medicine, University of Geneva, Rue Michel-Servet 1, 1206 Geneva (Switzerland)
[2] Department of Gynecology and Obstetrics, Valais Hospital, Av. Du Grand-Champsec 80. 1951 Sion (Switzerland)
[3] Department of Pediatrics, Gynecology and Obstetrics, Geneva University Hospitals, Bd. de la Cluse 30, 1205 Geneva (Switzerland)
* Correspondence: danielaemanuela.huber@hopitalvs.ch; Tel.: +41276038787

Simple Summary: Surgery is the cornerstone of ovarian cancer treatment. Transvaginal natural orifice transluminal endoscopic surgery (vNOTES) is a novel, minimally invasive technique that is gaining interest in gynecological oncology. However, its use in ovarian cancer is still limited, with only a few cases reported. This study presents our experience with 11 patients diagnosed with early-stage ovarian cancer or borderline ovarian tumors who were treated using vNOTES. Our results suggest that vNOTES is a promising approach for the surgical management of highly selected early-stage ovarian malignancies, offering potential advantages in terms of reduced invasiveness and faster recovery compared to traditional approaches. While these findings are encouraging, further research is needed to assess long-term safety and oncologic outcomes.

Abstract: Background/Objectives: Surgical approaches for ovarian cancer have advanced significantly in recent years. Transvaginal natural orifice transluminal endoscopic surgery (vNOTES) is an emerging technique in gynecological oncology, with limited reports of its use in ovarian cancer management. This study aimed to evaluate the feasibility and safety of vNOTES for the surgical staging of early-stage adnexal malignancies. **Methods:** We retrospectively reviewed all cases of borderline ovarian tumors (BOTs) and early-stage ovarian cancer surgically staged using vNOTES at our institution between October 2021 and August 2024. **Results:** Eleven patients were included, 7 with early-stage ovarian or tubal cancer and 4 with BOTs. The median age was 47 (27 – 81) years, and the median body mass index was 28.1 (22.4 – 39.2) Kg/m^2. Complete vNOTES staging was achieved in all cases, including peritoneal washing, unilateral/bilateral salpingo-oophorectomy, abdominal cavity inspection, peritoneal biopsies, infracolic omentectomy, and total hysterectomy when required. The median operating time was 70 (35 – 138) minutes, with a median blood loss of 50 (10 – 100) ml. No intraoperative complications occurred except for one case of minor ovarian spillage. No conversions to laparoscopy or laparotomy were needed. Postoperative complications included one surgical site infection (9.1%) and two cases of postoperative cystitis (18.2%). No severe complications graded ≥3 on the Clavien-Dindo classification were observed. **Conclusion:** vNOTES appears to be a feasible approach for the surgical staging of highly selected patients with early-stage adnexal malignancies. Further studies are needed to validate its long-term safety and oncological outcomes.

Keywords: early-stage ovarian cancer; borderline ovarian tumors; vNOTES; natural orifice transluminal endoscopic surgery; minimally invasive surgery; fertility-sparing surgery; tubal cancer; adnexal malignancies; surgical staging; ovarian cancer treatment

 doi:10.20944/preprints202410.0987.v1

1. Introduction

Surgery remains the cornerstone of ovarian cancer treatment, with the primary goal being the complete resection of the tumor. The quality of surgery and the surgeon's expertise are critical to patient outcomes and survival. With advances in surgical techniques and a growing focus on improving patient perioperative outcomes, minimally invasive surgery (MIS) has become increasingly important in managing gynecological malignancies. However, its application in the treatment of ovarian cancer remains a subject of ongoing debate.

Current guidelines recommend performing cytoreductive surgery for ovarian cancer via midline laparotomy, even in its early stages [1]. However, to date, no randomized controlled trials have directly compared MIS with open surgery for the treatment of early-stage ovarian cancer and borderline ovarian tumors (BOTs) [2], and minimally invasive approaches are increasingly applied in their treatment with promising results [3,4]. Several studies suggest the feasibility and safety of MIS approaches for the management of early-stage ovarian cancer, appearing to be non-inferior to laparotomy [5,6] and presenting with lower rates of surgical complications [7,8].

Transvaginal Natural Orifice Transluminal Endoscopic Surgery (vNOTES) is an innovative, minimally invasive approach that combines laparoscopy and vaginal surgery [9]. This approach has proven its feasibility and safety for treating several benign gynecological conditions, being a valuable option for performing hysterectomies, myomectomies, adnexal procedures, and pelvic organ prolapse treatments [3,9–12]. In addition, vNOTES has shown promising results in managing early-stage endometrial cancer, allowing complete surgical staging, including sentinel lymph node biopsies, lymphadenectomies, and omentectomies [12–17]. However, although increasing evidence supports the use of vNOTES approaches to manage early-stage endometrial cancer and to perform benign adnexal surgeries, little is known about the feasibility and safety of performing vNOTES oncological staging for tubo-ovarian malignancies [15,18–20].

Hereby, we report our initial experience performing vNOTES surgical staging for early-stage ovarian cancer and BOTs.

2. Materials and Methods

2.1. Patient Selection, Data Collection, and Methods

vNOTES was implemented in our institution in May 2020. Since January 2022, we have collected retrospectively and prospectively data concerning patients who underwent vNOTES procedures to create an institutional database using the Research Electronic Data Capture (REDCap) software. The project received approval from the local ethical committee (CER-VD), with registration number 2021-02346, and all patients gave written informed consent.

From this database, we retrospectively identified and analyzed data from all patients who had undergone surgical staging for BOTs or early-stage ovarian cancer by vNOTES. Demographic features, as well as clinical and perioperative information, were collected and analyzed. Intraoperative parameters included total operative time (from catheterization of the bladder to vaginal closure), vNOTES port insertion time (from incision to intrabdominal CO_2 insufflation), estimated blood loss, intraoperative complications (including transfusion-requiring bleeding or iatrogenic organ injury), and the necessity for conversion to conventional laparoscopy or laparotomy. Postoperative assessments comprised pain evaluation using the visual analog scale graded from 0 to 10 at 12-, 24-, and 48-hours post-surgery, opioid analgesic use, duration of hospital stay, and postoperative complications within 8 postoperative weeks, graded according to the Clavien-Dindo classification (CD) [21]. In addition, we recorded histopathological results, the timing and type of any adjuvant therapies, and the patient status at the last follow-up.

Continuous variables were expressed as median and range, while dichotomous variables were represented as absolute numbers and percentages (%). No statistical intergroup comparisons were undertaken. Statistical analyses were performed using IBM SPSS version 29.0.2.0.

 doi:10.20944/preprints202410.0987.v1

2.2. Surgical Technique

All interventions were performed by the same oncogynecological surgeon (DH). Patients received a single dose of clindamycin vaginal cream 2% (5 g of cream with 100 mg of clindamycin) the day before the surgery, and 2-4 hours before the intervention, in addition to cefuroxime 1.5 g (3 g for patients weighing more than 80 kg) and metronidazole 500 mg intravenously at induction of anesthesia. Under general anesthesia and muscular relaxation, patients were positioned in a horizontal dorsal lithotomy position, and a bladder catheter was placed.

Access was gained with a posterior 2 cm colpotomy through Douglas's pouch to perform interventions limited to the adnexa. If hysterectomies were performed, access to the abdominal cavity was achieved through anterior and posterior colpotomies, with the transvaginal uterosacral ligaments section when developing the posterior access. A vNOTES port (GelPoint vPath, Applied Medical, Rancho Santa Margarita, CA, USA) with an adapted diameter (7 cm for adnexectomies and 9.5 cm for hysterectomies) was placed in the abdominal cavity through the anterior and/or posterior colpotomies. Carbon dioxide was insufflated to create a pneumoperitoneum with an intraperitoneal pressure of 8-15 mmHg. Three 10 mm trocars were used to insert a 10-mm rigid 30° scope, 5-mm instruments such as Johan and bipolar graspers, and sealing devices. If necessary, a 4th 15 mm supplementary trocar was added.

Surgical staging included peritoneal washing, uni- or bilateral salpingo-oophorectomy, abdominal cavity inspection, peritoneal biopsies, infracolic omentectomy, and total hysterectomy. In selected cases, fertility-sparing approaches with unilateral salpingo-oophorectomy or cystectomy and uterus preservation were performed. To perform hysterectomies, the uterine vessels, broad ligaments, and round ligaments were sealed and cut from caudal to cranial. Salpingo-oophorectomies were always performed after correctly visualizing the ureters, the fallopian tubes, and the infundibulopelvic ligaments, with utmost care to avoid spillage.

All specimens have been extracted vaginally. To avoid intraabdominal spillage, large adnexal lesions were retrieved into an Inzii Endobag Retrieval System of 10 or 15 cm of diameter, or Alexis Contained Extraction System of 14 or 17 cm (Applied Medical, Rancho Santa Margarita, CA, USA). Intraoperative frozen section analysis was performed in cases with suspicious adnexal masses. Omentectomies were performed with an articulating sealing device, as we previously described [15].

At the end of the procedure, the colpotomy was closed under direct visualization using a running suture with Vicryl 0. Postoperatively, patients received a single dose of clindamycin vaginal cream 2% (5 g of cream with 100 mg of clindamycin) once a day during the first 7 postoperative days.

3. Results

From October 2021 to August 2024, 7 patients with early-stage tubal or ovarian cancer and 4 patients with BOTs underwent surgical staging by vNOTES at Valais Hospital (Sion, Switzerland).

The median age was 47 (27 - 81) years, with a median body mass index of 28.1 (22.4 – 39.2) Kg/m^2. Seven patients (63.6%) were classified as American Society of Anesthesiologists score (ASA) II and 4 (36.4%) as ASA III. No patients showed any evidence of advanced ovarian oncological disease at the preoperative workup, which included a pelvic ultrasound and a thoracoabdominal computed tomography. A pelvic magnetic resonance imaging was also performed when further ovarian lesion characterization was necessary. Table 1 provides an overview of patient characteristics and their perioperative outcomes.

Bilateral salpingo-oophorectomy was performed in 5 patients (45.5%), while 6 patients (54.5%) underwent fertility-sparing surgery with preservation of at least one ovary and the uterus. Table 2 summarizes the surgical procedures performed to complete surgical staging. The median operating time was 70 (35 – 138) minutes, with a median blood loss of 50 (10 – 100) ml. No conversion to standard laparoscopy or laparotomy was necessary, and all procedures were performed as planned. In a patient with suspicious pelvic implants, a hybrid approach was used to explore the utero-vesical peritoneum. All surgical material was extracted vaginally with an endobag. No intraoperative complications were reported, except for one case involving a minimal pelvic ovarian spillage during extraction in the retrieval system (9.1%) (Table 2).

 doi:10.20944/preprints202410.0987.v1

Post-operative complications were reported in 3 patients (27.3%). These included one surgical site infection (9.1%) and 2 cases of cystitis (18.2%). All 3 postoperative complications were graded as CD grade 2 and treated with antibiotics. The median hospital stay was 48 (24 – 96) hours. After the final histological results, 5 patients underwent a second intervention to complete the surgical staging, 4 by vNOTES and one by conventional laparoscopy.

Adjuvant chemotherapy was administered in 4 patients (36.4%), one of whom received palliative chemotherapy for relapsed pancreatic disease. The median time from surgery to adjuvant therapy was 23 (19 – 31) days. In this series, no evidence of recurrence was observed, with a median follow-up time of 9.6 (0.2 – 33.4) months. One patient (9.1%) died of metastatic pancreatic cancer one year after the surgery. The final histopathological diagnoses are summarized for each patient in Table 1.

Table 1. Patient characteristics and perioperative outcomes.

Patient	Previous abdominal surgery	Indication for surgery	Definitive histology	TNM / FIGO	Peri-operative complications
1	Right colectomy and ileal resection	Bilateral adnexal mass of undetermined origin	Low grade serous carcinoma	pT2bpN x / IIB	-
2	Multiple laparoscopic ovarian cystectomies and right adnexectomy	History of adult granulosa cell tumor on the right ovary, prophylactic contralateral adnexectomy	Adult granulosa cell tumor	pT2bpN x / IIB	-
3	Whipple procedure for pancreatic cancer	Suspicion of ovarian metastasis vs primary ovarian tumor	Mucinous BOT; pancreatic intraabdominal metastasis	pT1a / IA	-
4	Two cesarean sections	Suspicion of parasitic fibroma vs fibrosarcoma	High grade serous carcinoma	pT2aNx / IIA	-
5	TVT	Postmenopausal bleeding without suspicious adnexal lesions	Adult granulosa cell tumor	pT1a / IA	Surgical site infection
6	-	Suspicion of bilateral ovarian teratoma	Immature teratoma	pT1a / IA	Cystitis
7	Bilateral laparoscopic ovarian cystectomies	Persistent cyst of benign appearance	Serous BOT	pT1c1 / IC1	-
8	-	Suspicion of benign mucinous tumor	Mucinous ovarian carcinoma	pT1c1 / IC1	Pelvic ovarian spillage

 doi:10.20944/preprints202410.0987.v1

9	Laparotomic appendectomy	Suspicion of STIC	STIC	pT1a / IA	Cystitis
10	-	Suspicion of benign ovarian lesion of 7 cm	Serous BOT	pT1c3 / 1C1	-
11	One cesarean section	Adnexal mass of undetermined origin	Serous BOT	pT1a / IA	-

BOT = Borderline ovarian tumors, TVT = tension-free vaginal urinary mesh, STIC = Serous tubal intraepithelial carcinoma.

Table 2. Surgical procedure, operative characteristics, and perioperative outcomes.

	Total (n = 11)
Procedures performed	
Unilateral/bilateral salpingo-oophorectomy	11 (100)
Peritoneal washing	11 (100)
Infracolic omentectomy	9 (81.8)
Partial pelvic peritonectomy	3 (27.3)
Rectal mesenteric implant ablation	1 (9.1)
Total hysterectomy	5 (45.5)
Adnexal largest diameter *(mm)*	45 (12 – 120)
Operative time *(min)*	70 (35 – 138)
Estimated blood loss *(ml)*	50 (10 – 100)
Hybrid access	1 (9.1)
Perioperative complications	
Tumor spillage	1 (9.1)
Surgical site infection	1 (9.1)
Cystitis	2 (18.2)
Length of stay *(h)*	48 (24 – 96)

Data are presented as median (range) or absolute number (percentage).

4. Discussion

The role of MIS in gynecological oncology has undergone progressive development. This has involved introducing both conventional and robot-assisted laparoscopic techniques, which have demonstrated their feasibility and efficacy in staging and treating uterus-confined endometrial cancer [13,22,23]. In the case of early-stage ovarian cancer, the latest international guidelines maintain that the standard procedure for the treatment and staging of ovarian cancer is midline laparotomy. The rationale behind this is that the open procedure offers more accurate abdominal exploration and a reduced risk of rupture of the primary tumor. Nevertheless, the laparoscopic approach is frequently used worldwide for BOTs and early-stage ovarian cancer, and some studies have shown better surgical outcomes and no difference in recurrence rates or survival for those who received minimally invasive versus open surgical staging [24–28]. However, the oncologic outcomes remain a topic of debate, lacking sufficient high-quality evidence to change current guidelines [2,6,28,29]. To date, only a few publications report a vNOTES approach in the management of ovarian cancer [15,18,19].

According to the current guidelines of the European Society of Gynaecological Oncology (ESGO), surgical management of Stage I to II ovarian cancer must include a total hysterectomy and bilateral salpingo-oophorectomy or fertility-sparing surgery (unilateral salpingo-oophorectomy) in selected patients desiring fertility. Peritoneal washings or cytology, taken before manipulation of the tumor, and peritoneal biopsies with at least infracolic omentectomy are also recommended [30]. Since omentectomy via vNOTES has been proven to be feasible [15,19], in the case of intraoperative diagnosis of BOTs or early-stage ovarian cancer, surgical staging through the same vaginal incision

 doi:10.20944/preprints202410.0987.v1

is possible. In our series, 4 out of 11 patients have an intraoperative BOT diagnosis, and complete peritoneal staging was successfully performed by vNOTES.

A further challenge of the MIS approaches in early-stage ovarian cancers is the ability to perform a complete pelvic and paraaortic lymphadenectomy. However, many early-stage diagnoses are made postoperatively on lesions initially presumed benign [31]. In our series, only one case of STIC was identified preoperatively, 4 BOTs were detected intraoperatively via frozen section, and the last 6 cases were postoperative diagnoses. The survival benefit of complete staging with lymphadenectomy in early-stage ovarian cancer has not been confirmed in prospective trials [31], though it is known that 10-15% of cases are upstaged due to positive nodal involvement [32].

We hypothesize that both the vNOTES technique for pelvic lymphadenectomy and paraaortic lymphadenectomy can be successfully applied to early-stage ovarian malignancies. The vNOTES approach for pelvic lymphadenectomy was first described in 2014, with subsequent validation by other authors [33–35]. Additionally, in 2024, a hybrid technique combining vNOTES with a single-port retroperitoneal approach for pelvic and infrarenal paraaortic lymphadenectomy was reported [36]. For patients diagnosed intraoperatively with early-stage invasive ovarian cancer requiring both pelvic and paraaortic lymphadenectomy, a vNOTES hybrid approach, may be an option [36–38]. If restaging is required, the absence of an abdominal peritoneal scar after retroperitoneal vNOTES can simplify the subsequent procedure.

One limitation of VNOTES staging is the restricted accessibility of certain anatomical regions, including the prevesical peritoneum, the posterior costodiaphragmatic recesses, the Morrison's pouch, the lesser omentum, the omental foramen and bursa and the mesenteric root. Nevertheless, some of these regions can also be challenging to examine using conventional laparoscopy. In our series, in one patient we used a hybrid approach to explore and subsequently to excise the peritoneal disease completely.

The duration of vNOTES and standard laparoscopic procedures for early stages of adnexal malignancies seems equivalent. Data in the literature is heterogeneous, comparing the time of the open versus MIS approach with no clear advantage for one or another. The surgeons' experience may be the main factor influencing the operating time [6,7,29,39]. The blood loss reported in our series is low and consistent with existing literature [6,7,29,39].

In our series, perioperative complication rates were low. No intraoperative complications were noted, except for one case of minimal ovarian spillage during adnexal extraction in endobag (9,1%). This is crucial as spillage can lower survival rates, and is associated with an upstaging of the tumor [39–41]. Some studies suggest a higher risk of cyst rupture with laparoscopic cystectomy, which may be reduced if adnexectomy is performed rather than cystectomy [42]. Evidence on spillage risk with vNOTES is scarce but appears similar to the laparoscopic approach [3,43,44]. Tumor spillage might occur even in large laparotomies, raising the possibility that aggressive biology associated with more adherent and fragile tumors may be responsible for rupture more than the surgical approach[31].

Lower rates of all types of complications have been reported with the vNOTES approach in benign indications, ranging from 2.5% to 4.1% [45–47]. Laparoscopy has been demonstrated to significantly reduce the duration of hospitalization compared to laparotomy [48], a finding consistent with our series, which had a median hospital stay of 48 (24 – 96) hours. Postoperative complications related to surgery were minimal in our cohort, with one case surgical site infection (9.1%) and 2 cases of cystitis (18.2%), all successfully treated with antibiotics.

In the vNOTES approach, the single vaginal scar can improve the rapid post-operative recovery. Fast recovery is particularly important for the management of malignant cases, allowing for the earlier administration of adjuvant treatments. In our series, the median time from surgery to adjuvant therapy was 23 (19 – 31) days. Present recommendations endorse starting adjuvant treatments 28 to 42 days after the surgery [49,50].

Abdominal port site metastases has been an important concern in MIS for intra-abdominal malignancies. The vNOTES approach offers an advantage, particularly in patients requiring hysterectomy, by eliminating the need for additional abdominal incisions. For adnexal surgery, vNOTES limits this concern by the presence of a single vaginal incision. Furthermore, vNOTES

 doi:10.20944/preprints202410.0987.v1

allows extraction of masses of up to 6-7 cm without the need for morcelation or puncture. For bigger sizes, adnexal mass extraction after puncture in surgical bags is possible with the same approaches as with standard laparoscopy [3]. Baekelandt et al. have recently described a technique for bagging a 20 cm BOTs via vNOTES without spillage [20].

We acknowledge limitations in this study, notably the small sample size, which limits comparative analysis with other methods. Additionally, case heterogeneity and short follow-up as well as single-center setting with only one oncogynecological surgeon reduce generalizability. However, our focus on early surgical outcomes supports the feasibility of vNOTES for selected early-stage ovarian cancer patients, with potential benefits in perioperative morbidity and quality of life.

5. Conclusions

Despite the limited cohort size, our findings indicate the technical feasibility of vNOTES for selected patients with early-stage ovarian cancer, with potential benefits in reducing perioperative morbidity, improving postoperative quality of life and potential earlier introduction of adjuvant therapies. Further research with larger cohorts and extended follow-up is needed to assess the long-term oncological outcomes and safety of this technique.

Author Contributions: G.K. and J.N. have contributed equally to this work as first authors. Conceptualization, G.K, J.N. and D.H.; methodology, G.K and J.N.; formal analysis, G.K, J.N. and D.H.; data curation, Y.H. and D.H.; writing – original draft preparation, G.K and J.N.; writing – review and editing, J.N., Y.H. and D.H.; supervision, D.H.; project administration, D.H. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki. This study was approved by the institutional review board: project-ID 2021-02346 (21/01/2021, CER-VD, Lausanne, Switzerland).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. Written informed consent has been obtained from the patients to publish this paper.

Data Availability Statement: The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Hasenburg A, Eichkorn D, Vosshagen F, Obermayr E, Geroldinger A, Zeillinger R, et al. Biomarker-based early detection of epithelial ovarian cancer based on a five-protein signature in patient's plasma – a prospective trial. BMC Cancer 2021;21:1037. https://doi.org/10.1186/s12885-021-08682-y.
2. Falcetta FS, Lawrie TA, Medeiros LR, da Rosa MI, Edelweiss MI, Stein AT, et al. Laparoscopy versus laparotomy for FIGO stage I ovarian cancer. Cochrane Database Syst Rev 2016;2016:CD005344. https://doi.org/10.1002/14651858.CD005344.pub4.
3. Baekelandt J, De Mulder PA, Le Roy I, Mathieu C, Laenen A, Enzlin P, et al. Adnexectomy by vaginal Natural Orifice Transluminal Endoscopic Surgery versus laparoscopy: results of a first randomised controlled trial (NOTABLE trial). BJOG Int J Obstet Gynaecol 2021;128:1782–91. https://doi.org/10.1111/1471-0528.16838.
4. Capozzi VA, De Finis A, Scarpelli E, Gallinelli A, Monfardini L, Cianci S, et al. Infectious Complications in Laparoscopic Gynecologic Oncology Surgery within an ERAS-Compliant Setting. J Pers Med 2024;14:147. https://doi.org/10.3390/jpm14020147.
5. Weber S, McCann CK, Boruta DM, Schorge JO, Growdon WB. Laparoscopic surgical staging of early ovarian cancer. Rev Obstet Gynecol 2011;4:117–22.
6. Ghezzi F, Cromi A, Uccella S, Bergamini V, Tomera S, Franchi M, et al. Laparoscopy versus laparotomy for the surgical management of apparent early stage ovarian cancer. Gynecol Oncol 2007;105:409–13. https://doi.org/10.1016/j.ygyno.2006.12.025.
7. Chi DS, Abu-Rustum NR, Sonoda Y, Ivy J, Rhee E, Moore K, et al. The safety and efficacy of laparoscopic surgical staging of apparent stage I ovarian and fallopian tube cancers. Am J Obstet Gynecol 2005;192:1614–9. https://doi.org/10.1016/j.ajog.2004.11.018.

8. Colomer AT, Jiménez AM, Bover Barceló MI. Laparoscopic treatment and staging of early ovarian cancer. J Minim Invasive Gynecol 2008;15:414–9. https://doi.org/10.1016/j.jmig.2008.04.002.
9. Ferro R, Hurni Y, Seidler S, Huber D. Transvaginal natural orifice transluminal endoscopic surgery (vNOTES) in gynecological emergencies. Eur J Obstet Gynecol Reprod Biol X 2023;20:100261. https://doi.org/10.1016/j.eurox.2023.100261.
10. McCulloch P, Altman DG, Campbell WB, Flum DR, Glasziou P, Marshall JC, et al. No surgical innovation without evaluation: the IDEAL recommendations. Lancet Lond Engl 2009;374:1105–12. https://doi.org/10.1016/S0140-6736(09)61116-8.
11. Huber D, Hurni Y. Sentinel Node Biopsy for Endometrial Cancer by Retroperitoneal Transvaginal Natural Orifice Transluminal Endoscopic Surgery: A Preliminary Study. Front Surg 2022;9:907548. https://doi.org/10.3389/fsurg.2022.907548.
12. Huber D, Hurni Y. Anatomical Distribution of Sentinel Lymph Nodes Harvested by Retroperitoneal vNOTES in 34 Consecutive Patients With Early-Stage Endometrial Cancer: Analysis of 124 Lymph Nodes. J Minim Invasive Gynecol 2024;31:438–44. https://doi.org/10.1016/j.jmig.2024.02.007.
13. Lee C-L, Liu H-M, Khan S, Lee P-S, Huang K-G, Yen C-F. Vaginal natural orifice transvaginal endoscopic surgery (vNOTES) surgical staging for endometrial carcinoma: The feasibility of an innovative approach. Taiwan J Obstet Gynecol 2022;61:345–52. https://doi.org/10.1016/j.tjog.2022.02.026.
14. Baekelandt J, Jespers A, Huber D, Badiglian-Filho L, Stuart A, Chuang L, et al. vNOTES retroperitoneal sentinel lymph node dissection for endometrial cancer staging: First multicenter, prospective case series. Acta Obstet Gynecol Scand 2024;103:1311–7. https://doi.org/10.1111/aogs.14843.
15. Hurni Y, Huber D. Omentectomy for oncological surgical staging by transvaginal natural orifice transluminal endoscopic surgery (vNOTES): a preliminary study. Front Surg 2023;10:1224770. https://doi.org/10.3389/fsurg.2023.1224770.
16. Huber D, Hurni Y. Sentinel Lymph Node Mapping by Retroperitoneal vNOTES for Uterus-Confined Malignancies: A Standardized 10-Step Approach. Cancers 2024;16:2142. https://doi.org/10.3390/cancers16112142.
17. Şimşek E, Yıldız ÖA, Gündüz S, Karakaş S, Yaşar L. vNOTES scarless and painless endometrial cancer staging surgery. J Obstet Gynaecol Res 2024;50:1965–70. https://doi.org/10.1111/jog.16083.
18. Hurni Y, Romito F, Huber D. Transvaginal Natural Orifice Transluminal Endoscopic Surgery for Surgical Staging of Early-Stage Ovarian Cancers: A Report of Two Cases. Front Surg 2022;9:833126. https://doi.org/10.3389/fsurg.2022.833126.
19. Lowenstein L, Matanes E, Lauterbach R, Boulus S, Amit A, Baekelandt J. Transvaginal Natural Orifice Transluminal Endoscopic Surgery (vNOTES) for omentectomy - A case series. Surg Oncol 2020;34:186–9. https://doi.org/10.1016/j.suronc.2020.04.018.
20. Baekelandt J, Van Camp J, Vercammen L, Stuart A. Too big to bag? - Technique for bagging very large adnexal masses via vNOTES. J Gynecol Obstet Hum Reprod 2024:102857. https://doi.org/10.1016/j.jogoh.2024.102857.
21. Dindo D, Demartines N, Clavien P-A. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg 2004;240:205–13. https://doi.org/10.1097/01.sla.0000133083.54934.ae.
22. Deng L, Liu Y, Yao Y, Deng Y, Tang S, Sun L, et al. Efficacy of vaginal natural orifice transluminal endoscopic sentinel lymph node biopsy for endometrial cancer: a prospective multicenter cohort study. Int J Surg Lond Engl 2023;109:2996–3002. https://doi.org/10.1097/JS9.0000000000000551.
23. Wang Y, Deng L, Tang S, Dou Y, Yao Y, Li Y, et al. vNOTES Hysterectomy with Sentinel Lymph Node Mapping for Endometrial Cancer: Description of Technique and Perioperative Outcomes. J Minim Invasive Gynecol 2021;28:1254–61. https://doi.org/10.1016/j.jmig.2021.01.022.
24. Ds C, Nr A-R, Y S, J I, E R, K M, et al. The safety and efficacy of laparoscopic surgical staging of apparent stage I ovarian and fallopian tube cancers. Am J Obstet Gynecol 2005;192. https://doi.org/10.1016/j.ajog.2004.11.018.
25. Radosa JC, Radosa MP, Schweitzer PA, Juhasz-Boess I, Rimbach S, Solomayer E-F. Report of the survey on current opinions and practice of German Society for Gynecologic Endoscopy (AGE) members regarding the laparoscopic treatment of ovarian malignancies. Arch Gynecol Obstet 2018;297:1255–64. https://doi.org/10.1007/s00404-018-4709-5.
26. Brockbank EC, Harry V, Kolomainen D, Mukhopadhyay D, Sohaib A, Bridges JE, et al. Laparoscopic staging for apparent early stage ovarian or fallopian tube cancer. First case series from a UK cancer centre and systematic literature review. Eur J Surg Oncol J Eur Soc Surg Oncol Br Assoc Surg Oncol 2013;39:912–7. https://doi.org/10.1016/j.ejso.2013.05.007.
27. Lu Q, Qu H, Liu C, Wang S, Zhang Z, Zhang Z. Comparison of Laparoscopy and Laparotomy in Surgical Staging of Apparent Early Ovarian Cancer: 13-year Experience. Medicine (Baltimore) 2016;95:e3655. https://doi.org/10.1097/MD.0000000000003655.

28. Park HJ, Kim DW, Yim GW, Nam EJ, Kim S, Kim YT. Staging laparoscopy for the management of early-stage ovarian cancer: a metaanalysis. Am J Obstet Gynecol 2013;209:58.e1-8. https://doi.org/10.1016/j.ajog.2013.04.013.
29. Park J-Y, Bae J, Lim MC, Lim SY, Seo S-S, Kang S, et al. Laparoscopic and laparotomic staging in stage I epithelial ovarian cancer: a comparison of feasibility and safety. Int J Gynecol Cancer Off J Int Gynecol Cancer Soc 2008;18:1202–9. https://doi.org/10.1111/j.1525-1438.2008.01190.x.
30. Querleu D, Planchamp F, Chiva L, Fotopoulou C, Barton D, Cibula D, et al. European Society of Gynaecological Oncology (ESGO) Guidelines for Ovarian Cancer Surgery. Int J Gynecol Cancer 2017;27:1534–42. https://doi.org/10.1097/IGC.0000000000001041.
31. Somasegar S, Anastasio MK, Karam A, Rossi EC, Obermair A. Controversies in the Surgical Management of Gynecologic Cancer: Balancing the Decision to Operate or Hesitate. Am Soc Clin Oncol Educ Book 2024;44:e438550. https://doi.org/10.1200/EDBK_438550.
32. Morice P, Joulie F, Camatte S, Atallah D, Rouzier R, Pautier P, et al. Lymph Node Involvement in Epithelial Ovarian Cancer: Analysis of 276 Pelvic and Paraaortic Lymphadenectomies and Surgical Implications. J Am Coll Surg 2003;197:198–205. https://doi.org/10.1016/S1072-7515(03)00234-5.
33. Oh SH, Park SJ, Lee EJ, Yim GW, Kim HS. Pelvic lymphadenectomy by vaginal natural orifice transluminal endoscopic surgery (vNOTES) for early-stage endometrial cancer. Gynecol Oncol 2019;153:211–2. https://doi.org/10.1016/j.ygyno.2019.01.003.
34. Baekelandt JF. New Retroperitoneal Transvaginal Natural Orifice Transluminal Endoscopic Surgery Approach to Sentinel Node for Endometrial Cancer: A Demonstration Video. J Minim Invasive Gynecol 2019;26:1231–2. https://doi.org/10.1016/j.jmig.2019.05.002.
35. Lee C-L, Wu K-Y, Tsao F-Y, Huang C-Y, Han C-M, Yen C-F, et al. Natural orifice transvaginal endoscopic surgery for endometrial cancer. Gynecol Minim Invasive Ther 2014;3:89–92. https://doi.org/10.1016/j.gmit.2014.08.004.
36. Can B, Akgöl S, Adıgüzel Ö, Kaya C. A new, less invasive approach for retroperitoneal pelvic and para-aortic lymphadenectomy combining the transvaginal natural orifice transluminal endoscopic surgery (vNOTES) technique and single-port laparoscopy. Int J Gynecol Cancer 2024;34:789–90. https://doi.org/10.1136/ijgc-2023-005093.
37. Jung US, Choi JS, Bae J, Lee WM, Eom JM. Systemic Laparoscopic Para-Aortic Lymphadenectomy to the Left Renal Vein. JSLS 2019;23:e2018.00110. https://doi.org/10.4293/JSLS.2018.00110.
38. Foresta A, Capomacchia FM, Certelli C, Caricato C, Fagotti A, Scambia G, et al. Robotic staging for early ovarian cancer in 10 steps. Int J Gynecol Cancer 2024;34:1649–50. https://doi.org/10.1136/ijgc-2023-005135.
39. Droste A, Anic K, Hasenburg A. Laparoscopic Surgery for Ovarian Neoplasms - What is Possible, What is Useful? Geburtshilfe Frauenheilkd 2022;82:1368–77. https://doi.org/10.1055/a-1787-9144.
40. Vergote I, De Brabanter J, Fyles A, Bertelsen K, Einhorn N, Sevelda P, et al. Prognostic importance of degree of differentiation and cyst rupture in stage I invasive epithelial ovarian carcinoma. Lancet Lond Engl 2001;357:176–82. https://doi.org/10.1016/S0140-6736(00)03590-X.
41. Matsuo K, Huang Y, Matsuzaki S, Klar M, Roman LD, Sood AK, et al. Minimally Invasive Surgery and Risk of Capsule Rupture for Women With Early-Stage Ovarian Cancer. JAMA Oncol 2020;6:1110–3. https://doi.org/10.1001/jamaoncol.2020.1702.
42. Gal D, Lind L, Lovecchio JL, Kohn N. Comparative study of laparoscopy vs. laparotomy for adnexal surgery: efficacy, safety, and cyst rupture. J Gynecol Surg 1995;11:153–8. https://doi.org/10.1089/gyn.1995.11.153.
43. Wang C-J, Wu P-Y, Kuo H-H, Yu H-T, Huang C-Y, Tseng H-T. Natural orifice transluminal endoscopic surgery-assisted versus laparoscopic ovarian cystectomy (NAOC vs. LOC): a case-matched study. Surg Endosc 2016;30:1227–34. https://doi.org/10.1007/s00464-015-4315-6.
44. Li C-B, Hua K-Q. Transvaginal natural orifice transluminal endoscopic surgery (vNOTES) in gynecologic surgeries: A systematic review. Asian J Surg 2020;43:44–51. https://doi.org/10.1016/j.asjsur.2019.07.014.
45. Hou Q, Li X, Li Y, Zhang Q, Liu T, Huang L, et al. Analysis and suggestions on the complications in 2000 cases of transvaginal natural orifice transluminal endoscopic surgery: Can it be a conventional surgery? Int J Gynaecol Obstet Off Organ Int Fed Gynaecol Obstet 2024;164:541–9. https://doi.org/10.1002/ijgo.15035.
46. Baekelandt J, Kapurubandara S. Benign Gynaecological procedures by vaginal Natural Orifice Transluminal Endoscopic Surgery (vNOTES): Complication data from a series of 1000 patients. Eur J Obstet Gynecol Reprod Biol 2021;256:221–4. https://doi.org/10.1016/j.ejogrb.2020.10.059.
47. Huang L, Feng D, Gu D-X, Lin Y-H, Gong Z-L, Liu D-D, et al. Transvaginal natural orifice transluminal endoscopic surgery in gynecological procedure: Experience of a Women's and Children's Medical Center from China. J Obstet Gynaecol Res 2022;48:2926–34. https://doi.org/10.1111/jog.15402.
48. Medeiros LRF, Rosa DD, Bozzetti MC, Rosa MI, Edelweiss MI, Stein AT, et al. Laparoscopy versus laparotomy for FIGO Stage I ovarian cancer. Cochrane Database Syst Rev 2008:CD005344. https://doi.org/10.1002/14651858.CD005344.pub2.

 doi:10.20944/preprints202410.0987.v1

49. ARCAGY-GINECO DBP-. Cancer de l'ovaire - Les traitements selon les stades. Infocancer 2024. https://www.arcagy.org/infocancer/localisations/cancers-feminins/cancer-de-l-ovaire/traitements/les-traitements-selon-les-stades.html/ (accessed September 9, 2024).
50. Bolze P-A, Collinet P, Golfier F, Bourgin C. [Surgery in early-stage ovarian cancer: Article drafted from the French Guidelines in oncology entitled "Initial management of patients with epithelial ovarian cancer" developed by FRANCOGYN, CNGOF, SFOG, GINECO-ARCAGY under the aegis of CNGOF and endorsed by INCa]. Gynecol Obstet Fertil Senol 2019;47:168–79. https://doi.org/10.1016/j.gofs.2018.12.007.