

Evaluating the Outcomes of Vaginal Natural Orifice Transluminal Endoscopic Surgery (vNOTES) for Gynecologic Procedures at KAUH

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ABSTRACT

Vaginal natural orifice transluminal endoscopic surgery (vNOTES) is a new surgical approach that combines endoscopic benefits with the vaginal route for various gynecological issues. vNOTES is based on minimally invasive surgery, which offers several advantages, including shorter operative time, less blood loss, and reduced postoperative pain in procedures such as adnexal surgery, myomectomy, hysterectomy, and rectal prolapse repair. The aim of this study was to evaluate the feasibility, safety, and clinical outcomes of vNOTES for gynecological procedures by comparing preoperative and postoperative variables and assessing patient satisfaction. This retrospective observational study was conducted at King Abdulaziz University Hospital (KAUH), Saudi Arabia, and involved patients who underwent vNOTES for gynecologic procedures between January 2025 and April 2025. The patients' perioperative and postoperative data were primarily collected and analyzed from the hospital's electronic medical records. All patients were satisfied with the vNOTES approach. One (11.1%) of the nine patients experienced mild vaginal bleeding. The patient who underwent conversion to laparotomy had high blood loss and the second-longest operative time. There were significant differences in operative times among the procedural subgroups, and blood loss was directly associated with operative duration. This study supports the feasibility and safety of the vNOTES for benign gynecologic procedures, although further multicenter studies with large sample sizes are needed.

Keywords: Vaginal natural orifice transluminal endoscopic surgery, vNOTES, Minimally invasive gynecologic surgery, Benign gynecologic disease, Gynecologic surgery

INTRODUCTION

Vaginal natural orifice transluminal endoscopic surgery (vNOTES) represents an evolution in minimally invasive gynecologic surgery, which combines endoscopic visualization with transvaginal access^{1,2}. Since its initial description in 2004 and first clinical application in 2012, vNOTES has been increasingly adopted for a variety of benign gynecological procedures^{2,3}. Unlike traditional laparoscopy, vNOTES utilizes the vaginal canal to insert a single-port device, allowing instruments to access the peritoneal cavity without the need for an abdominal incision and potentially improving postoperative recovery².

Advances in endoscopic and single-site laparoscopic techniques have contributed to the evolution of vNOTES⁴. Compared with conventional laparoscopy, it offers advantages such as a reduced operative time, less intraoperative blood loss, faster recovery, shorter hospitalization, and improved cosmetic outcomes^{5,6}. Among all natural orifice approaches, the transvaginal route has become the preferred choice for NOTES because of its lower contamination risk, better visualization, easier closure, and improved healing^{4,6}. This method has been successfully used for procedures such as adnexal surgery, myomectomy, hysterectomy, and rectal prolapse repair².

Despite the growing preference for vNOTES, there are no published data on the feasibility, safety, or outcomes of vNOTES at our institution or in the region. Therefore, this case series aims to evaluate the feasibility, safety, and perioperative outcomes of vNOTES for

gynecological surgeries at King Abdulaziz University Hospital (KAUH). This will guide clinical practice, optimize protocols, and inform future comparative studies on the efficacy of vNOTES.

METHODOLOGY

This single-center retrospective observational study was conducted at King Abdulaziz University Hospital (KAUH), Saudi Arabia, between January 2025 and April 2025. The study included all patients who underwent vNOTES surgery or were later converted to laparotomy for various benign gynecological indications during the study period. Women were eligible if they had preoperative, intraoperative, and postoperative clinical records and underwent vNOTES or were converted to laparotomy for gynecological conditions. Patients with incomplete or missing key medical records were excluded.

A standardized data extraction form was designed to collect data from the hospital's electronic health records. Patient demographic data included age, body mass index (BMI), gravidity, parity, medical history, history of cesarean section, and history of abdominal surgery. Preoperative variables included indications for surgery, diagnosis, preoperative imaging, and hemoglobin (Hb) levels. Additionally, consent was obtained from all patients before surgery. Data on the procedure performed, operative time, blood loss, and observed complications were included in the intraoperative section. Postoperative data included length of hospital stay, late complications, follow-up visits, readmissions, and patient satisfaction.

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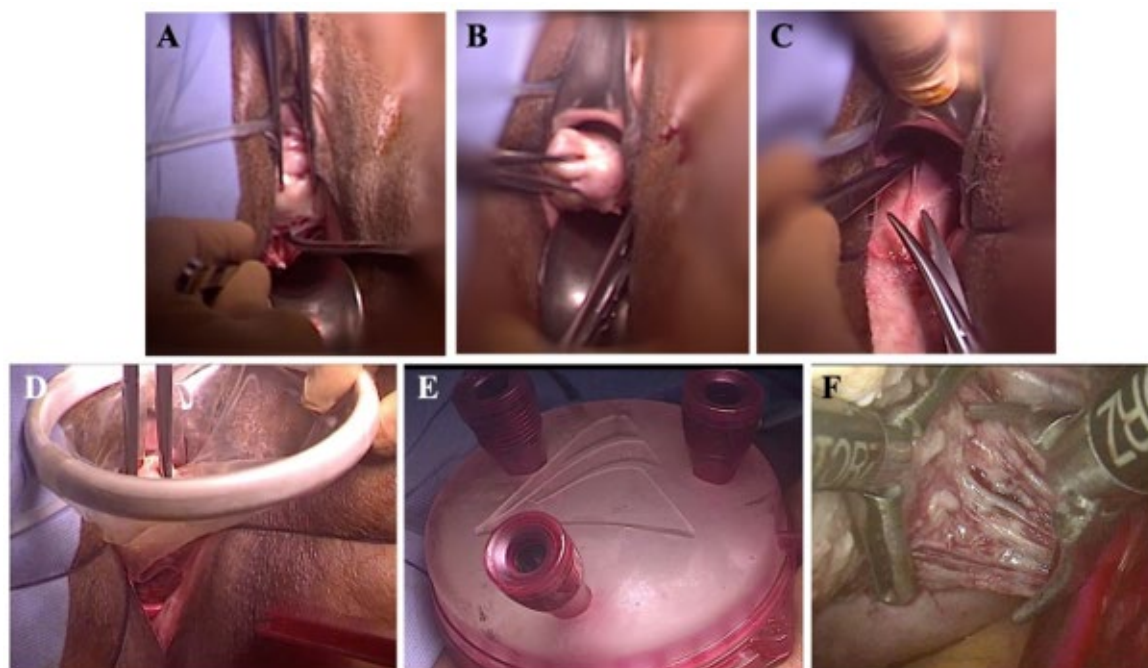


Figure 1. Intraoperative images during the vNOTES surgical procedure. The representative intraoperative images illustrate the steps involved in vNOTES hysterectomy surgery. A: Posterior colpotomy and transperitoneal entry; B: Completion of anterior colpotomy and confirmation of abdominal access; C: Transection of the uterosacral ligaments (USL); D: Placement of a traditional glove access platform; E: Placement of a commercial platform (GelPOINT Access System®) and configuration of ports; F: Transection of the uterine and cornual pedicles. Abbreviations: USL (uterosacral ligament); vNOTES (vaginal natural orifice transluminal endoscopic surgery).

The primary outcomes were the feasibility and safety of the vNOTES procedure, which was determined by successful completion of vNOTES without conversion to laparotomy and the absence of major intraoperative or postoperative complications. The secondary outcomes included operative time, blood loss, conversion rate, length of hospital stay, and self-reported patient satisfaction.

To illustrate the operative sequence and key safety checks, Figure 1 shows representative intraoperative images of the vNOTES hysterectomy procedure. Posterior and anterior colpotomies are performed for transperitoneal access. A transvaginal access platform is secured, using both a traditional glove platform and a commercial device (GelPOINT Access System®, Applied Medical, CA, USA). It enables visualization and instrument triangulation. The process continues with sealing and dividing the uterine and cornual pedicles.

To obtain insights from the data, statistical analysis was conducted via GraphPad Prism 10. The data were first cleaned and categorized as continuous or categorical variables. The Shapiro–Wilk test was used to assess the normality of the continuous variables. Normally distributed data are reported as the mean $\pm$ standard deviation, whereas nonnormally distributed data are summarized as the median. The relationships between continuous variables were examined via simple linear regression, and the relationships between continuous variables and categorical subgroups were analyzed via the Mann–Whitney U test.

RESULTS

Nine women who underwent vNOTES for benign gynecological indications between January 2025 and April 2025 for various gynecological procedures were included in this study. Table 1 summarizes the patient demographics, clinical characteristics, and preoperative data.

The patient demographics and preoperative data, including a history of abdominal surgery, indications for surgery, X-ray results, pelvic ultrasound imaging, and diagnostic results, are displayed in the table above. Abbreviations: Pre DM (prediabetes mellitus); Hb (hemoglobin); CS (cesarean section); g/dL (grams per decilitre).

The mean age was 54.6 ± 8.5 years, ranging from 44–72 years, and the mean BMI was 34.3 ± 4.5 kg/m². All patients were multiparous, with parity ranging from 4–10, and none had a history of cesarean section. Hypertension and thyroid-related disorders were the most common comorbidities (33.3% each), followed by asthma, Addison’s disease, prediabetes, and dyslipidemia. Two patients had more than two comorbidities, while three had no medical history of such conditions. Previous abdominal surgeries were reported in six patients (66.7%), the most common being laparoscopic cholecystectomy and appendectomy.

More than half of the women ($n=5$, 55%) were diagnosed with uterovaginal/genital prolapse followed by abnormal uterine/vaginal/postmenopausal bleeding; hypertrophy of the uterus; and disorders related to the ovary, fallopian tube, and broad ligament. Preoperative imaging consisted mainly of chest X-ray and pelvic ultrasound; the imaging tests used for diagnosis. Four patients were found to be anemic ($Hb < 12$ g/dL), with the lowest recorded Hb value of 8.5 g/dL.

Four patients underwent (44.4%) single surgeries, including vaginal salpingectomy or hysterectomy. In contrast, the remaining five (55.5%) patients underwent additional complex surgeries, including anterior and posterior (AP) repair, uterosacral ligament suspension (USLS), cystocele and rectocele repair, sacrospinous ligament suspension (SSLS), uterosacral ligament fixation (USLF), tension-free vaginal tape (TVT), and posterior repair, each in different patients. The longest operative time, 339 minutes, was recorded in a patient who underwent single-surgery procedures, including USLS and posterior repair. One patient was converted to laparotomy, had the second-longest operative

Table 1. Baseline patient demographics and clinical characteristics

Variables	Patients (n = 9)
Age (years)	54.6 ± 8.5 (range, 44-72)
BMI (kg/m ²)	34.3 ± 4.47 (range, 28.9-43.8)
No patient had a previous CS.	-
Gravidity & Parity	Multiparous (>4)
Medical History	
Hypertension	3 (33.3%)
Thyroid	3 (33.3%)
Addison's disease	1 (11.1%)
Asthmatic	1 (11.1%)
Medically free	3 (33.3%)
Pre DM/Dyslipidemia	1 (11.1%)
Patient >2 comorbidities	2 (22.2%)
Surgical history	
Laparoscopic cholecystectomy	2 (22.2%)
Appendectomy	2 (22.2%)
Endoscopy	1 (11.1%)
Myomectomy	1 (11.1%)
Bartholin cyst incision and drainage	1 (11.1%)
No surgical history	3 (33.3%)
Indications (Some are with multiple indications)	
Abnormal uterine/vaginal/postmenopausal bleeding	5 (55.5%)
Genital prolapse/Uterine prolapse	5 (55.5%)
Preoperative Imaging	
Chest X-ray	7 (77.8%)
Chest X-ray and Pelvic ultrasound	2 (22.2%)
Diagnosis	
Abnormal uterine/vaginal/postmenopausal bleeding	4(44.4%)
Female uterovaginal/genital prolapse	5 (55.5%)
Benign neoplasm/hypertrophy of the uterus	1 (11.1%)
Noninflammatory disorder of the ovary, fallopian tube, and broad ligament Unspecified	1 (11.1%)
Hb (g/dl)	11.69 ±1.5 (range, 8.5-13.3)

Table 2. Intraoperative and postoperative outcomes

Variables	Patients (n = 9)
Procedures	
Basic vaginal salpingectomy or hysterectomy	4 (44.4%)
Basic with additional procedures	5 (55.5%)
AP repair	1 (11.1%)
USLS, repair of cystocele and rectocele	1 (11.1%)
SSLS, USLF	1 (11.1%)
AP REPAIR, TVT	1 (11.1%)
USLS, posterior repair	1 (11.1%)
Intraoperative Outcomes	
Operative time (min)	211.1 ± 86.7 (range, 81-339)
Blood loss (ml)	200.0 (range, 100-400)
Intraoperative Complications	
Mild vaginal bleeding	1 (11.1%)
None	8 (88.8%)
Postoperative Outcomes	
Conversion to laparotomy	1 (11.1%)
Length of hospital stay	4.0 (range, 2-12)
No late complications	-
Readmission	1 (11.1%)
Patient satisfaction	9 (100%)
Follow-up completion	8 (88.8%)

time (298 minutes), and had the greatest amount of blood loss (400 mL). Mild vaginal bleeding occurred in one patient (11.1%) aged 72 years, with no other intraoperative complications reported.

The intraoperative details, along with postoperative and follow-up outcomes, are shown in Table 2.

Intraoperative and postoperative data for the patients, including procedures performed for gynecological problems, duration of surgery, blood loss, and complications, are summarized in the table above. Postoperative data indicate the length of hospital stay and, more importantly, the absence of complications, resulting in complete patient satisfaction. Abbreviations: AP (anterior and posterior); USLS (uterosacral ligament suspension); SSLS (sacrospinous ligament suspension); USLF (uterosacral ligament fixation); TVT (tension-free vaginal tape).

The mean hospital stay was 4.8 days (range, 2–12 days), with the patients who had the longest hospital stay (12 days) also having the longest operative time (339 minutes). One patient did not attend follow-up visits, and one participated in a visit two weeks later. None of the patients experienced late complications; however, one patient was readmitted for treatment. All patients reported satisfaction with the vNOTES procedure. To gain insights from the data, the variables are correlated with one another, and the differences between the groups are tested. Figure 2 below displays some of the correlations and differences in the surgical procedure groups with respect to operative time.

An inverse relationship was observed between patient age and BMI

($p=0.048$, $R^2=0.4492$), with BMI decreasing with increasing age. A positive association was found between operative time and blood loss ($p=0.0338$, $R^2=0.4974$), indicating more blood loss with longer operative times. The patient with the second-highest operative time, who was converted to laparotomy, had the highest blood loss. No correlation was detected between the operative time and the length of hospital stay. Furthermore, grouping procedure types into single-surgery procedures (SSP) and multiple-surgery procedures (MSP) revealed a difference with respect to operative time ($p=0.0238$). SSP involves basic procedures such as vaginal salpingectomy or hysterectomy, whereas MSP includes all additional procedures listed in Table 2. The differences in surgery indications across operative times and subgroups of surgery types and comorbidities with respect to BMI are displayed in Figure 3. The results also revealed the relationship between hemoglobin levels and the operative time.

Compared with abnormal uterine bleeding (AUB) cases, genital or uterine prolapse (GP/UP) cases were associated with significantly longer operative times ($p = 0.0397$). The AUB group included uterine, vaginal, and postmenopausal bleeding, as well as noninflammatory disorders of the ovary, fallopian tube, and broad ligament. The analysis of single versus multiple procedures in relation to BMI, as shown in Figure 3B, revealed no significant correlation. Hemoglobin levels were directly related to operative time ($R^2 = 0.4909$). The recorded comorbidities are divided into two subgroups: CM+, which includes hypertension, thyroid disorders, and dyslipidemia, and CM-, which includes patients without these conditions. No significant difference in BMI was observed between these groups, suggesting that comorbidities are not linked to BMI in this context.

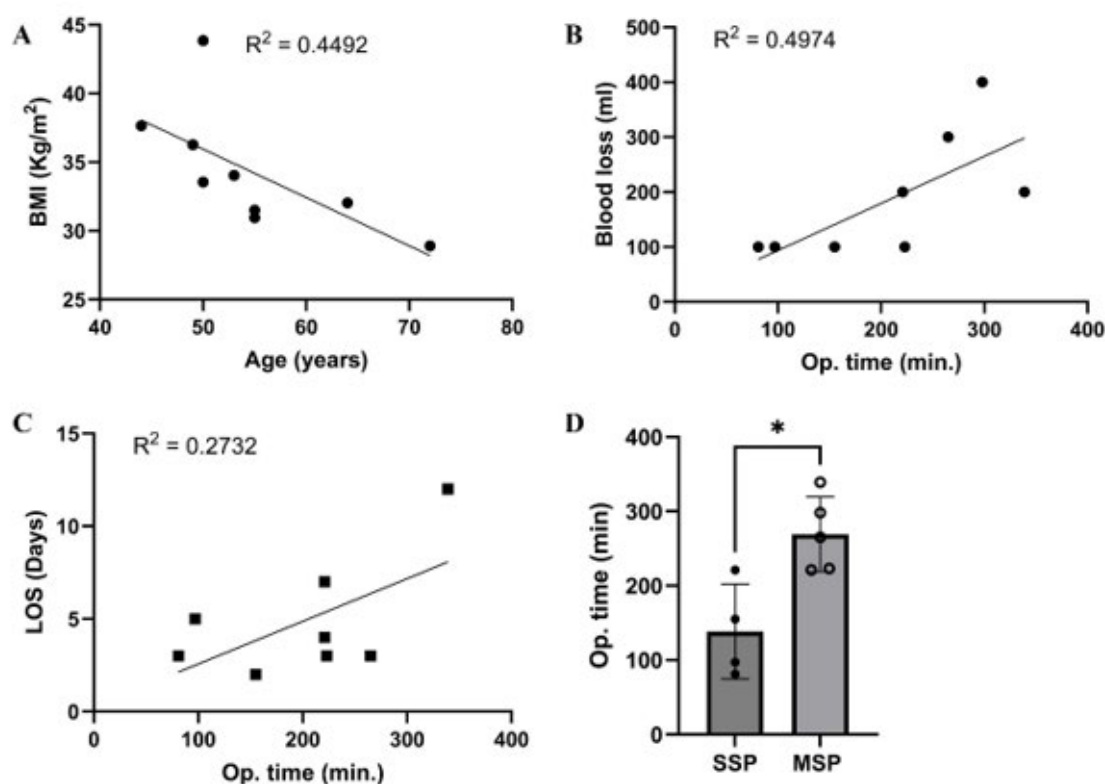


Figure 2. Graphs of comparative analysis between perioperative and postoperative outcomes. The perioperative and postoperative variables are compared in the figure above. A. Age was compared with BMI via a simple linear regression. An inverse relationship is observed, where one variable decreases as the other increases in value. A decline in BMI is observed with increasing age. B. The graph shows an association between operative time and blood loss. C. This graph indicates that there was no statistically significant correlation between the operative time and the length of hospital stay. D. Comparison of procedures grouped into two categories, single surgery (SSP) and multiple surgery (MSP), against operative time revealed a difference between the groups.

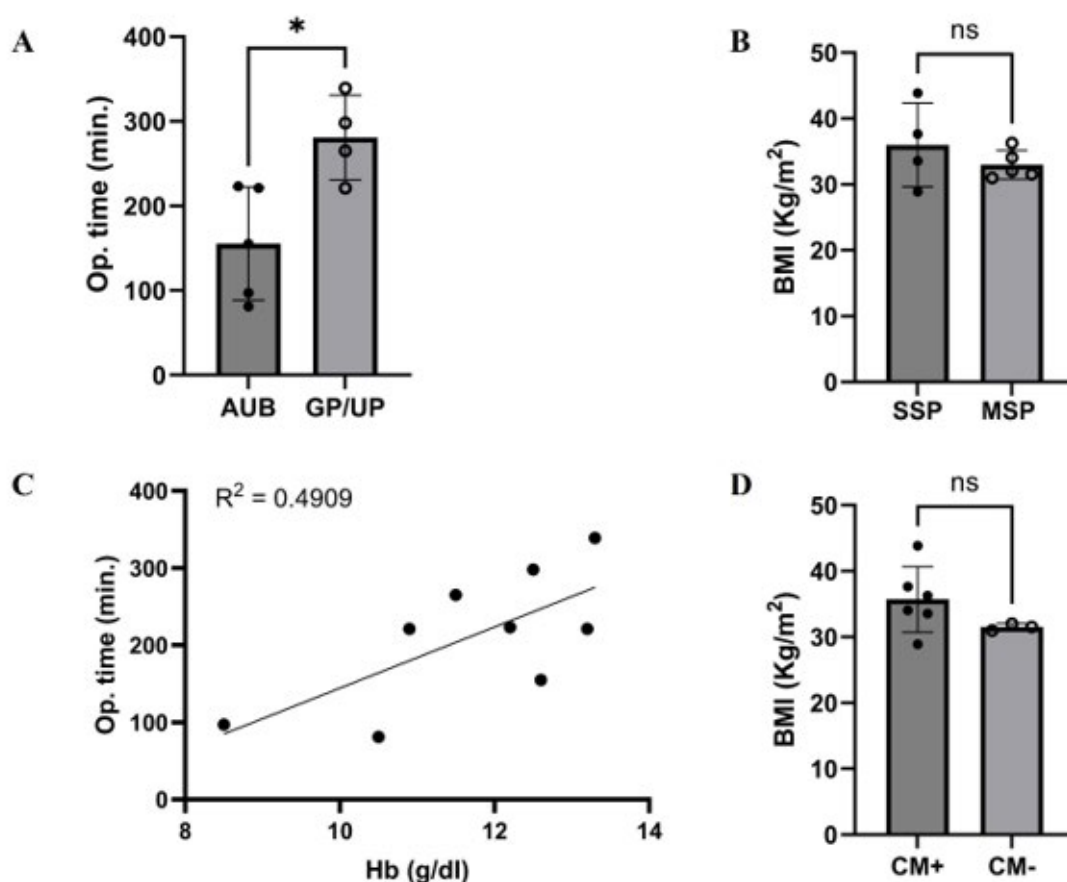


Figure 3. Associations of comorbidities, surgical indications, and preoperative factors with BMI and operative time

A. This graph shows the grouping of surgery indications into two subgroups: abnormal uterine bleeding (AUB) and genital prolapse/uterine prolapse (GP/UP). There was a significant difference in the operative time between these groups. B. No significant difference was observed between simple and complex surgical procedures with respect to BMI. C. An association exists between preoperative Hb and operative time. D. Patient groups with comorbidities such as hypertension, thyroid-related disorders, and dyslipidemia, represented as CM+ patients, and those without comorbidities, represented as CM- patients, did not significantly differ in BMI.

DISCUSSION

Initial institutional experience demonstrated that vNOTES is a feasible and safe approach for managing benign gynecological conditions. In this case series, procedures were completed in nearly all nine patients, with only 1 requiring conversion to laparotomy. The complication rate was low and was limited to one patient (11.1%) who experienced postoperative mild vaginal bleeding. Postoperative data indicate that none of the patients developed late complications. A patient survey revealed that all patients responded positively to this surgical approach.

The mean operative time (211 minutes) of the patients in this study aligns with that of a single-center retrospective study (200 minutes). This case series reported an average hospital stay of 4.8 days, which is relatively longer than the reported hospital stay elsewhere after the vNOTES procedure. A total of 4 complications, including bladder perforation ($n=1$, 1.6%), which occurred in a vNOTES procedure case, were noted⁷.

The study with vNOTES adnexal surgery reported a shorter operative time (38.7 minutes) and minimal blood loss (26 mL) for single surgery procedures, including bilateral salpingectomy or salpingo-oophorectomy, than did this case series, where more than half of the patients ($n = 5$, 55%) underwent more complicated procedures in addition to vaginal salpingectomy or hysterectomy. The present study

also reported shorter hospital stays for patients discharged on the same day of surgery than for this series of patients. In our case, surgeons used the vNOTES technique for the first time in the hospital and in the region, which may be the reason for the longer hospital stays, allowing them to assess the immediate and late complications associated with this technique⁸.

A key strength of this study is the introduction of the vNOTES approach at our institution, providing the first data on its feasibility, safety, and outcomes in this region. This research provides valuable insights to inform clinical practice, enhance training protocols, and support future comparative studies. Comprehensive preoperative and intraoperative data were included, with no missing key variables. This thorough description of surgical procedures highlights the value of vNOTES in complex cases.

The primary limitation of this study is the small sample size, which limits the ability to make broader inferences about the patient population. Data from a single institute might introduce selection bias; thus, multicenter studies are necessary. Additionally, the absence of a comparator group limits the ability to compare different surgical procedures. Patients were followed for only a few weeks, and no long-term follow-up data are available to assess potential complications beyond that period. Additionally, the retrospective design needs to be standardized.

This study provides preliminary evidence about the advantages of the vNOTES surgical approach. Blood loss, operative time, indications managed, complications observed, duration of hospital stay, and patient feedback are key variables that are helpful in patient counseling for vNOTES. There is a need for a prospective, multicenter study with a larger sample size that can help make inferences about the impact of vNOTES on the population. A comparison with a comparable cohort undergoing conventional laparoscopy or vaginal surgery procedures will help determine its efficacy relative to traditional methods. Patients who undergo this type of surgery need to be followed up for an extended period of time.

CONCLUSION

This study demonstrated that vNOTES is a feasible and safe surgical approach for managing benign gynecological conditions. The procedure was successfully performed in most cases, with minimal complications and high patient satisfaction. The operative time was influenced by the complexity of the procedure and the surgical indications, and longer operative durations were associated with greater blood loss. These initial institutional findings provide valuable insight into the practical application of vNOTES and lay the groundwork for future multicenter, comparative studies with larger sample sizes and longer follow-up periods to validate these outcomes.

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Competing Interest: None

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