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Impact of obesity on surgical outcomes after v-NOTES hysterectomy: A single-center retrospective cohort study

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ABSTRACT

Objective: To evaluate the impact of body mass index (BMI) on surgical outcomes in patients undergoing vaginal-natural orifice transluminal endoscopic surgery (v-NOTES) hysterectomy.

Materials and Methods: This single-center retrospective cohort study included 104 women who underwent v-NOTES hysterectomy for gynecologic indications between May 2023 and March 2025. Patients were divided into two groups according to BMI: Group 1 (<30 kg/m², n=62) and Group 2 (≥30 kg/m², n=42). Demographic characteristics, operative time, uterine weight, conversion rates, hemoglobin change, hospital stay, and intra- and postoperative complications were compared. All procedures were performed by two surgeons experienced in both endoscopic and vaginal surgery, following a standardized ten-step v-NOTES technique.

Results: The median age was 54 years and the median BMI was 28 kg/m². Uterine weight was significantly higher in the obese group compared to the non-obese group (255 g vs. 172 g; p=0.020). However, there were no significant differences in operative time (44 vs. 47 minutes; p=0.169), conversion rates (1.6% vs. 4.8%; p=0.346), complication rates (3.2% vs. 4.8%; p=0.462), or hospital stay (48 hours in both groups; p=0.904). All complications were minor and successfully managed conservatively without reoperation.

Conclusion: Despite higher uterine weights in obese patients, surgical outcomes of v-NOTES hysterectomy were comparable between obese and non-obese women. These findings highlight the safety and feasibility of v-NOTES as a minimally invasive option across different BMI groups, supporting its broader application in gynecologic surgery.

Keywords: v-NOTES hysterectomy; body mass index; obesity; minimally invasive surgery; surgical outcomes

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INTRODUCTION

Vaginal-natural orifice transluminal endoscopic surgery (v-NOTES) is an innovative minimally invasive surgical technique that combines the advantages of both laparoscopic and vaginal approaches and has gained widespread acceptance among surgeons over the past decade.[1,2] By avoiding an abdominal incision, v-NOTES offers distinct advantages, including reduced postoperative pain, shorter recovery time, improved cosmetic outcomes, and lower complication rates.[3,4]

Obesity is strongly associated with increased technical difficulties and higher complication risks in gynecologic surgery.[5] In abdominal procedures, obese patients are frequently associated with greater blood loss, prolonged operative times, and delayed postoperative recovery.[6,7] Consequently, minimally invasive approaches have gained particular importance in this population, and v-NOTES has emerged as a promising alternative, especially for patients with risk factors such as obesity.[8]

While the safety and efficacy of laparoscopic and vaginal hysterectomy in obese women have been extensively studied, evidence regarding v-NOTES, particularly across different body mass index (BMI) categories, remains scarce.[9,10] Obesity-related pelvic anatomical changes, limited instrument manoeuvrability, and visualization difficulties represent potential barriers to the use of v-NOTES. However, with increasing surgical expertise and advances in technology, emerging evidence indicates that v-NOTES can also be performed safely in obese patients.[11,12]

In this context, evaluating the impact of BMI on surgical outcomes in patients undergoing v-NOTES hysterectomy is crucial to determine the safety and feasibility of this approach across different patient groups. This study aimed to compare operative time, complication rates, conversion to conventional laparoscopy, and length of hospital stay between patients with BMI <30 and those with BMI ≥30, thereby assessing the applicability of v-NOTES in obese women.

MATERIALS AND METHODS

This study was designed as a single-centre, retrospective cohort analysis. The medical records of patients who underwent v-NOTES hysterectomy for gynecologic indications between May 2023 and March 2025 were retrospectively reviewed. The study protocol was approved by the Institutional Review Board of University of Health Sciences Türkiye, Ankara Etlik City Hospital (approval no: AEŞH-BADEK2-2025-413, date: 19.08.2025). A total of 104 women, aged ≥18 years, who underwent elective condition v-NOTES hysterectomy with complete perioperative clinical data were included. Patients who required emergency surgery, underwent procedures other than v-NOTES, or had incomplete data were excluded from the study.

Participants were categorized into two groups based on BMI: Group 1 included 62 patients with BMI <30 kg/m², whereas Group 2 comprised 42 patients with BMI ≥30 kg/m².

The following variables were systematically extracted from the medical records: age, BMI (kg/m²), parity, history of previous surgery, and surgical indication. Operative parameters included operative time (minutes), uterine weight (grams), need for conversion to laparoscopy, preoperative and postoperative hemoglobin levels (g/dL), length of hospital stay (hours), and intraoperative or postoperative complications.

All procedures were performed by two gynecologic surgeons experienced in both endoscopic and vaginal surgery. When indicated, bilateral salpingectomy and/or oophorectomy were performed in conjunction with v-NOTES hysterectomy. Uterine weights were obtained from postoperative pathology reports. Laparoscopic conversion was carried out when deemed necessary, and intraoperative decisions regarding conversion and complication management were made based on real-time surgical findings.

Surgical Procedure

All v-NOTES hysterectomy procedures were performed according to the standardized ten-step approach defined in certified v-NOTES training courses.[13] The procedure comprised three phases: (1) An initial vaginal phase, including circumcision of the cervix and anterior/posterior colpotomy with dissection of the uterosacral ligaments; (2) a laparoscopic phase, during which the GelPOINT vPath transvaginal access platform (Applied Medical, Rancho Santa Margarita, CA, USA) was inserted, pneumoperitoneum was established at 10-12 mmHg, and adnexal pedicles were transected under endoscopic guidance; and (3) a final vaginal phase, in which the specimen was removed and the vaginal cuff was closed using absorbable sutures. When indicated, bilateral salpingectomy and/or oophorectomy were performed concomitantly. For transvaginal access, the GelPOINT® V-Path platform was used in all cases.

Statistical Analysis

All data were analyzed using IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp., Armonk, NY, USA). The distribution of continuous variables was assessed by the Shapiro-Wilk test. Variables that did not conform to normal distribution were presented as median (minimum-maximum) and compared between groups using the Mann-Whitney U test. Categorical variables were expressed as frequencies and percentages, and comparisons between groups were performed with the chi-

square test or Fisher's exact test when appropriate. A *p*-value <0.05 was considered statistically significant.

RESULTS

A total of 104 patients were included in the study. Their general demographic and clinical characteristics are summarized in Table 1. The median age was 54 years (33-78), the median BMI was 28 kg/m² (21-57), and the median parity was 2 (0-6). Previous abdominal surgery was reported in 55.8%, and prior cesarean section in 25% of patients. The median operative time was 45 minutes (24-90), median uterine weight 186 g (48-1036), and median hospital stay 48 hours (24-120). The intraoperative and postoperative complication rates were 1.0% and 3.9%, respectively.

Patients were stratified into two groups according to BMI: Group 1 (n=62; BMI <30 kg/m²) and Group 2 (n=42; BMI ≥30 kg/m²). Intergroup comparisons are presented in Table 2.

There were no statistically significant differences in age (*p*=0.059) or parity (*p*=0.051) between the groups. Previous abdominal surgery was reported in 51.6% of Group 1 and 61.9% of Group 2 (*p*=0.622). The rates of prior cesarean section were 29% and 19%, respectively (*p*=0.465).

The median operative time was 44 minutes in Group 1 and 47 minutes in Group 2, with no significant difference (*p*=0.169). However, uterine weight was significantly higher in Group 2 compared to Group 1 (255 g vs. 172 g; *p*=0.020). Conversion rates were 1.6% (1 case) in Group 1 and 4.8% (2 cases) in Group 2, with no significant difference (*p*=0.346).

Preoperative hemoglobin levels were 13.3 g/dL in Group 1 and 12.9 g/dL in Group 2 (*p*=0.304), while postoperative hemoglobin levels were 11.5 g/dL and 11.8 g/dL, respectively (*p*=0.621). No significant difference was observed regarding hemoglobin decline. Median hospital stay was 48 hours in both groups (*p*=0.904).

Regarding complications, no intraoperative complications occurred in Group 1, whereas one patient (2.4%) in Group 2 required intraoperative blood transfusion due to bleeding (*p*=0.222). Postoperative complications were observed in 3.2% of Group 1 (1 hematoma, one transfusion) and 4.8% of Group 2 (1 hematoma) (*p*=0.462). All complications were successfully managed with conservative medical treatment, and no patient required reoperation. The bleeding originated from the vaginal cuff dissection site and was successfully controlled intraoperatively. In addition, one patient (1.6%) in the non-obese group required postoperative blood transfusion due to anemia secondary to vaginal cuff hematoma, which was managed conservatively without reoperation.

DISCUSSION

In this study, surgical outcomes of v-NOTES hysterectomy were compared according to body mass index. Patients with BMI ≥30 kg/m² showed comparable perioperative and postoperative results to those with BMI <30 kg/m². The only significant difference was a higher uterine weight in the obese group, whereas operative time, complication rates, hospital stay, and conversion rates were similar. These findings support the feasibility and safety of v-NOTES in obese women.

Obesity is known to increase technical difficulties during gynecologic surgery, raise anesthetic risk, and contribute to higher postoperative morbidity.[6,7,14] In conventional abdominal and laparoscopic hysterectomies, obese patients have been reported

Table 1. General characteristics of the cohort undergoing v-NOTES hysterectomy

Variables	
Number of patients	104
Age (years), median (min-max)	54 (33-78)
BMI (kg/m²), median (min-max)	28 (21-57)
Parity, median (min-max)	2 (0-6)
Prior surgery, n (%)	58 (55.8)
Prior caesarean section, n (%)	26 (25)
Operation time (min), median (min-max)	45 (24-90)
Uterine weight (g), median (min-max)	186 (48-1036)
Length of hospital stay (hour), median (min-max)	48 (24-120)
Hemoglobin before surgery (g/dL), median (min-max)	13.2 (8.6-15.9)
Hemoglobin after surgery (g/dL), median (min-max)	11.6 (8.2-14.8)
Indication for surgery, n (%)	
Myomatous uterus	23 (22.1)
Adenomyosis	3 (2.9)
Prolapse	20 (19.2)
Adnexal mass	21 (20.2)
Treatment-resistant DUB	7 (6.8)
Atypical endometrial hyperplasia	14 (13.5)
Endometrial intraepitelial neoplasia	7 (6.7)
Endometrial adenocarsinoma	9 (8.7)
Conversions, n (%)	3 (2.9)
Complications	
Intra-operative, n (%)	1 (1)
Post-operative, n (%)	4 (3.9)

Data are expressed as median, minimum, maximum or number (%)
BMI: body mass index; DUB: dysfunctional uterine bleeding; v-NOTES: vaginal-natural orifice transluminal endoscopic surgery

Table 2. Intergroup comparison according to BMI

Variables	Group 1 (n=62)	Group 2 (n=42)	*p*
Age (years), median (min-max)	54 (33-74)	53 (45-78)	0.059
Parity, median (min-max)	2 (0-6)	3 (0-6)	0.051
Prior surgery, n (%)	32 (51.6)	26 (61.9)	0.622
Prior caesarean section, n (%)	18 (29)	8 (19)	0.465
Operation time (min), median (min-max)	44 (24-90)	47 (27-85)	0.169
Uterine weight (g), median (min-max)	172 (58-1036)	255 (48-761)	0.020
Length of hospital stay (hour), median (min-max)	48 (24-120)	48 (24-96)	0.904
Hemoglobin before surgery (g/dL), median (min-max)	13.3 (8.9-15.8)	12.9 (8.6-15.9)	0.304
Hemoglobin after surgery (g/dL), median (min-max)	11.5 (8.2-14.7)	11.8 (8.9-14.8)	0.621
Conversions, n (%)	1 (1.6)	2 (4.8)	0.346
Complications			
Intra-operative, n (%)	0	1 (2.4)*	0.222
Post-operative, n (%)	2 (3.2)**	2 (4.8)***	0.462

Data are expressed as median, minimum, maximum or number (%)
p≤0.05 significant difference, comparison of groups
BMI: body mass index, Group 1: BMI <30 kg/m^2, Group 2: BMI ≥30 kg/m^2
*: Bleeding requiring intraoperative blood transfusion; **: One patient received postoperative blood transfusion; 1 patient had a postoperative hematoma; ***: Postoperative hematoma

to experience greater blood loss, longer operative times, and higher infection rates.[7,11,15] Minimally invasive approaches are therefore considered particularly valuable for this population, owing to their potential to mitigate these adverse outcomes.

In this regard, v-NOTES offers distinct advantages. The absence of an abdominal incision, direct endoscopic visualization of pelvic anatomy, and improved uterine mobilization are particularly valuable in obese patients.[1-3,16] Previous studies have suggested that uterine weights exceeding 280 g may increase technical difficulty and complication rates in laparoscopic hysterectomy.[16-20] In our study, although uterine weight was significantly higher in the obese group, operative time and complication rates did not appear to be adversely influenced. This finding suggests that the direct visualization provided by v-NOTES may overcome certain anatomic limitations associated with obesity.

The current evidence on the use of v-NOTES in obese women remains limited, though the available data are steadily expanding. In a comparative study, Kaya et al.[12] demonstrated that v-NOTES was associated with shorter operative times and lower postoperative pain scores than TLH in obese patients. Likewise, Nulens et al.,[9] in a retrospective cohort of 114 patients, reported low complication rates despite elevated BMI. Furthermore, Baekelandt et al.,[3] in a randomized controlled trial, showed that v-NOTES was associated with lower complication rates and shorter hospital stays compared with laparoscopy, while achieving non-inferior overall clinical outcomes.

An important contribution of our study is the demonstration that complication, blood loss, and conversion rates were not increased in obese patients. Although conversion was more frequent in the obese group (4.8% vs. 1.6%), this difference was not statistically significant. This finding underscores that, with careful patient selection and adequate surgical expertise, v-NOTES can be safely applied in obese women.

Our results are consistent with previous large series showing low complication rates and high feasibility of v-NOTES.[8-10,17,18] In our cohort, the low overall complication rate (3.9%) and absence of reoperation further support its safety profile. Moreover, previous studies have confirmed that v-NOTES is effective and safe in benign and complex gynecologic cases, comparable to conventional vaginal surgery.[18] Nevertheless, the decline in vaginal surgery rates globally has been attributed, at least in part, to limited training opportunities, thereby driving interest toward minimally invasive alternatives such as v-NOTES.[19]

Stuart et al.[21] recently conducted a large multicenter retrospective study including 4,565 patients who underwent hysterectomy with the v-NOTES technique. They reported an intraoperative complication rate of 3.2% (n=144) and a postoperative complication rate of 2.5% (n=115). The overall conversion rate was 1.6% (n=72), of which only 10 cases (0.2%) required conversion to laparotomy. The most common intraoperative complication was cystotomy, observed in 1.3% of cases, and notably, 50% of these events were performed by inexperienced surgeons. Only one ureteral injury was reported. Postoperative complications

most frequently included bleeding (n=28), vault complications such as infected vault hematoma (n=26), and cystitis (n=18). In our study, no major organ injury (such as cystotomy, ureteral or bowel injury) occurred. Minor complications were observed in 4% of cases intraoperatively (n=2) and in 4% postoperatively (n=2). The overall complication rate was 8% (n=4), and the 30-day readmission rate was 2% (n=2). Notably, the complete absence of major complications in our cohort represents an even more favorable outcome compared to the rates reported in the literature.[19] These findings further emphasize the safety and feasibility of v-NOTES, particularly when performed by experienced surgeons following standardized techniques.

Study Limitations

The strengths of our study include the uniformity of surgical technique, clear stratification of patients according to BMI, and the utilization of prospectively collected perioperative data for retrospective analysis. Nonetheless, the retrospective design and relatively limited sample size may limit the generalizability of our results.

CONCLUSION

This study contributes to the growing body of evidence regarding the impact of BMI on v-NOTES hysterectomy outcomes. Despite significantly higher uterine weights in obese patients, operative time, hospital stay, complication rates, and conversion requirements were comparable to those of non-obese patients. These findings support the safety and feasibility of v-NOTES in obese women, highlighting its potential as a minimally invasive option across diverse patient populations

ETHICS

Ethics Committee Approval: The study protocol was approved by the Institutional Review Board of University of Health Sciences Türkiye, Ankara Etlik City Hospital (approval no: AEŞH-BADEK2-2025-413, date: 19.08.2025).

Informed Consent: Retrospective study.

FOOTNOTES

Authorship Contributions

Surgical and Medical Practices: C.H., Concept: C.H., H.N.Ö., O.K.K., Design: H.N.Ö., V.K., Data Collection or Processing: H.N.Ö., N.Ö., V.K., Analysis or Interpretation: H.N.Ö., V.K., Literature Search: V.K., Writing: C.H., N.Ö.

DISCLOSURES

Conflict of Interest: No conflict of interest was declared by the authors.

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