



Postoperative pain after vNOTES versus laparoscopic hysterectomy: A procedure-specific comparative study

vNOTES ile laparoskopik histerektomi sonrası postoperatif ağrının karşılaştırılması: Prosedüre özgü karşılaştırmalı bir çalışma

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Abstract

Objective: Vaginal natural orifice transluminal endoscopic surgery (vNOTES) is associated with lower postoperative pain, reduced analgesic requirements, and faster early postoperative recovery compared with laparoscopy in patients undergoing hysterectomy for benign indications. To compare postoperative pain and early recovery outcomes between vNOTES and conventional laparoscopy in patients undergoing hysterectomy for benign gynecologic indications.

Materials and Methods: This single-center retrospective cohort study included 192 patients who underwent hysterectomy between March 2021 and September 2025. Patients were grouped according to surgical approach (vNOTES vs. laparoscopy). Postoperative pain was assessed using the visual analog scale at 6 and 24 hours. Primary outcomes were pain intensity and the requirement for additional analgesia. Secondary outcomes included operative time, change in hemoglobin, time to first flatus, and length of hospital stay. Multivariable logistic regression analysis was performed to identify predictors of analgesic requirement.

Results: Of 192 patients, 75 (39.1%) underwent laparoscopy and 117 (60.9%) underwent vNOTES. Baseline characteristics were similar between groups. The vNOTES group had significantly lower pain scores at 6 and 24 hours ($p=0.001$) and a reduced need for additional analgesia (23.9% vs. 60.0%, $p=0.001$). Operative time was shorter and recovery outcomes, including time to first flatus and length of hospital stay, were significantly improved in the vNOTES group ($p=0.001$). Surgical approach, uterine weight, and operative time were independent predictors of analgesic requirement.

Conclusion: In this retrospective cohort study, vNOTES was associated with lower postoperative pain scores, reduced analgesic requirement, and earlier recovery than conventional laparoscopy. These findings should be confirmed in prospective randomized studies.

Keywords: vNOTES, laparoscopic hysterectomy, postoperative pain, minimally invasive surgery, gynecology

Öz

Amaç: Vajinal doğal orifis transluminal endoskopik cerrahi (vNOTES), benign endikasyonlarla histerektomi uygulanan hastalarda laparoskopiyi kıyasla daha düşük postoperatif ağrı, daha az analjezik gereksinimi ve daha hızlı erken iyileşme sağlar. Benign jinekolojik endikasyonlarla histerektomi uygulanan hastalarda vNOTES ile konvansiyonel laparoskopinin postoperatif ağrı ve erken iyileşme sonuçlarının karşılaştırılması amaçlandı.

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Gereç ve Yöntemler: Bu tek merkezli retrospektif kohort çalışmasına Mart 2021-Eylül 2025 tarihleri arasında histerektomi uygulanan toplam 192 hasta dahil edildi. Hastalar cerrahi yaklaşıma göre vNOTES ve konvansiyonel laparoskopi gruplarına ayrıldı. Postoperatif ağrı, standart kurumsal protokol kapsamında 6. ve 24. saatlerde görsel analog skala kullanılarak değerlendirildi. Primer sonuçlar ağrı şiddeti ve ek analjezik gereksinimi olarak belirlendi. Sekonder sonuçlar ameliyat süresi, hemoglobin değişimi, ilk gaz çıkarma zamanı ve hastanede kalış süresini içermektedir. Ek analjezik gereksiniminin bağımsız belirleyicilerini saptamak amacıyla çok değişkenli lojistik regresyon analizi gerçekleştirildi.

Bulgular: Toplam 192 hastanın 75'i (%39,1) laparoskopi, 117'si (%60,9) vNOTES yöntemiyle opere edildi. Gruplar arasında demografik ve klinik başlangıç özellikleri açısından anlamlı fark saptanmadı. vNOTES grubunda hem 6. hem de 24. saatlerde postoperatif ağrı skorları anlamlı derecede daha düşük bulundu ($p=0,001$). Ek analjezik gereksinimi vNOTES grubunda belirgin olarak daha azdı (%23,9'a karşı %60,0; $p=0,001$). Ayrıca ameliyat süresi daha kısa olup, ilk gaz çıkarma zamanı ve hastanede kalış süresi anlamlı şekilde daha iyiydi ($p=0,001$). Cerrahi yaklaşım, uterus boyutu ve ameliyat süresi analjezik gereksiniminin bağımsız belirleyicileri olarak saptandı.

Sonuç: Bu retrospektif kohort çalışmada, vNOTES'nin geleneksel laparoskopiye kıyasla daha düşük postoperatif ağrı skorları, daha az analjezik ihtiyacı ve daha hızlı erken iyileşme ile ilişkili olduğu gözlemlenmiştir. Bu bulguların prospektif randomize çalışmalarla doğrulanması gerekmektedir.

Anahtar Kelimeler: vNOTES, laparoskopik histerektomi, postoperatif ağrı, minimal invaziv cerrahi, jinekoloji

Introduction

Minimally invasive surgery is widely used to manage benign gynecologic conditions because it is associated with reduced surgical trauma, faster recovery, and improved patient comfort. Conventional laparoscopy remains the standard approach; however, abdominal trocar placement may contribute to postoperative pain through parietal tissue injury, potentially increasing analgesic requirements and limiting patient-centered recovery outcomes⁽¹⁾.

To overcome these limitations, vaginal natural orifice transluminal endoscopic surgery (vNOTES) has emerged as an alternative minimally invasive technique that utilizes a transvaginal approach, thereby eliminating abdominal wall incisions. This scarless approach combines the advantages of endoscopic surgery with reduced parietal trauma and has gained increasing acceptance, particularly in hysterectomy and adnexal procedures⁽²⁾.

By avoiding abdominal wall disruption, vNOTES has the potential to reduce postoperative pain and analgesic requirements while promoting faster functional recovery. Recent studies have reported favorable early postoperative outcomes with vNOTES, including lower pain scores and reduced analgesic consumption compared with conventional laparoscopy⁽³⁾.

Postoperative pain remains a key determinant of patient-centered outcomes, influencing early mobilization, recovery trajectory, and overall patient satisfaction. Therefore, accurate assessment of pain outcomes across surgical approaches is essential for optimizing clinical decision-making.

However, a major limitation of the current literature is procedural heterogeneity. Many comparative studies evaluating vNOTES and conventional laparoscopy include mixed surgical procedures, such as hysterectomy, salpingectomy, and sterilization, which differ substantially in operative complexity and postoperative pain profiles. This heterogeneity introduces significant confounding and limits the interpretability of pain-related outcomes⁽⁴⁾.

To address this limitation, the present study was designed as a procedure-specific analysis restricted to hysterectomy

cases to minimize procedural confounding and to provide a more internally valid comparison. The primary objective was to evaluate postoperative pain intensity and analgesic requirements following vNOTES versus conventional laparoscopic hysterectomy. Secondary outcomes included operative time and indicators of early postoperative recovery.

Materials and Methods

This study was designed as a single-center, retrospective comparative cohort study. Clinical and surgical data for patients who underwent hysterectomy for benign gynecologic indications between March 2021 and September 2025 were retrospectively retrieved from institutional electronic medical records.

To address procedural heterogeneity observed in prior comparative studies, the present analysis was restricted to patients undergoing hysterectomy, thereby minimizing confounding due to variations in surgical complexity and postoperative pain profiles.

Eligible patients were aged 18 years or older and underwent hysterectomy for benign indications. Exclusion criteria included suspected or confirmed malignancy, emergency surgery, intraoperative conversion to laparotomy, and incomplete clinical data. All eligible patients within the study period were included. Given the retrospective design and inclusion of the entire available cohort, no a priori sample size calculation was performed. The study was approved by the University of Health Sciences Türkiye, Sancaktepe Şehit Prof. Dr. İlhan Varank Training and Research Hospital Scientific Research Ethics Committee (approval number: 122, date: 25.02.2026) and conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants. The patient selection process is summarized in Figure 1.

All procedures were performed at a single institution by the same surgical team under standardized perioperative and postoperative care protocols. The choice of surgical approach was not randomized and was determined according to real-world clinical decision-making. vNOTES was generally preferred in patients with adequate vaginal access

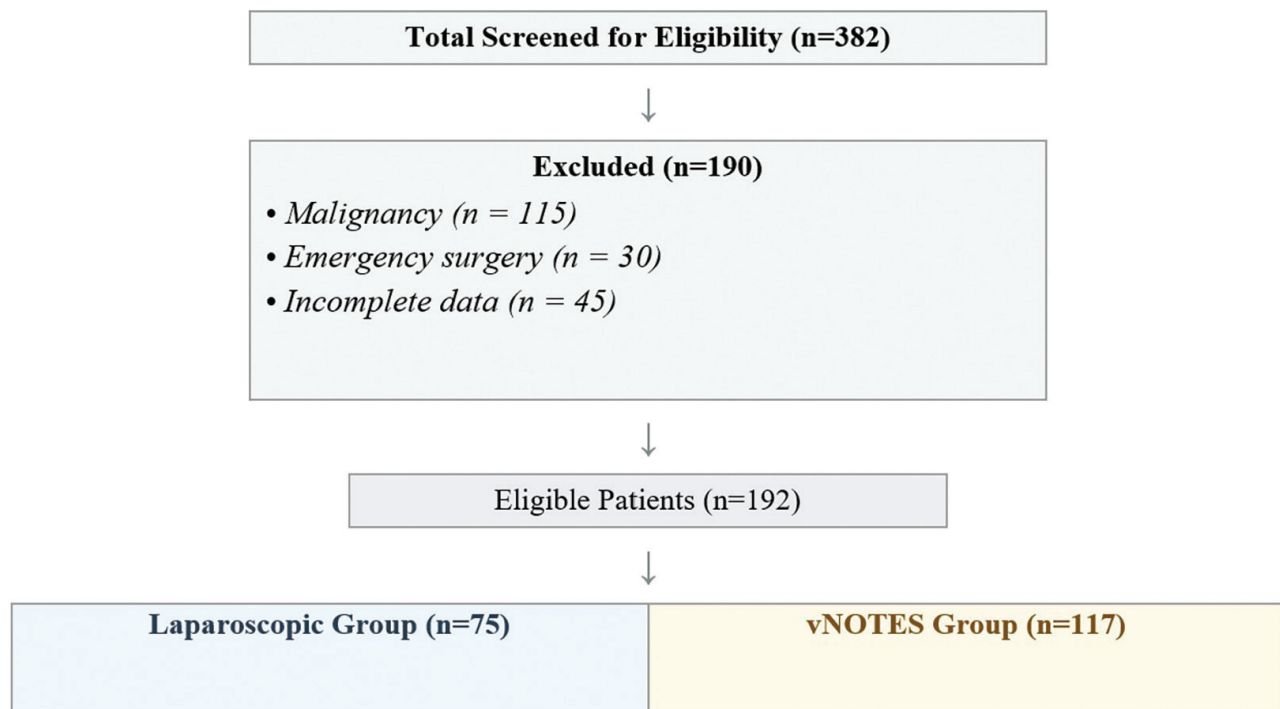


Figure 1. Flow diagram of patient selection and study inclusion

vNOTES: Vaginal natural orifice transluminal endoscopic surgery

and favorable pelvic accessibility. Preoperative assessment included gynecologic examination and ultrasonographic evaluation, including assessment of uterine size, pelvic mobility, and the sliding sign when an adhesion risk was suspected. Importantly, no intentional exclusion of larger uteri from the vNOTES group was performed.

Conventional laparoscopic hysterectomy was performed using a standardized multiport technique with carbon dioxide pneumoperitoneum. In the vNOTES group, transvaginal access was achieved using a dedicated vaginal access platform (GelPoint V-Path, Applied Medical, Rancho Santa Margarita, CA, USA), allowing endoscopic visualization and instrumentation. Vaginal cuff closure was completed according to standard surgical protocols.

A standardized postoperative analgesia protocol was applied to all patients. All patients received intramuscular diclofenac sodium (75 mg twice daily) as routine postoperative analgesia during the first 24 hours after surgery. Postoperative pain was assessed using the visual analog scale (VAS) at 6 and 24 hours after surgery as part of the institutional postoperative care protocol. Rescue analgesia was administered only after pain assessment in patients with a VAS score >4 or in those with inadequate pain control despite the standard analgesic regimen. Therefore, the VAS scores analyzed in this study represent pain intensity measured before administration of rescue analgesia when additional analgesia was required.

Pain was assessed using the VAS at 6 and 24 hours postoperatively (0=no pain, 10=worst imaginable pain).

Postoperative pain assessment was an integral component of the institutional routine protocol, and all patients were systematically evaluated at predefined time points (6 and 24 hours postoperatively). Pain scores were recorded in the electronic medical record system. Pain assessments were performed by physicians blinded to the study hypothesis. These assessments were conducted by ward physicians who were not involved in the study design. However, because the study was retrospective, formal blinding of outcome assessment cannot be guaranteed.

The primary outcomes were postoperative pain intensity and the need for rescue analgesia. To complement subjective pain assessment, the requirement for additional analgesia was included as an objective outcome measure. Secondary outcomes included operative time, hemoglobin change, time to first flatus, length of hospital stay, and perioperative complications. Uterine weight was included as a clinically relevant variable to account for potential differences in surgical complexity.

Statistical Analysis

Statistical analyses were performed using SPSS version 27.0 (IBM Corp., Armonk, NY, USA). Continuous variables were assessed for normality using the Shapiro-Wilk test and presented as mean $\pm$ standard deviation or median (interquartile range), as appropriate. Between-group comparisons were conducted using the Student's t-test or Mann-Whitney U test. Categorical variables were compared using the chi-square test or Fisher's exact test.

To partially account for the non-randomized study design and potential confounding, univariable and multivariable logistic regression analyses were performed to identify independent predictors of the need for additional analgesia. Variables with $p < 0.05$ in univariable analysis were included in the multivariable model. A two-sided p -value < 0.05 was considered statistically significant.

Results

A total of 192 patients who underwent hysterectomy for benign gynecologic indications were included in the analysis, comprising 75 (39.1%) patients in the conventional laparoscopy group and 117 (60.9%) patients in the vNOTES group. The annual distribution of cases remained balanced throughout the study period, with both laparoscopic hysterectomy and vNOTES being performed each year. The numbers of patients undergoing laparoscopy and vNOTES were 8 and 9 in 2021; 13 and 18 in 2022; 17 and 28 in 2023; 20 and 31 in 2024; and 17

and 31 in 2025, indicating that both surgical approaches were consistently utilized throughout the study period.

Baseline demographic and preoperative clinical characteristics are presented in Table 1. There were no statistically significant differences between the groups in terms of age (50.3 ± 7.9 vs. 48.1 ± 8.9 years, $p = 0.074$), body mass index ($p = 0.963$), or preoperative hemoglobin levels ($p = 0.105$). Similarly, parity, menopausal status, history of cesarean section, and surgical history were comparable between the two cohorts. Uterine weight did not differ significantly between groups ($p = 0.102$), suggesting comparable surgical complexity. No significant differences were observed between the two groups in the indications for hysterectomy, including leiomyoma, abnormal uterine bleeding, adenomyosis, cervical intraepithelial neoplasia, and endometrial hyperplasia. Likewise, the rates of concomitant bilateral salpingectomy and bilateral salpingo-oophorectomy were comparable between the groups (all $p > 0.05$).

Table 1. Baseline demographic and clinical characteristics of patients undergoing vNOTES and laparoscopic surgery

	Laparoscopy (n=75)	vNOTES (n=117)	p-value
Age (years)*	50.3±7.9	48.1±8.9	0.074
BMI (kg/m ²)*	29.0±4.7	28.9±6.6	0.963
Parity status**			
Gravidity	3.0 (2.0-5.0)	3.0 (3.0-4.0)	0.855
Parity	3.0 (2.0-4.0)	3.0 (2.0- 4.0)	0.989
Menopausal status, n (%)	44 (58.7%)	54 (46.2%)	0.091
Previous cesarean, n (%)	22 (29.3%)	32 (27.3%)	0.765
Surgical history, n (%)			
None	34 (45.3%)	50 (42.7%)	0.554
Gynecologic surgery	27 (36.0%)	40 (34.2%)	
Non-gynecologic abdominal surgery	7 (9.3%)	8 (6.8%)	
Other	7 (9.3%)	19 (16.2%)	
Indication for hysterectomy			
Leiomyoma	32 (42.7%)	48 (41.0%)	0.814
Abnormal uterine bleeding	24 (32.0%)	41 (35.0%)	0.658
Adenomyosis	11 (14.7%)	16 (13.7%)	0.846
CIN	5 (6.7%)	8 (6.8%)	0.965
Endometrial hyperplasia	3 (4.0%)	4 (3.4%)	0.835
Concomitant procedure			
Bilateral salpingectomy	52 (69.3%)	85 (72.6%)	0.618
Bilateral Salpingo-oophorectomy	18 (24.0%)	26 (22.2%)	0.771
Preoperative Hb*	11.8±1.4	12.2±1.5	0.105

* Mean ± standard deviation, ** median (IQR), BMI: Body mass index, IQR: Interquartile range, vNOTES: Vaginal natural orifice transluminal endoscopic surgery, Hb: Hemoglobin, CIN: Cervical intraepithelial neoplasia

Postoperative outcomes are summarized in Table 2. The vNOTES group demonstrated significantly higher postoperative hemoglobin levels (11.0 ± 1.4 g/dL vs. 10.2 ± 1.7 g/dL, $p=0.001$) and a significantly lower hemoglobin decrease (1.2 ± 0.9 g/dL vs. 1.6 ± 0.9 g/dL, $p=0.001$), indicating reduced intraoperative blood loss.

Operative duration was significantly shorter in the vNOTES group than in the laparoscopy group (median 86.0 vs. 105.0 minutes, $p=0.001$). Additionally, patients undergoing vNOTES experienced an earlier return of bowel function, as reflected by a shorter time to first flatus (10.0 vs. 13.0 hours, $p=0.001$) and a reduced length of hospital stay ($p=0.002$).

The requirement for additional analgesia was significantly lower in the vNOTES group than in the laparoscopy group (23.9% vs. 60.0%, $p=0.001$). Postoperative pain scores were consistently and significantly lower following vNOTES at both 6 hours (median 4 vs. 6, $p=0.001$) and 24 hours (median 2 vs. 3, $p=0.001$). No statistically significant differences were observed between the groups in either intraoperative or postoperative complications. All bladder and ureteral injuries were recognized intraoperatively and managed immediately without conversion to laparotomy. Bladder injuries were repaired primarily with layered suturing followed by

temporary urinary catheterization, whereas the single ureteral injury was managed intraoperatively by ureteral stent placement in consultation with the urology team. No delayed diagnosis of urinary tract injury occurred during the postoperative period.

In the multivariable logistic regression analysis, laparoscopy (reference category: vNOTES) was independently associated with a higher likelihood of requiring additional analgesia [odds ratio (OR): 4.62, 95% confidence interval (CI): 2.31-9.26, $p=0.001$]. Patients undergoing laparoscopic hysterectomy had approximately 4.6-fold higher odds of requiring rescue analgesia compared with patients undergoing vNOTES. Additionally, uterine weight (OR: 1.01, 95% CI: 1.01-1.02, $p=0.002$) and operative time (OR: 1.02, 95% CI: 1.01-1.03, $p=0.007$) remained independent predictors of the requirement for additional analgesia (Table 3).

Discussion

In the present study, the vNOTES approach in patients undergoing hysterectomy for benign indications was associated with lower postoperative pain scores, reduced need for additional analgesia, and improved early recovery parameters compared with conventional laparoscopy. These

Table 2. Comparison of postoperative results between groups

	Laparoscopy (n=75)	vNOTES (n=117)	p-value
Postoperative hemoglobin*	10.2 ± 1.7	11.0 ± 1.4	0.001
Hemoglobin decrease*	1.6 ± 0.9	1.2 ± 0.9	0.001
Operation time (min)**	105.0 (89.0-125.0)	86.0 (63.0-103.0)	0.001
Uterine weight (g)**	210.0 (140.0-350.0)	255.0 (165.0-375.0)	0.102
Hospitalization (day)**	2.0 (1.0-2.0)	1.0 (1.0-2.0)	0.002
Time to first flatus (hour)**	13.0 (10.0-18.0)	10.0 (8.0-13.0)	0.001
Additional analgesic requirement, n (%)	45 (60.0%)	28 (23.9%)	0.001
VAS pain score (6 th hour)**	6.0 (5.0-7.0)	4.0 (3.0-6.0)	0.001
VAS pain score (24 th hour)**	3.0 (2.0-4.0)	2.0 (0-3.0)	0.001
Intraoperative complications ^a	3 (4.0%)	2 (1.7%)	NA
Bladder injury	1 (1.3%)	2 (1.7%)	
Ureteral injury	1 (1.3%)	-	
Conversion to laparotomy	1 (1.3%)	-	
Postoperative complications ^a	5 (6.7%)	5 (4.2%)	0.466
Vaginal vault hematoma	1 (1.3%)	2 (1.7%)	
Pelvic infection/abscess	1 (1.3%)	1 (0.8%)	
Urinary tract infection	2 (2.7%)	3 (2.5%)	
Blood transfusion	3 (4.0%)	1 (0.8%)	

* Mean $\pm$ standard deviation, ** median (IQR), *: Values represent the number of events. Because some patients experienced more than one postoperative complication, the total number of events may exceed the number of affected patients

VAS: Visual analogue scale, vNOTES: Vaginal natural orifice transluminal endoscopic surgery, IQR: Interquartile range

Table 3. Factors associated with additional analgesic requirement: univariable and multivariable logistic regression

Variable	Univariable OR (95% CI)	p-value (univariable)	Multivariable OR (95% CI)	p-value (multivariable)
Age	1.03 (0.99-1.07)	0.107	-	-
BMI	1.02 (0.97-1.07)	0.366	-	-
Uterine weight	1.01 (1.01-1.02)	0.004	1.01 (1.01-1.02)	0.002
Surgical approach laparoscopy (reference = vNOTES)	4.77 (2.55-8.93)	0.001	4.62 (2.31-9.26)	0.001
Menopausal status	0.60 (0.33-1.08)	0.089	-	-
Operation time	1.02 (1.01-1.03)	0.001	1.02 (1.01-1.03)	0.007

BMI: Body mass index, OR: Odds ratio, CI: Confidence interval, vNOTES: Vaginal natural orifice transluminal endoscopic surgery

findings suggest that, among minimally invasive surgical techniques, the choice of surgical approach plays a key role in determining patient-centered outcomes.

One of the main strengths of this study lies in its procedure-specific design, as the analysis was deliberately restricted to hysterectomy cases. In much of the existing literature, comparisons between vNOTES and laparoscopy often include a heterogeneous mix of procedures, which can introduce variability that is difficult to fully account for^(5,6). Differences in surgical complexity, extent of tissue manipulation, and postoperative pain responses across procedures may act as important confounders and complicate the interpretation of comparative findings⁽⁷⁾. By focusing exclusively on hysterectomy, we aimed to minimize this variability and provide a more internally consistent and clinically meaningful comparison.

In our study, the decrease in postoperative hemoglobin levels was smaller in the vNOTES group, suggesting less intraoperative blood loss. Previous studies have similarly reported that vNOTES may be associated with less blood loss, possibly due to reduced tissue trauma and more limited dissection^(8,9). However, the clinical significance of this difference may still depend on patient selection and surgical expertise.

The significantly shorter operative time observed in the vNOTES group is a notable finding of our study. The literature reports mixed results on this issue. Earlier studies have suggested that vNOTES requires longer operative times during the initial learning curve. In contrast, more recent evidence indicates that operative duration decreases with increasing surgical experience and may even become shorter than that of conventional laparoscopy in experienced centers^(10,11).

Our findings are consistent with more recent data, suggesting that when performed by an experienced surgical team, vNOTES does not confer a time disadvantage and may, in fact, be associated with shorter operative times. The shorter operative time may be explained by the more direct transvaginal access and the technical ease of opening and closing the vaginal cuff in experienced hands.

Regarding functional recovery, patients in the vNOTES group experienced an earlier return of bowel function and a shorter hospital stay. These findings are consistent with previous studies reporting faster gastrointestinal recovery and earlier mobilization following vNOTES^(12,13). Reduced peritoneal irritation and lower overall surgical trauma may contribute to these improved outcomes.

The primary finding of this study relates to postoperative pain. Patients undergoing vNOTES reported significantly lower VAS scores at both 6 and 24 hours and a markedly reduced need for additional analgesia. These findings support the hypothesis that minimizing abdominal wall trauma plays a central role in reducing postoperative pain.

Previous studies have consistently demonstrated lower postoperative pain scores and decreased analgesic consumption in patients undergoing vNOTES compared with conventional laparoscopy^(14,15). Previous studies have consistently demonstrated lower postoperative pain scores and reduced analgesic consumption following vNOTES compared with conventional laparoscopy. These findings are generally attributed to the avoidance of abdominal wall incisions, thereby reducing trocar-related somatic pain and overall surgical trauma. Our findings are consistent with this proposed mechanism⁽¹⁶⁾. From a clinical perspective, these improvements in postoperative pain may facilitate reduced opioid use, earlier mobilization, and enhanced overall patient comfort, all of which are important components of patient-centered recovery.

Multivariable analysis in our study identified the surgical approach and operative time as independent predictors of postoperative analgesic requirement. The association between longer operative duration and increased postoperative pain has been described previously⁽¹⁷⁾. However, the persistence of an independent effect of the surgical approach suggests that the impact of vNOTES on pain cannot be explained solely by shorter operative time.

In terms of safety, no significant differences were observed between the two groups with respect to perioperative and postoperative complication rates. This finding indicates that the improved recovery profile associated with vNOTES does

not come at the expense of surgical safety and is consistent with the current literature⁽¹⁸⁾.

Study Limitations

Several limitations of this study should be considered. The retrospective design and lack of randomization may increase the risk of selection bias. However, the inclusion of all eligible cases from a single center and the use of standardized perioperative protocols may have partially mitigated this effect.

Although baseline characteristics were largely comparable and multivariable analyses were performed, the retrospective non-randomized design precludes complete adjustment for selection bias and unmeasured confounding. Importantly, no deliberate case selection was performed between groups. On the contrary, larger uteri were preferentially managed using the vNOTES approach, reflecting its application even in potentially more challenging cases. Conventional laparoscopy was primarily favored for patients with a preoperative suspicion of significant abdominal adhesions, which was assessed by ultrasonographic evaluation, including the sliding sign. While this approach reflects real-world clinical decision-making, it may still have influenced case allocation, and this influence should be considered when interpreting the findings.

Postoperative pain assessment using the VAS is inherently subjective and may vary depending on individual pain perception; however, the use of standardized time points for assessment may have contributed to measurement consistency. However, due to the retrospective design, formal blinding of pain assessment was not feasible, and this may have introduced measurement bias. Although pain evaluation was performed as part of a standardized institutional protocol, variability in documentation and subjective pain reporting cannot be entirely excluded.

Importantly, to strengthen the reliability of pain-related outcomes, the requirement for additional analgesia was included as an objective measure, providing supportive evidence alongside subjective VAS scores. Nevertheless, because the study was retrospective and the surgical approach was not randomized, selection bias cannot be completely excluded. Although baseline characteristics were comparable between groups and adjusted analyses were performed to reduce the effect of measured confounders, unmeasured confounding may still have influenced the results. Although the study was conducted over a five-year period, both surgical approaches were performed consistently throughout the study. Nevertheless, because vNOTES is a relatively new technique, the potential influence of increasing surgical experience (the learning curve) cannot be completely excluded and should be considered when interpreting the findings.

The single-center nature of the study may limit the generalizability of the results; further validation in larger multicenter studies would be valuable.

Conclusion

In patients undergoing hysterectomy, the vNOTES approach is associated with lower postoperative pain, reduced analgesic requirements, and faster recovery compared with conventional laparoscopy. By adopting a procedure-specific analytical approach, this study minimizes the impact of procedural heterogeneity and provides more reliable comparative evidence. These findings suggest that vNOTES may be a promising alternative to conventional laparoscopy for hysterectomy. However, given the retrospective non-randomized design, prospective randomized studies are warranted to confirm these observations.

Ethics

Ethics Committee Approval: The study was approved by the University of Health Sciences Türkiye, Sancaktepe Şehit Prof. Dr. İlhan Varank Training and Research Hospital Scientific Research Ethics Committee (approval number: 122, date: 25.02.2026) and conducted in accordance with the Declaration of Helsinki.

Informed Consent: Written informed consent was obtained from all participants.

Footnotes

Authorship Contributions

Surgical and Medical Practices: T.Ş., E.A.Ş., B.S.P., A.B.T., H.Ş., Concept: T.Ş., E.A.Ş., G.G., K.G., H.Ş., Design: T.Ş., E.A.Ş., B.S.P., G.G., A.B.T., H.Ş., Data Collection or Processing: T.Ş., G.G., K.G., H.Ş., Analysis or Interpretation: T.Ş., B.S.P., A.B.T., K.G., H.Ş., Literature Search: T.Ş., G.G., K.G., H.Ş., Writing: T.Ş., A.B.T., H.Ş.

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