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Original Research

Postoperative Recovery Following Vaginal Natural Orifice Transluminal Endoscopic Surgery Versus Total Laparoscopic Hysterectomy in Older Women: A Retrospective Cohort Study

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Abstract

Background: Minimally invasive hysterectomy techniques are increasingly preferred in older women because they may reduce surgical trauma and facilitate postoperative recovery. This study aimed to compare postoperative recovery outcomes between vaginal natural orifice transluminal endoscopic surgery (V-NOTES) and total laparoscopic hysterectomy (TLH) in women aged ≥60 years. **Methods:** This retrospective cohort study used a per-protocol analysis comparing 43 completed V-NOTES cases with 44 TLH cases. 5 planned V-NOTES procedures requiring conversion to laparotomy were classified as Clavien–Dindo grade IIIb complications. Primary outcomes included time to ambulation, return to daily activities, and visual analog scale (VAS) pain scores on postoperative days 1, 3, and 7. Multivariable linear regression was employed to adjust for age, body mass index (BMI), parity, presence of ≥1 comorbidity, and prior pelvic surgery. **Results:** In unadjusted analyses, the V-NOTES group showed significantly lower estimated blood loss, shorter hospital stay, earlier ambulation, faster return to daily activities, and lower postoperative pain scores compared with the TLH group. After multivariable adjustment for age, BMI, parity, presence of ≥1 comorbidity, and prior pelvic surgery, only postoperative day 1 pain remained independently associated with surgical approach ($\beta = -1.16$, 95% confidence interval [CI]: −2.13 to −0.19; $p = 0.028$). Differences in time to ambulation and return to daily activities did not retain statistical significance after adjustment. **Conclusion:** For women aged ≥60, V-NOTES was associated with significantly lower early postoperative pain compared with TLH. Although unadjusted functional recovery metrics initially appeared superior, these differences lost significance after adjustment for age and BMI. These findings suggest that although V-NOTES may provide advantages in early postoperative recovery, patient-related factors and procedural feasibility remain important determinants of postoperative outcomes in older women.

Keywords: V-NOTES; total laparoscopic hysterectomy; older women; postoperative outcomes; minimally invasive surgery; hysterectomy

1. Introduction

The global increase in life expectancy has resulted in a growing population of older women requiring surgical treatment for benign gynecologic conditions. Women aged 60 years and older frequently present with reduced physiological reserve, multiple comorbidities, and a higher postoperative morbidity risk, making minimally invasive surgical strategies particularly valuable in this population [1]. Minimally invasive surgery (MIS), particularly total laparoscopic hysterectomy (TLH), has been shown to reduce postoperative pain, shorten hospital stay, and decrease cardiopulmonary stress compared with abdominal hysterectomy. However, TLH still requires abdominal trocar placement, which may contribute to wound-related complications and increased postoperative discomfort in older patients [2,3,4]. Vaginal hysterectomy also remains an important minimally invasive approach, particularly because it avoids abdominal access and may facilitate postoperative recovery in appropriately selected patients. However, anatomical limitations, restricted visualization, and technical constraints may limit the applicability of conventional vaginal surgery in some cases [5].

Vaginal natural orifice transluminal endoscopic surgery (V-NOTES) has emerged as an alternative MIS approach that eliminates abdominal incisions and uses the vaginal route for access. By avoiding trocar placement and minimizing fascial disruption and pneumoperitoneum requirements, V-NOTES may offer additional advantages for older patients, who may be more susceptible to cardiopulmonary stress and delayed postoperative recovery [6,7].

A growing body of prospective and retrospective studies suggests that V-NOTES is safe, feasible, and associated with favorable postoperative outcomes [8,9]. Indeed, several systematic reviews and meta-analyses have compared V-NOTES hysterectomy with conventional laparo-

scopic hysterectomy for benign indications and have generally reported comparable perioperative outcomes between the two approaches, with potential advantages of V-NOTES in terms of postoperative pain and early recovery. In particular, previous studies have demonstrated reduced postoperative pain and shorter recovery times associated with the natural orifice approach [9,10,11,12]. However, most of these analyses include heterogeneous patient populations with a wide age range, and evidence specifically focused on older women remains limited.

Moreover, although some studies have explored the feasibility of V-NOTES in older populations, the available literature consists primarily of descriptive case series and provides limited comparative evidence regarding postoperative recovery trajectories in this age group [7,8]. Functional recovery parameters, such as early ambulation, postoperative pain progression, and return to daily activities, are particularly relevant in older patients, as delayed mobilization may increase the risk of thromboembolism, pulmonary complications, and functional decline. Therefore, the present study aimed to compare postoperative recovery outcomes between V-NOTES and TLH in women aged 60 years and older, providing age-specific evidence to support surgical decision-making in this aging population while considering conversion events as an important clinical factor in surgical planning [11,13].

2. Material and Methods

2.1 Study Design and Setting

This retrospective cohort study was conducted at a tertiary referral center and included women aged 60 years and older who underwent minimally invasive hysterectomy for benign gynecologic conditions between January 2023 and June 2025. Ethical approval was obtained from the Institutional Review Board of Zeynep Kamil Women and Children's Diseases Training & Research Hospital (Approval No. 83/2025), and the study was conducted in accordance with the principles of the Declaration of Helsinki.

2.2 Patient Selection

A total of 93 women aged ≥60 years were scheduled for minimally invasive hysterectomy over the course of the study. The surgical approach (V-NOTES or TLH) was determined according to routine clinical practice and surgeon preference rather than randomization. Factors influencing the selection of the surgical technique included anatomical feasibility, suspected adhesions, prior abdominal or pelvic surgery, uterine characteristics, and intraoperative surgical assessment. Concurrent adnexectomy or opportunistic salpingectomy was performed in both groups when clinically indicated and anatomically feasible.

V-NOTES hysterectomy was initially planned in 49 patients. 5 procedures required conversion to laparotomy due to dense adhesions (n = 3) or inadequate visualization (n = 2). These conversion cases were classified as intraoperative complications (Clavien–Dindo grade IIIb). For the analysis of postoperative recovery outcomes (pain scores and time to mobilization), a per-protocol approach was used, including only successfully completed procedures. However, conversion cases were retained in the complication analysis to reflect the inherent procedural risk associated with the technique.

Because postoperative recovery variables for conversion cases were not consistently available in the retrospective dataset, reliable intention-to-treat analyses of recovery outcomes could not be performed. Therefore, postoperative recovery outcomes were analyzed using a per-protocol framework restricted to successfully completed MIS. However, conversion cases were retained in the complication analysis to better reflect overall procedural feasibility and surgical burden associated with the V-NOTES approach. As such, the final comparative cohort consisted of 43 completed V-NOTES procedures and 44 TLH procedures.

2.3 Surgical Procedures

All procedures were performed by senior surgeons experienced in MIS. Each participating surgeon had previously performed more than 25 procedures using both surgical techniques, thereby minimizing the potential influence of the surgical learning curve on perioperative outcomes.

V-NOTES procedures were performed using a standardized transvaginal endoscopic access platform with low-pressure carbon dioxide insufflation (8–10 mmHg). TLH procedures were performed using a conventional four-port laparoscopic technique.

2.4 Postoperative Management

All patients followed standardized institutional postoperative care protocols emphasizing early mobilization and multimodal postoperative analgesia. Standard postoperative pain management consisted of intravenous paracetamol and nonsteroidal anti-inflammatory drugs, with rescue opioid analgesia administered as necessary according to institutional pain management protocols.

2.5 Data Collection and Outcome Measures

Baseline variables included age, body mass index (BMI), gravida, parity, prior pelvic surgery, uterine size, surgical indication, and comorbidities, including hypertension, diabetes mellitus, coronary artery disease, and chronic obstructive pulmonary disease. Primary postoperative recovery outcomes included: time to independent ambulation (hours), return to daily activities (days), and postoperative pain scores measured using a 10-point visual analog scale (VAS) on postoperative days 1, 3, and 7.

Return to daily activities was defined as the patient's self-reported ability to resume routine household and personal daily activities without external assistance. These data were collected during standardized postoperative follow-up visits scheduled at 1 week and 4 to 6 weeks

postoperatively, using standardized clinical questioning to assess complication resolution and functional recovery.

Perioperative outcomes included operative time, estimated blood loss, length of hospital stay, conversion to laparotomy, and perioperative complications.

Data were retrospectively extracted from standardized electronic medical records and nursing charts by a single investigator blinded to the study hypothesis to minimize measurement bias.

2.6 Statistical Analysis

All statistical analyses were performed using Statistical Package for the Social Sciences (SPSS) version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were assessed for normality using the Shapiro–Wilk test. Normally distributed continuous variables were compared using the independent samples *t*-test, whereas non-normally distributed variables were analyzed using the Mann–Whitney U test. Categorical variables were compared using the chi-square test or Fisher's exact test, as appropriate. Prior to multivariable regression analysis, model assumptions were verified; multicollinearity was assessed using variance inflation factor and tolerance statistics, and residual distribution and homoscedasticity were evaluated by visual inspection of residual plots.

Multivariable linear regression analyses were performed to evaluate the independent association between surgical approach and postoperative recovery outcomes while adjusting for clinically relevant confounders, including age, BMI, parity, presence of ≥1 comorbidity, and prior pelvic surgery. Regression coefficients (β), 95% confidence intervals (CI), and adjusted *p*-values were reported.

Given the retrospective design of the study, no *a priori* sample size calculation was performed. A post hoc power analysis was additionally conducted for the primary postoperative pain outcome (VAS Day 1), demonstrating a statistical power of >99%. Propensity score matching was not performed due to the relatively limited sample size and the potential for significant sample loss after matching. Therefore, multivariable regression adjustment was preferred. Statistical significance was defined as $p < 0.05$.

3. Results

3.1 Study Population and Baseline Characteristics

A total of 93 women aged ≥60 years undergoing minimally invasive hysterectomy for benign gynecologic conditions were evaluated. In the planned V-NOTES cohort (n = 49), 5 procedures required conversion to laparotomy due to dense pelvic adhesions or inadequate visualization. In addition, 1 case was excluded due to incomplete postoperative recovery data. Therefore, the final per-protocol recovery analysis included 43 successfully completed V-NOTES procedures and 44 TLH procedures (Fig. 1). Baseline demographic and clinical characteristics, including age, BMI, gravidity, parity, presence of ≥1 comorbidity, and prior pelvic surgery, were comparable between the two groups (Table 1).

3.2 Perioperative and Complication Outcomes

Perioperative and complication outcomes are summarized in Table 2. Mean operative time was comparable between the V-NOTES and TLH groups (94.2 ± 34.0 vs. 103.6 ± 36.8 minutes; $p = 0.21$). However, estimated blood loss was significantly lower in the V-NOTES group (124.3 ± 91.2 vs. 306.7 ± 132.7 mL; $p < 0.001$). Furthermore, patients undergoing V-NOTES exhibited a significantly shorter postoperative hospital stay compared with the TLH group (1.0 [1.0–2.0] vs. 2.0 [2.0–2.0] days; $p < 0.001$). The overall conversion rate in the initially planned V-NOTES cohort was 10.2% (5/49). Conversion to laparotomy was primarily due to dense pelvic adhesions and inadequate intraoperative visualization. No major intraoperative organ injury, reoperation, or intensive care unit (ICU) admission occurred in converted cases. Detailed perioperative complications and conversion events are summarized in Table 3. In the TLH group, postoperative complications primarily included trocar-site infections, vaginal cuff-related complications, and 1 umbilical hernia. All complications occurred in the early postoperative period.

The overall postoperative complication rate in the TLH group was 15.9%, including trocar-site infection in 6.8%. All trocar-site infections were superficial and were managed successfully with oral antibiotics and/or local wound care, without reoperation, ICU readmission, or long-term morbidity. Although this proportion appears relatively high compared with rates reported in contemporary laparoscopic hysterectomy series [3], it should be interpreted with caution due to the small sample size and the exclusive inclusion of older patients. Formal age-specific institutional quality-registry data for TLH were not available for direct comparison; therefore, this finding should not be interpreted as evidence of systematic underperformance of TLH at our institution.

3.3 Unadjusted Postoperative Recovery Outcomes

The V-NOTES group demonstrated significantly faster postoperative recovery than the TLH group. Time to ambulation was significantly shorter in patients undergoing V-NOTES (5.77 ± 1.13 vs. 6.57 ± 1.13 hours; $p = 0.001$). Similarly, return to daily activities occurred earlier in the V-NOTES cohort (6.60 ± 1.20 vs. 7.84 ± 1.31 days; $p < 0.001$). Postoperative pain scores were also significantly lower in the V-NOTES group at all time points, including postoperative day 1 (2.42 ± 1.01 vs. 3.93 ± 1.07), day 3 (1.30 ± 0.60 vs. 2.00 ± 0.43), and day 7 (0.63 ± 0.49 vs. 0.89 ± 0.39) (all $p < 0.05$). However, because postoperative recovery analyses were performed using a per-protocol framework excluding conversion cases and patients with incomplete recovery data, these findings should be interpreted with caution when considering overall procedural

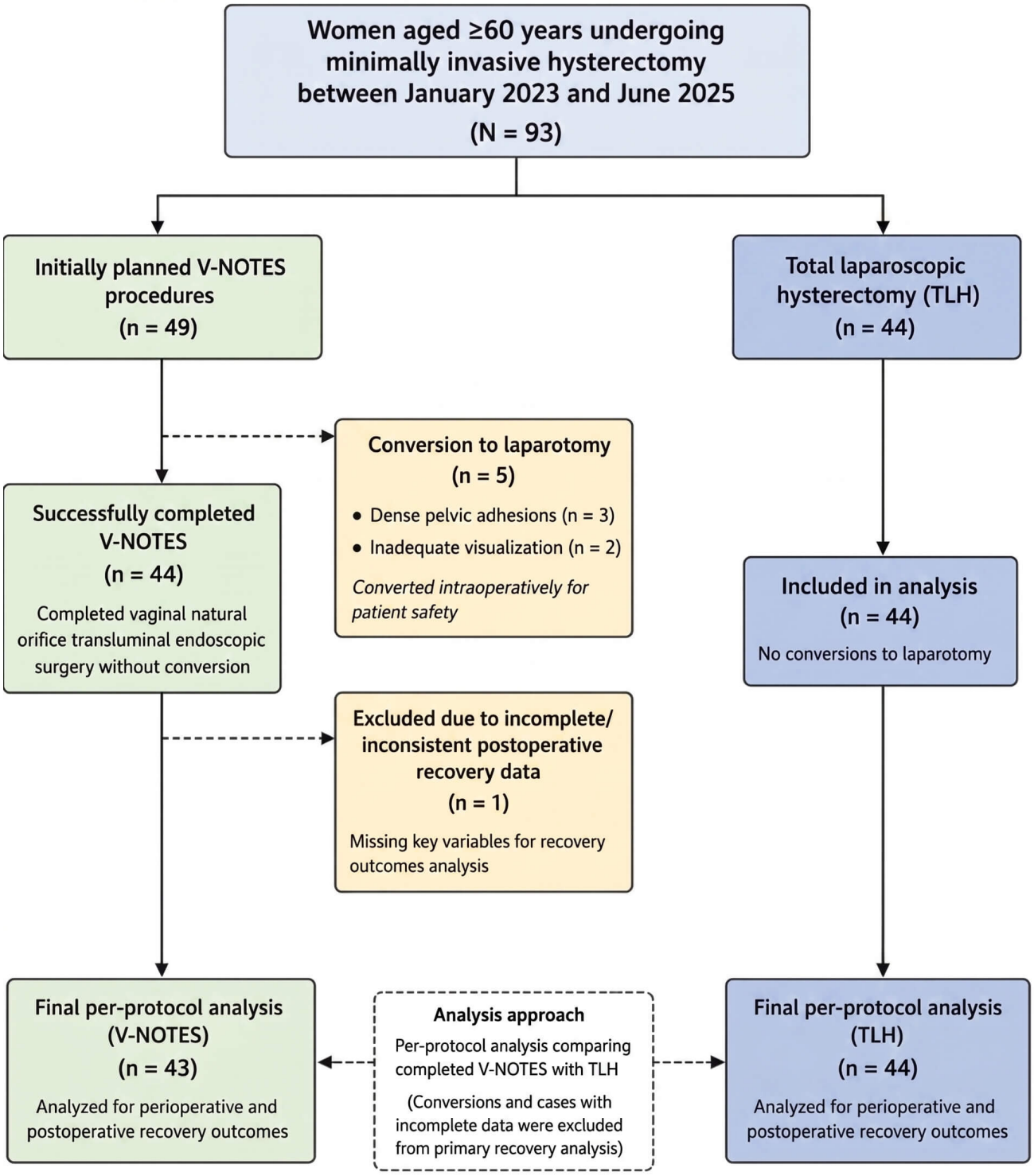

Fig. 1. Study flowchart of patient selection and allocation. V-NOTES, vaginal natural orifice transluminal endoscopic surgery; TLH, total laparoscopic hysterectomy.

performance. (Table 2). Detailed perioperative complications and conversion events are presented in Table 3.

3.4 Multivariable Adjusted Analysis

To minimize the potential influence of baseline imbalance and patient-selection bias, multivariable linear regression models were applied, adjusting for age, BMI, presence of ≥1 comorbidity, parity, and prior pelvic surgery. After adjustment, V-NOTES remained independently associated with significantly lower VAS pain score on postoperative day 1 ($\beta = -1.16$, 95% CI: -2.13 to -0.19; $p = 0.028$). However, differences in time to ambulation and return to

Table 1. Baseline demographic and clinical characteristics of the study population.

Variable	V-NOTES (n = 43)	TLH (n = 44)	*p*-value
Age (years)	63.4 ± 3.1	62.8 ± 2.4	0.31
BMI (kg/m^2)	30.7 ± 3.2	30.4 ± 2.0	0.58
Gravida	3.2 ± 1.3	3.0 ± 1.4	0.47
Parity	2.5 ± 1.0	2.4 ± 1.2	0.69
Prior pelvic surgery, n (%)	14 (32.6%)	15 (34.1%)	0.88
≥1 Comorbidity, n (%)	27 (62.8%)	29 (65.9%)	0.77
Uterine size (weeks)	10.1 ± 2.8	10.7 ± 3.1	0.39
Indication			
Leiomyoma	21 (48.8%)	23 (52.3%)	0.72
Adenomyosis	11 (25.6%)	12 (27.3%)	0.84
Abnormal uterine bleeding	11 (25.6%)	9 (20.4%)	0.56

Data are presented as mean ± standard deviation (SD) or number (percentage). *p*-values were calculated using independent sample *t*-test or chi-square test as appropriate.

BMI, body mass index.

Table 2. Comparison of perioperative and postoperative recovery outcomes between V-NOTES and TLH groups.

Outcome	V-NOTES (n = 43)	TLH (n = 44)	Unadjusted *p*-value
Operative time (min), mean ± SD	94.2 ± 34.0	103.6 ± 36.8	0.210
Estimated blood loss (mL), mean ± SD	124.3 ± 91.2	306.7 ± 132.7	<0.001
Hospital stay (days), median (IQR)	1.0 (1.0–2.0)	2.0 (2.0–2.0)	<0.001
Time to ambulation (hours), mean ± SD	5.77 ± 1.13	6.57 ± 1.13	0.001
Return to daily activities (days), mean ± SD	6.60 ± 1.20	7.84 ± 1.31	<0.001
VAS Day 1, mean ± SD	2.42 ± 1.01	3.93 ± 1.07	<0.001
VAS Day 3, mean ± SD	1.30 ± 0.60	2.00 ± 0.43	<0.001
VAS Day 7, mean ± SD	0.63 ± 0.49	0.89 ± 0.39	0.008

Data are presented as mean ± standard deviation (SD) or median (interquartile range), as appropriate. Unadjusted comparisons were performed using independent samples *t*-test or Mann–Whitney U test according to data distribution.

VAS, visual analog scale; SD, standard deviation; IQR, interquartile range.

Table 3. Perioperative complications and conversion events.

Complication/Event	Group	n (%)	Timing	Management	Outcome	Clavien–Dindo
Conversion due to dense pelvic adhesions	V-NOTES	3/49 (6.1%)	Intraoperative	Laparotomy conversion	Recovered without reoperation or major morbidity	IIIb
Conversion due to inadequate visualization	V-NOTES	2/49 (4.1%)	Intraoperative	Laparotomy conversion	Uneventful recovery	IIIb
Trocar-site infection	TLH	3/44 (6.8%)	Postoperative	Oral antibiotics and/or local wound care	Resolved	II
Vaginal cuff-related complication	TLH	3/44 (6.8%)	Postoperative	Conservative management/observation/medical treatment	Resolved	II
Umbilical hernia	TLH	1/44 (2.3%)	Postoperative	Surgical follow-up	Stable	IIIa

Conversion percentages were calculated using the initially planned V-NOTES cohort as the denominator (n = 49). TLH complication percentages were calculated using the TLH cohort as the denominator (n = 44). Conversion events were categorized within the Clavien–Dindo framework to reflect deviation from the planned minimally invasive approach and overall procedural burden. TLH-related complications were early postoperative events; trocar-site infections were superficial and resolved with conservative treatment.

Table 4. Multivariable linear regression analysis for postoperative recovery outcomes.

Outcome	β coefficient (V-NOTES)	95% CI	Adjusted *p*-value
Time to ambulation	−0.29	−0.88 to 0.31	0.340
Return to daily activities	−0.41	−1.07 to 0.24	0.210
VAS Day 1	−1.16	−2.13 to −0.19	0.028
VAS Day 3	−0.58	−1.20 to 0.03	0.060
VAS Day 7	−0.19	−0.44 to 0.05	0.110

Footnotes: Multivariable linear regression models were adjusted for age, BMI, parity, presence of ≥1 comorbidity, and prior pelvic surgery. β coefficients represent the independent association between surgical approach and postoperative recovery outcomes.
CI, confidence interval.

daily activities were no longer statistically significant after adjustment (Table 4).

4. Discussion

In this study, we reported that V-NOTES may provide reduced immediate postoperative pain compared with TLH in older women undergoing minimally invasive hysterectomy. Perceived advantages in functional recovery, such as time to ambulation and return to daily activities, are closely associated with patient-specific factors like age and BMI [12]. The observed reduction in VAS pain scores on postoperative day 1 remained significant after multivariable adjustment. This finding aligns with the underlying rationale of V-NOTES, which minimizes abdominal wall trauma and nociceptive stimulation by avoiding trocar incisions. In older patients, for whom effective pain control is important to reduce the risk of delirium and cardiopulmonary complications, this independent effect may support the use of a natural orifice minimally invasive approach in appropriately selected patients [14]. In addition to reduced postoperative pain, the V-NOTES group demonstrated significantly lower estimated blood loss and shorter postoperative hospital stay in unadjusted analyses. These findings may be associated with avoidance of abdominal wall trauma and reduced tissue manipulation inherent to the transvaginal natural orifice approach. Similar perioperative advantages have been reported in previous comparative studies evaluating minimally invasive transvaginal hysterectomy techniques [15,16]. A key finding in this analysis was the loss of statistical significance for time to ambulation and return to daily activities after adjustment for age and BMI. This finding suggests that patient-related factors may play a greater role in postoperative recovery trajectories in older populations than the surgical technique alone. Recovery speed is not determined solely by surgical approach but is also influenced by baseline characteristics such as age and BMI. While V-NOTES appears to facilitate faster recovery in unadjusted models, these findings suggest that patients with more favorable anatomical characteristics and lower anticipated surgical complexity may have been preferentially selected for the V-NOTES approach [15]. In terms of surgical safety, a 10% conversion rate was observed in the V-NOTES group. This conversion rate was higher than that reported in a previous study [15]. This difference may be attributable to the exclusive inclusion of older patients in our study, who are more likely to have a history of prior abdominal surgery and pelvic adhesions. Furthermore, a conservative intraoperative decision-making strategy favoring early conversion to laparotomy in cases of dense adhesions or inadequate visualization may have contributed to this rate. The procedures were performed by senior surgeons with experience of more than 25 cases in each technique, ensuring that the results reflect the intrinsic efficacy of the procedures rather than learning-curve artifacts. Careful preoperative patient selection and imaging-based assessment may help reduce conversion risk in future cases. Avoidance of abdominal trocar access may represent a potential perioperative advantage of the V-NOTES approach. Interestingly, the TLH group experienced a higher rate of postoperative wound-related complications, such as trocar-site infections and hernias, further supporting the potential benefit of avoiding abdominal access when feasible [16].

However, this observation requires cautious interpretation. Previous systematic reviews and meta-analyses comparing V-NOTES hysterectomy with conventional laparoscopic hysterectomy for benign indications have generally reported low and comparable overall complication rates between these two approaches [6,11]. Therefore, the relatively higher percentage of complications observed in the TLH group in our cohort may reflect the small sample size, the older age profile of the study population, and the vulnerability of this selected subgroup rather than an intrinsically inferior performance of TLH as a comparator. In addition, the TLH complications were predominantly minor postoperative events, including superficial trocar-site infections and conservatively managed vaginal cuff-related complications, all of which resolved without major sequelae. Accordingly, these findings should not be interpreted as evidence of the general superiority of V-NOTES over TLH, but rather as suggesting a potential advantage of V-NOTES in early postoperative pain among carefully selected older women.

Although a previous comparative study has evaluated V-NOTES hysterectomy and conventional laparo-

scopic hysterectomy, most have included heterogeneous patient populations across a wide age range [15]. Evidence specifically focused on older women remains limited. The present study therefore contributes age-specific comparative data on postoperative recovery following V-NOTES and TLH in women aged 60 years and older, with particular emphasis on functional recovery parameters such as early ambulation, postoperative pain trajectory, and return to daily activities. These outcomes are particularly relevant in geriatric populations, in whom delayed mobilization may increase the risk of complications and functional decline.

Furthermore, recent literature emphasizes the importance of evaluating alternative minimally invasive approaches and optimizing patient selection criteria. Broadening the comparative perspective beyond the V-NOTES framework highlights that anatomical feasibility and individualized surgical planning are critical for improving postoperative recovery and minimizing procedural burden in older populations [5]. Although conventional vaginal hysterectomy remains an important minimally invasive alternative, TLH was selected as the comparator in the present study because it represents the most commonly used minimally invasive hysterectomy approach at our institution throughout the study period.

The subjective nature of metrics such as return to daily activities and pain scores represents a limitation of this study. Given its retrospective design, outcomes such as postoperative pain scores and return to daily activities may be subject to recall bias and individual patient perception. Furthermore, the absence of a standardized geriatric frailty scale represents an additional limitation. Future prospective trials incorporating frailty instruments such as the Clinical Frailty Scale (CFS) would provide more nuanced insight into postoperative recovery trajectories in older patients. However, the use of a per-protocol analysis enabled a focused evaluation of procedural efficacy in successfully completed cases, providing a pragmatic assessment of the potential role of V-NOTES in a geriatric setting [17,18]. Although a per-protocol framework was used to evaluate recovery following successfully completed minimally invasive procedures, this approach may not fully reflect the overall patient experience when V-NOTES is the initially planned intervention. Therefore, conversion events were retained in the complication analysis to capture the procedural risk associated with this technique.

Strengths and Limitations

This study has several strengths. It focuses on an older population, which remains underrepresented in comparative studies of minimally invasive hysterectomy. Detailed postoperative recovery parameters, including pain trajectories and time to ambulation, were systematically evaluated. In addition, multivariable regression analysis allowed adjustment for several clinically relevant confounders.

Nevertheless, several limitations should be acknowledged. First, the retrospective design may introduce selection bias, and the surgical approach was determined by routine clinical practice rather than randomization. Second, the sample size was relatively modest and no *a priori* power calculation was performed. Third, although age and BMI were controlled, the absence of a standardized geriatric frailty scale limited the ability to comprehensively assess baseline health status and functional status, which may influence postoperative recovery in older populations. American Society of Anesthesiologists (ASA) classification and formal frailty scores were not consistently available in the retrospective dataset, further limiting evaluation of baseline functional reserve.

Finally, subjective outcomes such as postoperative pain and return to daily activities may be influenced by individual patient perception. Although the authors are affiliated with multiple institutions, all procedures included were performed in a single tertiary referral center, which may limit the generalizability of the findings. These factors should be considered when interpreting the findings.

Lastly, exclusion of conversion cases from postoperative recovery analyses may have led to overestimation of functional recovery benefits associated with V-NOTES. However, postoperative recovery variables for converted cases were not consistently available in the retrospective dataset, limiting the feasibility of robust intention-to-treat analyses.

5. Conclusion

In conclusion, V-NOTES was associated with lower early postoperative pain, reduced estimated blood loss, and shorter hospital stay in older women undergoing minimally invasive hysterectomy. However, adjusted analyses suggested that postoperative recovery trajectories were also strongly influenced by patient-related factors, including age and BMI. A conversion rate of 10% was observed due to intraoperative challenges; however, successfully completed V-NOTES procedures effectively avoided abdominal wound-related complications. Future prospective multicenter studies incorporating standardized frailty assessment and intention-to-treat analyses are warranted to better define optimal patient selection criteria for V-NOTES in older women.

Availability of Data and Materials

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions

Conceptualization, GBİ and SŞ; Data collection, GBİ, GBUB and EB; Data analysis and interpretation, GBİ, ABAD and EB; Responsible surgeon, EB; Statistical

analysis, GBİ; Writing—original draft preparation, GBİ; Writing—review and editing, GBİ, GBUB, EB, ABAD, and SŞ. All authors have read and agreed to the published version of the manuscript. All authors agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of Zeynep Kamil Women and Children's Diseases Training & Research Hospital (Approval No: 83/2025). Patient consent was waived due to the retrospective nature of the study.

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Conflicts of Interest

The authors declare no conflicts of interest.

Declaration of AI and AI-Assisted Technologies in the Writing Process

During the preparation of this manuscript, the authors used ChatGPT (GPT-5.6 Luna) for language editing and grammar checking purposes. After using this tool, the authors carefully reviewed, revised, and approved the final content of the manuscript and take full responsibility for the integrity and accuracy of the work.

Supplementary Material

Supplementary material associated with this article can be found, in the online version, at https://doi.org/10.31083/CEOG53383.

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