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Comparison of Perioperative Outcomes Between V-NOTES and Total Laparoscopic Hysterectomy: A Retrospective Analysis

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ABSTRACT

Background: This retrospective study compared the perioperative outcomes of vaginal natural orifice transluminal endoscopic surgery (V-NOTES) and total laparoscopic hysterectomy (TLH).

Materials and methods: This analysis included 62 patients: 32 underwent V-NOTES and 30 underwent TLH. Patients with a body mass index (BMI) >30, a history of endometriosis, multiple cesarean sections, or a uterine size >12 week were excluded. Perioperative data—including visual analog scale (VAS) scores, analgesia use, mobilization time, hospitalization duration, and hemoglobin deficit—were compared using independent sample *t* tests and Mann–Whitney *U* tests.

Results: There were no significant differences in BMI, number of pregnancies, or operative time ($p > 0.05$). VAS scores at 6 and 24 h were significantly lower in the V-NOTES group ($p < 0.001$). Patients in the V-NOTES group required less analgesia, had shorter mobilization and hospitalization periods, and returned to daily activities sooner ($p < 0.001$). However, the hemoglobin deficit was higher in the V-NOTES group (1.85 g/dl vs. 0.7 g/dl, $p < 0.001$). The neutrophil-to-lymphocyte ratio (NLR) was lower in the V-NOTES group ($p = 0.013$), whereas the platelet-to-lymphocyte ratio (PLR) and mean platelet volume (MPV) did not differ significantly between the two groups.

Conclusion: V-NOTES offers advantages such as reduced postoperative pain and faster recovery compared to TLH. The higher hemoglobin deficit observed with V-NOTES may be related to the surgeon's experience. Further randomized studies are warranted to validate these findings and define appropriate patient selection criteria.

KEYWORDS: Minimally invasive surgery; neutrophil-to-lymphocyte ratio (NLR); postoperative recovery; total laparoscopic hysterectomy (TLH); V-NOTES

INTRODUCTION

Hysterectomy is the most common gynecological operation performed worldwide [1]. As many as 20–40% of women undergo this procedure by the age of 60 [2,3]. Several approaches to hysterectomy exist, including abdominal total laparoscopic hysterectomy (TLH), as well as vaginal natural orifice transluminal endoscopic surgery (V-NOTES).

V-NOTES is a minimally invasive technique that employs the vaginal route to access the abdominal cavity, eliminating the need for external incisions. In recent years, it has gained popularity because of its cosmetic advantages, particularly the absence of visible scars in gynecological surgery.

Complication rates vary among different surgical approaches and can be broadly categorized into anatomical injuries (e.g., to the urinary bladder, ureters, intestines, rectum, anus, and nervous structures) and functional disorders (e.g., sexual dysfunction or urinary incontinence) [4]. Although hysterectomy is frequently performed, the optimal surgical method remains controversial. If a gynecologic procedure can be completed *via* the vaginal route, this approach is often recommended [3]. Nevertheless, TLH remains more popular among gynecologists than V-NOTES [5]. A comprehensive comparison of the perioperative outcomes between V-NOTES and TLH is therefore crucial for determining the most advantageous approach in terms of patient recovery, pain management, complication rates, and overall safety. Additionally, this study examined markers such as the neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR), which have not been widely compared across these two procedures but may provide valuable insights into the inflammatory response and overall patient recovery.

In this regard, we hypothesized that V-NOTES would yield superior perioperative outcomes compared with TLH. Specifically, we anticipated that patients undergoing V-NOTES would experience reduced postoperative pain, shorter hospitalization, more rapid recovery, and comparable or lower complication rates than those undergoing TLH.

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MATERIALS AND METHODS

This retrospective observational study was conducted from October 2021 to March 2022 in the Department of Obstetrics and Gynecology at Balikesir University Medical Faculty Training and Research Hospital. It was approved by the Balikesir University Clinical Research Ethics Committee (approval number 488766011/010.99/129696). Permission to access and utilize patient data and laboratory test results was also granted by the Chief Physician of Balikesir University Medical Faculty Training and Research Hospital.

Data were retrospectively collected from the hospital's electronic medical records system, encompassing preoperative, intraoperative, and postoperative details for all participants. Patients were included if they were aged 18–65 years, had a body mass index (BMI) between 20 and 29.9, and underwent elective hysterectomy for benign gynecological conditions (such as fibroids, adenomyosis, or other causes of menometrorrhagia). Two groups were defined based on the surgical method: the V-NOTES group (Group 1, $n = 32$) and the TLH group (Group 2, $n = 30$).

Exclusion criteria were implemented to minimize factors that could confound perioperative outcomes. Patients were excluded if they had a history of significant pelvic adhesions, advanced endometriosis, or previous pelvic radiation—conditions that tend to increase surgical complexity. A uterine size larger than 12 week of gestation, which might require additional surgical maneuvers, also led to exclusion, as did a BMI greater than 30 or active pelvic or systemic illnesses that could distort postoperative results. Additional exclusions included coagulopathy or active anticoagulant use, more than one prior cesarean delivery, any cancer diagnosis, or the need for emergency surgery. Patients with substantial cardiopulmonary comorbidities that rendered them unsuitable for elective procedures were likewise excluded. A detailed flowchart in Figure 1 illustrates the inclusion and exclusion process.

Perioperative data—including operation time, visual analog scale (VAS) scores, use of analgesia, time to first mobilization, length of hospital stay, time to resumption of daily activities, hemoglobin deficit, BMI, number of pregnancies, neutrophil-to-lymphocyte ratio (NLR), platelet-to-lymphocyte ratio (PLR), and mean platelet volume (MPV)—were compared between the two groups. Hemoglobin levels were measured at least 30 days preoperatively and at 6 and 24 h postoperatively. All surgeries were performed by the same two surgeons under general anesthesia to ensure consistency.

Operation Technique for V-NOTES Hysterectomy

Each patient was placed in a 20° Trendelenburg position. The cervix was incised using a monopolar energy source, and the uterosacral ligaments were dissected. The bladder was then dissected away from the uterus, and the posterior peritoneal fold was opened to reach the pouch. A GelPoint V-Path device (Applied Medical, Rancho Santo, Margarita, CA, USA) was used to establish a transvaginal access system. After positioning the device, a pneumoperitoneum was created with CO_2 at 12 mmHg, at a flow rate of 0.5 L/min. A 10 mm, 0° laparoscope was inserted for visualization.

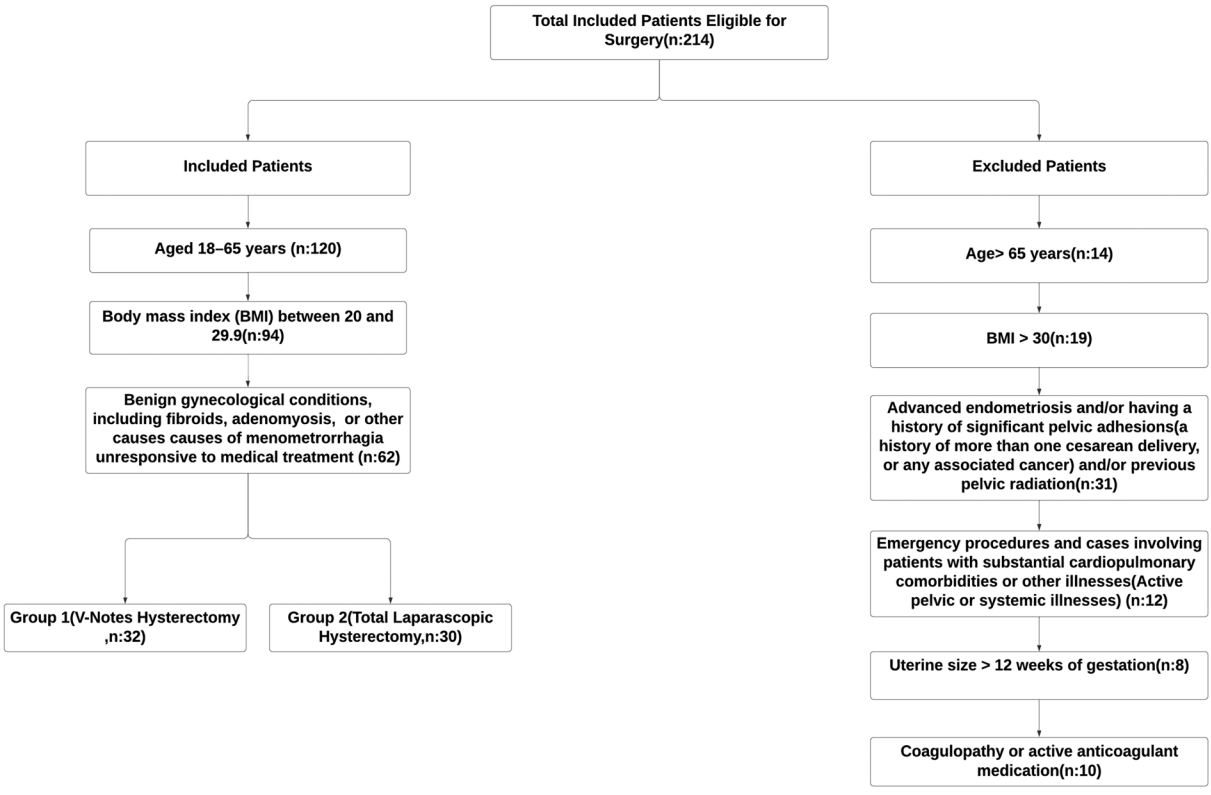

FIGURE 1. Flowchart depicting patient screening, exclusion, and inclusion process.

The broad, utero-ovarian, and round ligaments were transected using an electrothermal bipolar vessel sealing device (LigaSure, 5 mm diameter, blunt tip; Covidien). If ovarian resection was planned, the infundibulopelvic ligaments were also transected. The uterus and adnexa were removed through the vaginal route. Hemostasis was confirmed, and the vaginal cuff was closed with a single-layer Vicryl suture (60 cm, polyglactin 910; Ethicon Endosurgery).

Operation Technique for TLH

A pneumoperitoneum was created using CO_2 at 12 mmHg (flow rate of 0.5 L/min), and one umbilical port plus three lateral ports were placed. Ligation of the round ligaments and utero-ovarian ligaments (or infundibulopelvic ligaments, if the ovaries were removed) was performed. The bladder was dissected from the cervix, and the uterine arteries were ligated. A colpotomy was then made with monopolar energy, and the uterus and adnexa were removed vaginally. The vaginal cuff was closed with a single-layer Vicryl suture (60 cm, polyglactin 910; Ethicon Endosurgery), and the port sites were sutured.

For this study, V-NOTES operative time began at the first cervical incision and ended after closure of the vaginal cuff. For TLH, operative time started when the first trocar was introduced and ended after the closure of all trocar sites.

Postoperative treatment was standardized. Each patient received 100 mL of intravenous (IV) fluid and 100 mg of IV medication post-surgery. diclofenac sodium (75 mg, intramuscularly [IM]) was administered every 12 h. If pain persisted, an additional dose of diclofenac sodium (75 mg IM) and meperidine (100 mg IM) was given. On postoperative day 1, a maximum of two doses of diclofenac sodium (75 mg IM) were administered. Pain assessments were conducted at 6 and 24 h post-surgery using a 0–100 VAS scale (0 indicating no pain, 100 the worst pain). Other parameters noted included age, BMI, number of pregnancies, NLR, PLR, MPV, time to first mobilization, length of hospital stay, and time to return to daily activities.

Statistical Analyses

Statistical analyses were performed using independent samples *t* test for normally distributed data and Mann–Whitney *U* test for non-normally distributed data. Correlations between numerical variables were evaluated using Pearson's *r* for normal distributions and Spearmans's Rho otherwise. All analyses were performed with the Jamovi software (version 2.3) [The Jamovi project (2022), https://www.jamovi.org] and R (version 4.1) [R Core Team (2021), https://cran.r-project.org], with MRAN snapshot 2022-01-01 for package retrieval. A *p* value <0.05 was considered statistically significant.

RESULTS

Our study population comprised 32 patients who underwent V-NOTES (Group 1) and 30 patients who underwent TLH (Group 2). Perioperative outcomes are summarized in the accompanying tables. Groups 1 and 2 exhibited no significant differences in BMI, number of pregnancies, or operation time ($p = 0.527$, $p = 0.587$, and $p = 0.116$, respectively; Tables 1 and 2). At 6 and 24 h postoperatively, VAS scores were significantly higher in the TLH group ($p < .001$; Table 2), while the use of analgesics was significantly lower in the V-NOTES group ($p < .001$; Table 2). In addition, time to first mobilization ($p < .001$), hospitalization duration ($p < .001$) and time to return to daily activities ($p < .001$) were all significantly shorter in the V-NOTES group (Table 2).

The hemoglobin deficit was 0.7 g/dl in patients who underwent TLH and 1.85 g/dl in those who underwent V-NOTES (Table 3). This difference was statistically significantly

TABLE 1. Comparison of perioperative parameters between V-NOTES and TLH

Parameters	V-NOTES ($n = 32$) Median (Min–Max)	TLH ($n = 30$) Median (Min–Max)	*p* value
Age (years)	59.1 (43–73)	50.9 (42–65)	0.013[a]
BMI (kg/m^2)	28.0 (25.3–29.9)	27.5 (23.4–29.8)	0.527[b]
Number of pregnancies	2.63 (2–5)	2.40 (1–4)	0.587[b]

BMI, body mass index; TLH, total laparascopic hysterectomy.
Median values are presented with their corresponding range (minimum–maximum).
Statistical significance was determined using the Mann–Whitney *U* test for continuous variables that did not follow a normal distribution.
[a]Significant difference between groups for age ($p < 0.05$).
[b]No statistically significant difference between groups for BMI and number of pregnancies ($p > 0.05$).

TABLE 2. Perioperative differences in efficiency and patient outcomes between V-NOTES and TLH

Parameter	V-NOTES ($n = 32$) Median (Min–Max)	TLH ($n = 30$) Median (Min–Max)	*p* value
Begining of the uterine surgery (min)	13.50 (10–20)	6 (4–9)	<0.001[a]
Operation time (min)	71 (44–110)	65 (56–76)	0.116[a]
First mobilization after operation (hours)	5 (4–6)	6 (5.5–7)	<0.001[b]
Post-op 6th hours VAS	5 (4–7)	7 (6–7)	<0.001[b]
Post-op 24 hours VAS	2 (2–4)	4 (4–5)	<0.001[b]
Hospitalization time (hours)	32.50 (25–40)	43.00 (36–46)	<0.001[a]
Return to daily life (hours)	15 (9–22)	30 (10–40)	<0.001[b]
Analgesia in the first 24 hours	1 (0–2)	2 (1–3)	<0.001[b]

Median values are presented with their corresponding range (minimum–maximum).
[a]Mann–Whitney *U* test.
[b]Significant difference between groups ($p < 0.05$).

TABLE 3. Comparison of hematologic and inflammatory markers in V-NOTES versus TLH

Parameter	V-NOTES (*n*:32) Median (Min–Max)	TLH (*n*:30) Median (Min–Max)	*p* value
Neutrophil lymphocyte ratio (NLR)	12.121 (3.269–18.50)	17.714 (3.905–32.75)	0.013[a]
Platelet lymphocyte ratio (PLR)	235.53 (90–498.57)	291.25 (128.88–475)	0.252[a]
Mean platelet volume (MPV) (fL)	8.5 (6.9–10.1)	8.9 (6.9–11.8)	0.341[a]
Hg deficit (g/dL)	1.85 (0.6–2.7)	0.7 (0.3–1.5)	<.001[a]

[a]Mann–Whitney *U* test was used.
[b]Data are presented as median (min–max).
$p < 0.05$ was considered statistically significant.

($p < .001$). The NLR was also lower in the V-NOTES group ($p = 0.013$; Table 3). However, no significant differences were observed between the groups in the PLR or MPV ($p = 0.252$ and $p = 0.341$, respectively; Table 3).

DISCUSSION

This study compared the perioperative outcomes of V-NOTES and TLH in hysterectomy. Our results show that V-NOTES is associated with significantly lower VAS scores, reduced analgesic use, earlier mobilization, shorter hospital stays, and quicker return to daily activities (Table 2). These advantages align with the hypothesis that V-NOTES offers superior perioperative outcomes and underscores the technique's potential to enhance recovery and patient satisfaction in eligible cases.

Despite the frequent use of hysterectomy worldwide, the optimal surgical approach remains controversial. Literature suggests that the vaginal route should be chosen whenever feasible due to its minimally invasive nature. However, TLH is still common among gynecologists, possibly due to its ease of visualization and instrument control in complex cases. A recent study by Giannini et al. [6] underscored the evolution of hysterectomy techniques and the growing focus on minimally invasive methods, including robotic and single-port laparoscopic surgeries, and highlighted how technological advancements in robot-assisted and single-port laparoscopic procedures continue to shape surgical practices. These findings further support the need for the continuous evaluation and improvement of hysterectomy methods to ensure optimal patient outcomes.

Our findings demonstrate that V-NOTES provides superior pain management in the immediate postoperative period ($p < 0.001$), which aligns with previous studies [7–9]. Interestingly, while our study indicates a notable reduction in postoperative analgesic requirements in the V-NOTES group ($p < 0.001$; Table 2), Kaya et al. [10] did not observe such a difference between V-NOTES and TLH. This discrepancy may reflect differing protocols or patient populations. Additionally, Gündoğdu et al. [11] suggested that spinal anesthesia in V-NOTES could further minimize postoperative analgesic needs; however, we maintained general anesthesia in both groups to limit anesthesia type as a confounding factor. Future research should explore how alternative anesthesia regimens may further optimize V-NOTES outcomes.

In our study, V-NOTES resulted in a significantly shorter mean hospital stay (32.5 vs. 43.0 h; Table 2) confirming the findings of Wang et al. [12], Yang et al. [13], Baekelandt et al. [9], and Kaya et al. [10]. Unlike Kim et al. [14], who reported longer operative times for V-NOTES, we observed no significant difference between the groups ($p = 0.116$, Table 2). This discrepancy may reflect variations in surgical experience, as evidenced by Kaya et al. [15], who noted shorter V-NOTES operative times once proficiency was established. Indeed, our own data (Figures 2 and 3) suggest that V-NOTES operative times decrease with increased surgeon familiarity, whereas TLH times were more consistent, likely due to greater collective experience with TLH in our clinic.

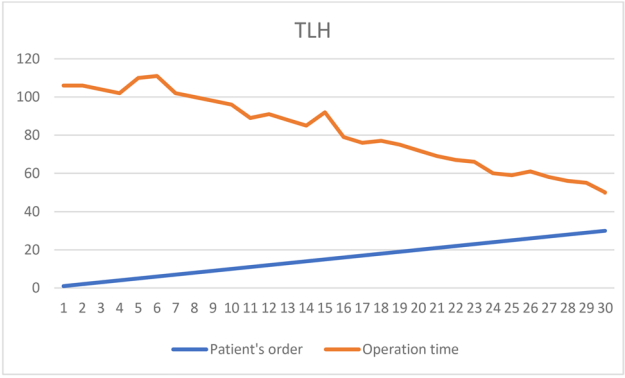

FIGURE 2. Operation time for TLH with the serial number of patients.

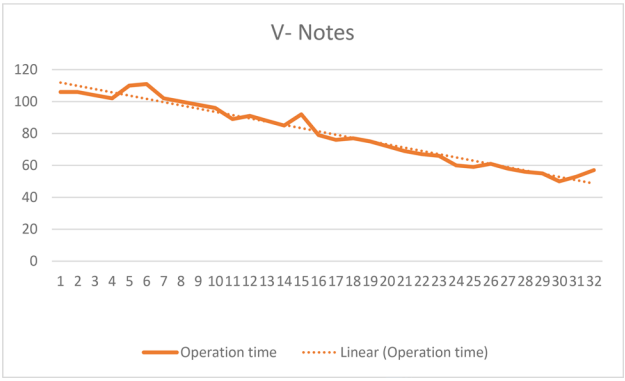

FIGURE 3. Operation time for V-NOTES with the serial number of patients.

Although V-NOTES was linked to significant improvements in perioperative outcomes, we also observed a higher hemoglobin deficit compared with TLH (1.85 vs. 0.7 g/dl, $p < 0.001$; Table 3). We propose that this might be partly attributed to a learning curve; as surgeons gain experience with V-NOTES, procedural efficiency and hemostatic control generally improve, potentially mitigating blood loss. Beyond surgical proficiency, strategies such as careful application of electrothermal devices, preoperative coagulation optimization, and using hemostatic agents may further reduce the hemoglobin deficit.

Our inclusion of a broad but carefully selected patient population (BMI range of 20–29.9, uterine size ≤12 week) limits the study's applicability to more diverse groups. Future research should evaluate V-NOTES in individuals with higher BMI or larger uteri, as indicated by other authors who have reported successful V-NOTES in more complex cases [16,17]. It is important to note that the exclusion of patients with a BMI >30 or uterine size >12 week limits the generalizability of our findings. Future studies should evaluate the V-NOTES in a broader patient population to determine its applicability. Importantly, we achieved a 100% completion rate for V-NOTES, consistent with findings by Raquet et al., who noted that conversion to laparoscopic or open approaches was rarely required [18].

Another distinguishing feature of our study was the inclusion of inflammatory markers, including NLR, PLR, and MPV. These have been recognized as useful indicators of perioperative stress and potential complications [19–26]. We

found that NLR was significantly lower in the V-NOTES group ($p = 0.013$; Table 3), suggesting a reduced inflammatory response compared with TLH. PLR and MPV did not differ significantly between the two groups ($p = 0.252$; Table 3). Moreover, similar to the study by Rotem et al., we did not find any relationship between NLR/PLR and operation time or blood loss [26]. Although our cohort experienced no major perioperative complications, these findings lay the groundwork for future investigations into whether lower NLR translates into improved long-term outcomes. As NLR is often used as a marker for systemic inflammation, this suggests that V-NOTES might be less invasive or cause less tissue trauma, leading to better perioperative recovery and fewer complications associated with inflammation. Further studies are necessary to confirm the clinical significance of the NLR in this context, but the current evidence suggests that it may be a useful marker for evaluating the overall invasiveness and safety of different surgical approaches such as V-NOTES and TLH.

Like many studies, ours has both strengths and limitations. One strength lies in our evaluation of mobilization time and return to normal daily activities, providing direct insights into functional recovery. Another strength is our inclusion of inflammatory markers—namely PLR, NLR, and MPV—in both the TLH and V-NOTES groups, which adds a novel dimension to the comparative data. A key limitation is that we did not compare the financial costs associated with the two techniques. Although V-NOTES has demonstrated benefits such as diminished postoperative pain and quicker recovery, its higher initial expense can hinder widespread adoption. In this context, a recent and thorough review by Chaccour et al. [27] reported that V-NOTES hysterectomy is not inferior to laparoscopic hysterectomy in key surgical outcomes, including reduced operating time, shorter hospital stays, less postoperative pain, and fewer complications. However, V-NOTES hysterectomy is more expensive than laparoscopic hysterectomy. This cost difference may be mitigated by various factors, including country-specific healthcare analyses, insurance policies, and more efficient resource allocation.

Although the upfront costs of V-NOTES may be substantial, emerging data suggest that its long-term economic impact could be smaller than initially perceived. Shorter hospital stays, fewer postoperative complications, and faster recoveries can help reduce overall healthcare expenditures. Moreover, as surgical proficiency increases, operative times typically decrease, which may further reduce intraoperative costs. A recent systematic review highlighted the need for improved surgical training and more streamlined protocols to address financial barriers associated with V-NOTES [27]. However, additional cost–benefit analyses are necessary, particularly those examining long-term outcomes, to better understand the economic feasibility of this approach.

Other limitations of our study include its retrospective design and relatively small sample size, which may limit the statistical power to detect subtle differences—particularly for secondary outcomes such as inflammatory markers (NLR, PLR, and MPV). In addition, we did not assess long-term outcomes such as quality of life or sexual well-being [28,29], which are crucial for establishing a comprehensive picture of V-NOTES' clinical benefits.

CONCLUSION

In conclusion, our results indicate that V-NOTES offers considerable advantages over TLH in terms of postoperative pain, analgesic use, mobilization time, hospitalization length, and return to daily activities. Although V-NOTES showed a higher hemoglobin deficit, this may be mitigated by increased surgical expertise and improved hemostatic measures. Our comparative assessment of inflammatory markers suggests that V-NOTES may provoke a lower systemic inflammatory response than TLH, highlighting its potential benefits in reducing perioperative stress. Our results provide opportunities for further research in other fields. Additional randomized controlled trials should validate these findings, evaluate outcomes in more diverse patient populations, and include long-term assessments of quality of life, sexual function, and cost effectiveness. V-NOTES appears to be a promising alternative to TLH, offering improved patient outcomes and potentially transforming the future of minimally invasive gynecological surgery.

AUTHOR CONTRIBUTIONS

CRediT: **Serkan Sarikaya**: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Validation, Visualization, Writing – original draft; **Mine Islimye Taskin**: Conceptualization, Project administration, Resources, Validation, Visualization, Writing – original draft; **Tuba Bozhuyuk Sahin**: Writing – original draft; **Gurhan Guney**: Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing; **Mehmet Kececioglu**: Validation, Visualization; **Selim Afsar**: Supervision, Validation, Visualization.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

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