

Interventional procedure overview of vaginal transluminal endoscopic hysterectomy and adnexal surgery for benign gynaecological conditions

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Table 1 Abbreviations

Abbreviation	Definition
CCT	Controlled clinical trials
CD	Clavien-Dindo (for example, CD-1 = Clavien-Dindo grade 1)
DVT	Deep venous thrombosis
EQ-5D-3L	EuroQol five-dimension three-level patient-reported outcome measure
NR	Not reported
PID	Pelvic inflammatory disease
QoL	Quality of life
RCT	Randomised controlled trials
RoB2	Risk of bias 2
ROBINS-I	Risk of bias in non-randomised studies
SE	Standard error
TLH	Total laparoscopic hysterectomy
TU-LESS	Transumbilical laparoendoscopic single-site surgery
VAS	Visual analogue scale
vNOTES	Transvaginal natural orifice transluminal endoscopic surgery

Indications and current treatment

Benign gynaecological conditions refer to non-cancerous conditions affecting the female reproductive systems. These include chronic pelvic pain, uterine prolapse, fibroids and abnormal vaginal bleeding. The causes of these types of conditions are not always known but can be linked to periods, hormones and genetics. Left untreated, these conditions can lead to severe and prolonged pain, infections, and reduced quality of life.

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The typical treatments for these vaginal conditions are medications (such as antibiotics, painkillers and hormonal medicines), physiotherapy (such as pelvic floor exercises to relieve pain), and surgical intervention (such as hysterectomy).

The focus of this overview is on selected surgical interventions, namely hysterectomy, adnexectomy and myomectomy.

- Conventional hysterectomy is done through a cut in the abdomen or via the vagina. There are also laparoscopic approaches. A vaginal hysterectomy is usually preferred over an abdominal or laparoscopic hysterectomy because it's less invasive and involves a shorter stay in hospital. Limitations of vaginal hysterectomy includes poor visualisation and the limited space for manipulation.
- Adnexectomy is a surgical procedure which removes part of the adnexal tissue of the uterus and can be done with a hysterectomy or in isolation. Adnexectomies include the removal of one or both of the fallopian tubes (salpingectomy), the removal of one or both of the ovaries (oophorectomy) or the removal of ligaments that support the uterus and ovaries.
- A myomectomy is the surgical removal of fibroids that develop in or around the womb. These surgeries can be done as either keyhole or open surgeries depending on the size and position the fibroids.

What the procedure involves

The vaginal transluminal endoscopic hysterectomy procedure is done in a similar way to a conventional vaginal hysterectomy but uses an endoscopic view and laparoscopic instruments. The patient is placed in the lithotomy position. Under general anaesthesia, a circular incision is made in the vagina (around the cervix). Following anterior/posterior colpotomy and transecting the sacro-uterine ligaments, a keyhole instrument port with transvaginal indication is then inserted to improve access and visibility. The abdominal cavity is accessed through the

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colpotomy and then insufflated. Laparoscopic instruments are inserted and the surgery is done in a Trendelenburg (head down) position. Then the uterus, fallopian tubes or ovaries are removed vaginally (depending on the procedure type). Then the instrument port is removed, the abdomen is deflated, and the vaginal incision is closed with absorbable sutures.

Outcome measures

The main outcomes included procedure success rates, operation time, intra- and postoperative complications, length of stay, readmission rates, postoperative pain and quality of life.

Evidence summary

Population and studies description

This interventional procedures overview is based on 5,032 people from 1 systematic review, 1 RCT, 2 prospective case series and 5 retrospective cohort studies. Of these 5,032 people, 3,594 had the procedure. This is a rapid review of the literature, and a flow chart of the complete selection process is shown in [figure 1](#). This overview presents 9 studies as the key evidence in [table 2](#) and [table 3](#), and lists 37 other relevant studies in [table 5](#).

The systematic review by Chaccour et al. (2023) reviewed 7 studies for 1,770 hysterectomy procedures in adult women for benign gynaecological conditions. There were 743 people in the vNOTES arms of studies and 1,027 in the comparator arms. The studies included 2 international meta-analyses, 1 RCT from Belgium, 2 retrospective cohort studies from Taiwan, 1 retrospective cohort study from Thailand and 1 retrospective cohort study from South Korea.

The RCT by Baekelandt et al. (2021a) compared vNOTES with laparoscopy for adnexectomy in 67 adult women with an adnexal mass presumed to be benign.

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The study was done at a single centre in Belgium and randomly assigned 34 people to the vNOTES group and 33 to the laparoscopy group. The mean ages were 50 (plus or minus 10) and 52 (plus or minus 8.5), respectively. Follow up of 6 months captured pain and quality-of-life outcomes.

The study by Karkia et al. (2019) was a prospective case series in a UK setting. They investigated the safety and efficacy of hysterectomy and adnexectomy using vNOTES. The population included 33 women with benign uterine pathology or grade 1 stage 1 endometrial cancer suitable for hysterectomy at a local unit. The patients were aged between 35 and 70 with a mean age of 50. Indications for surgery included treatment resistant dysfunctional uterine bleeding (14), atypical endometrial hyperplasia (5), BRCA positive breast cancer (2), pelvic pain (7), post-menopausal bleeding (4) and endometrial cancer stage 1 (1). Follow-up data was captured at 3 months but is not publicly available.

The study by Baekelandt and Kapurubandara (2021b) is a prospective case series study that captured perioperative outcome data for 1,000 people having vNOTES for benign gynaecological conditions. 73% of procedures were hysterectomies and the rest were adnexal surgeries (18%) or other. All the procedures were done at a single centre in Belgium. The mean age of this cohort of women was 46 years.

Huang et al. (2022) is a retrospective study of patient data at a single centre in China for people who had vNOTES surgery for gynaecological conditions. The procedures included 902 adnexal surgeries, 98 myomectomies, 82 hysterectomies, 51 pelvic floor reconstruction surgeries and 14 malignant tumour surgeries. The mean ages across surgery groups ranged from 30.89 (plus or minus 6.26) to 63.55 (plus or minus 9.12) years old.

Ovarian cystectomies were the subject of the retrospective cohort study by Huang et al. (2021). They analysed 296 people, with a mean age of 30.1 (plus or

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minus 7.65), in need of laparoscopic surgery for ovarian cysts. This was a study in China where 86 women had vNOTES procedures and 210 were in the TU-LESS group.

Yan et al. (2022) is a retrospective study of 361 women who had either a vNOTES (n=228) or TU-LESS (129) hysterectomy at a single centre in China. The mean ages of each group were 53.03 (plus or minus 9.44) and 54.26 (plus or minus 10.33), respectively.

Temtanakitpaisan et al. (2018) retrospectively studied the outcomes of vNOTES hysterectomy across uterine sizes for benign pelvic organ lesions of the uterus, cervix or ovaries. The procedures were done for 275 women at a single centre in Taiwan. Group 1 included 191 people with uterine weights less than 500 g, group 2 included 67 people with uterine weights of 500 g to 999 g, and group 3 included 17 people with uterine weights of 1,000 g or higher. The mean ages of the groups were 48.68 (plus or minus 6.63), 47.22 (plus or minus 3.81) and 46.53 (plus or minus 2.96), respectively.

The study by Kaya et al. (2022) was a cross-sectional of surgical outcomes for vNOTES compared with laparoscopic hysterectomy for benign gynaecological conditions in women with obesity. The study was done in Turkey and the cohort (n=83) consisted of adult women with a BMI of 30 kg/m² or greater. The mean age in the laparoscopy arm was 49 years (range 40 to 71) and the mean age in the vNOTES group was 52 (range 40 to 74).

[Table 2](#) presents study details.

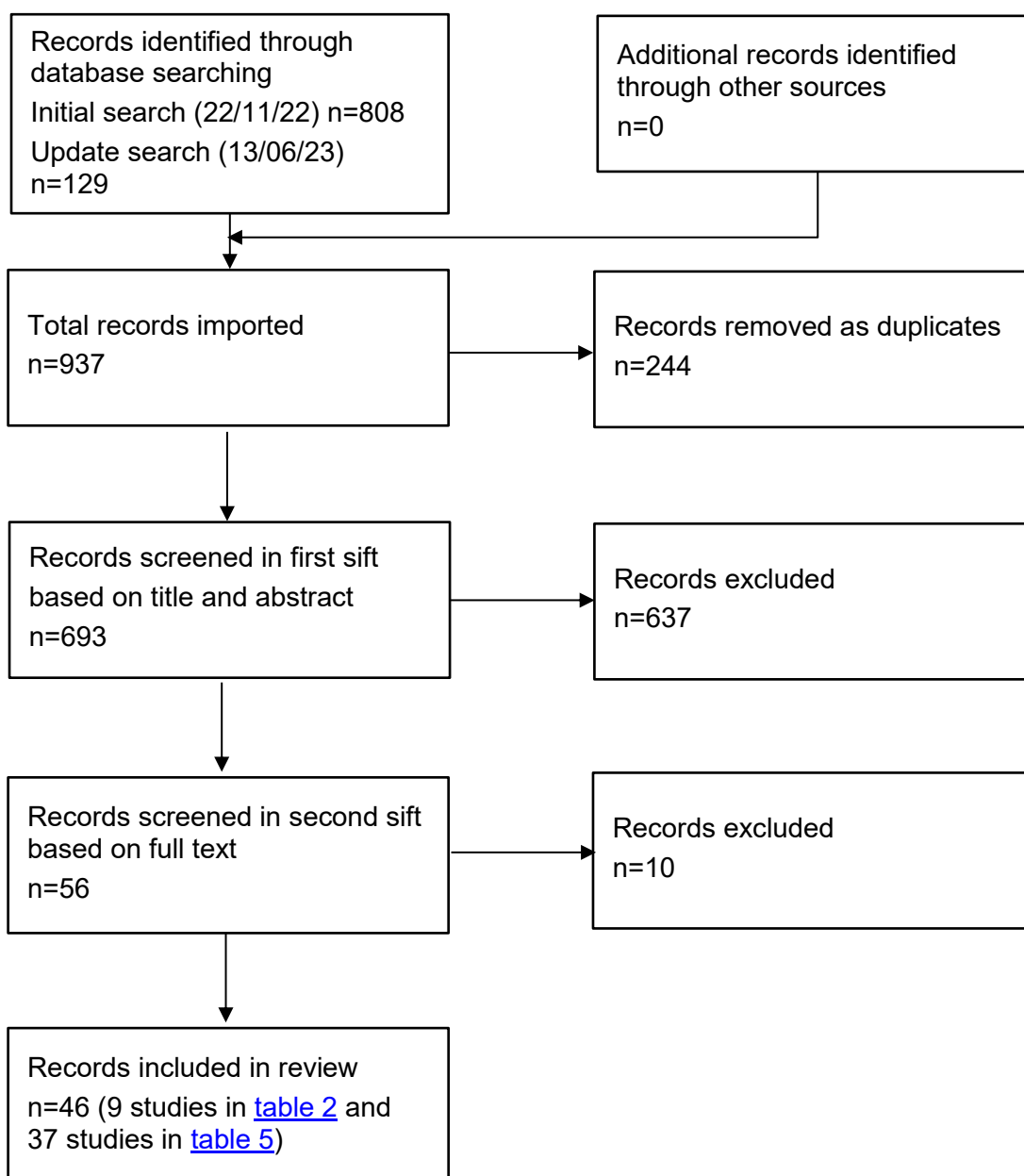
Figure 1 Flow chart of study selection

Table 2 Study details

Study no.	First author, date country	Patients (female)	Age (range)	Study design	Inclusion criteria	Intervention	Follow up
1	Chaccour, 2023 Multiple	n=1,770 (n=743 in vNOTES arms)	Mean ages across studies varied between 45 and 49 years	Systematic review	RCTs, CCT, prospective or retrospective cohort studies, case-control studies and systematic reviews. Exclusions: Case reports or series Other NOTES procedures (for example, transgastric, transurethral) Robotic and single-port procedures Non-hysterectomy procedures (for example, adnexectomy) Oncological indications Prolapse	vNOTES hysterectomy and classic laparoscopic hysterectomy	NR
2	Baekelandt, 2021a Belgium	n=67 (n=34 in vNOTES arm)	Mean= 52 (plus or minus 11)	Randomised controlled trial	Women who were not pregnant, and were sexually active with an intact uterus and without obliteration of the pouch of Douglas scheduled to	vNOTES adnexectomy compared with laparoscopic adnexectomy	6 months pain/QoL

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Study no.	First author, date country	Patients (female)	Age (range)	Study design	Inclusion criteria	Intervention	Follow up
					have removal of a benign adnexal mass. Exclusions: History of rectal surgery Suspected rectovaginal endometriosis Suspected malignancy Pelvic inflammatory disease Active lower genital tract infection		
3	Karkia, 2019 UK	n=33	Mean = 50 (35 to 75)	Prospective case series	Women with benign uterine pathology or grade 1 stage 1 endometrial cancer suitable for hysterectomy at a local unit. Exclusions: History of surgery to the rectovaginal pouch History of rectovaginal endometriosis Two or more caesarean sections Uterine prolapse	vNOTES hysterectomy and adnexectomy	NR

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Study no.	First author, date country	Patients (female)	Age (range)	Study design	Inclusion criteria	Intervention	Follow up
4	Baekelandt, 2021b Belgium	n=1,000	Mean= 46 (22 to 83)	Prospective case series	Women with benign gynaecological conditions. Exclusions: History of rectal surgery History of pelvic radiotherapy Suspected rectovaginal endometriosis Suspected malignancy Pelvic inflammatory disease Active lower genital tract infection	vNOTES hysterectomy (n=730) vNOTES other (n=270)	NR
5	Huang, 2022 China	n=1,147	Mean = 30.89 (plus or minus 6.26) to 63.55 (plus or minus 9.12)	Retrospective cohort	Women with gynaecological conditions. Exclusions: Unstable vital signs with intolerability of the procedure Acute infection Preoperative DVT or hypercoagulability Liver or kidney dysfunction	vNOTES hysterectomy, adnexal surgery, myomectomy, pelvic floor reconstruction or malignant tumour surgery	NR

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Study no.	First author, date country	Patients (female)	Age (range)	Study design	Inclusion criteria	Intervention	Follow up
					Mental illness Other conditions that rendered the patient unable to tolerate laparoscopy (for example, severe cardiopulmonary disease) History of rectal surgery Suspected rectovaginal septum endometriosis or severe adhesions Virginity Pregnancy		
6	Huang, 2021 China	n=296	Mean = 30.1 (plus or minus 7.65)	Retrospective cohort	In need of laparoscopic surgery for unilateral ovarian cysts Stable vital signs and laparoscopic surgery can be tolerated Low probability of malignancy Exclusions: History of rectal surgery Suspected of rectovaginal septum	vNOTES ovarian cystectomy (n=86) compared with TU-LESS ovarian cystectomy (n=210)	NR

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Study no.	First author, date country	Patients (female)	Age (range)	Study design	Inclusion criteria	Intervention	Follow up
					endometriosis, tumours or severe adhesions Virginity Pregnancy		
7	Yan, 2022 China	n=361	Mean = 53.04 (plus or minus 9.44) to 54.26 (plus or minus 10.33)	Retrospective cohort	Woman with benign gynaecological conditions	vNOTES hysterectomy (n=232) compared with TU-LESS hysterectomy (n=129)	NR
8	Temtanakitpaisan, 2018 Taiwan	n=275	Mean= 46.53 (plus or minus 2.96) to 48.68 (plus or minus 6.63)	Retrospective cohort	Women with benign pelvic organ lesions of the uterus, cervix, or ovaries that need surgical intervention. Exclusions: Virginity History of tubo-ovarian abscess Severe endometriosis Suspected severe pelvic adhesions History of abandoned NOTES hysterectomy	vNOTES hysterectomy	NR

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Study no.	First author, date country	Patients (female)	Age (range)	Study design	Inclusion criteria	Intervention	Follow up
9	Kaya, 2022 Turkey	n=83	Mean= TLH, 49 (40 to 71) vNOTES, 52 (40 to 74)	Cross-sectional	Women who had hysterectomy for benign gynaecological conditions with a BMI of 30 kg/m ² or greater. Exclusions: Active urinary tract or pelvic infections Pregnancy Endometriosis Gynaecological malignancy History of pelvic radiotherapy Trendelenburg position	vNOTES hysterectomy compared with total laparoscopic hysterectomy	NR

Table 3 Study outcomes (option 1)

First author, date	Efficacy outcomes	Safety outcomes
Chaccour, 2023*	Procedure success: Either none or one conversion procedures were reported across studies. Operation time: Six studies reported shorter operation times in vNOTES than comparator by at least 16 minutes, on average, and 5 were	Readmissions: Readmissions up to 6 weeks were reported in the RCT only (n=70). There were 6 readmissions in the TLH arm and 1 in the vNOTES arm. This was not statistically significant. Intraoperative: Across studies, there were 2 complications reported in the vNOTES arms and 5

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First author, date	Efficacy outcomes	Safety outcomes
	statistically significant. One study reported a statistically significant longer operation time in the vNOTES arm by 17.1 minutes on average. Length of hospital stay: 6 of 7 studies reported length of stay. 5 of 6 studies reported statistically significant shorter stays following vNOTES which were at least 0.3 days shorter than comparator. Estimated blood loss: 3 studies reported blood loss, 1 of which was not a statistically significant difference. Mean blood loss was statistically significantly higher for vNOTES in 1 study (300 ml compared with 100 ml in the comparator) and lower in another study (191.8 ml compared with 324.6 ml). Patients needing transfusion was reported in 2 studies. No statistically significant difference in 1 study, while the other study showed statistically significant difference of 9 of 147 people who had vNOTES and needed transfusion compared with 25 of 147 people in the comparator arm. Postoperative pain: 3 studies reported VAS pain scores at various intervals. One study (Puisungnoen, 2020) reported lower short-term pain after vNOTES at 6 hours and 1 day after surgery, which is statistically significant. At 6 hours after surgery, the mean VAS pain score was 3.4 in the vNOTES group compared with 4.9 in the TLH group. At 1 day, the mean VAS pain score was 1.7 in the vNOTES arm compared with 2.7 in the TLH	in the comparator arms. There was no significant difference. Postoperative: Across studies, 24 complications were reported in vNOTES arms and 54 were reported in the comparator arms. 6 studies compared rates of postoperative complications and 5 reported lower rates in the vNOTES arm. Only 1 study, the RCT, reported a significant difference of 4 in the vNOTES arm and 15 in the TLH arm.

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First author, date	Efficacy outcomes	Safety outcomes
	arm. Another study (Yang, 2020) reported VAS pain scores at least 4 times and reported statistically significant lower pain in the vNOTES arm (n=20) compared with the TLH arm (n=66). The RCT (Baekelandt, 2016) reported a mean VAS score over 7 days after surgery. The vNOTES group had a 7-day mean score of 1.746 compared to 2.655 in the TLH arm, which was a statistically significant difference. They also reported lower mean analgesics use postoperatively in the vNOTES arm (8) than the TLH arm (14), which was a significant difference. Longer-term pain/QoL: The RCT reported pelvic pain and QoL at 3 months and 6 months. There was no statistically significant difference between vNOTES and TLH arms at either time point for pelvic pain and QoL.	
Baekelandt, 2021a	Procedure success: Zero conversions were needed in either arm (vNOTES or laparoscopy). Operation time: The vNOTES procedure was on average 15 minutes quicker (95%CI 11 to 19) (p<0.001). Length of hospital stay: There was no statistically significant difference between day-0 discharge. Postoperative pain: The mean use of analgesics in the vNOTES arm was 6 units compared with 11	Intraoperative complications: 1 case of intraperitoneal spilling in the vNOTES group and none in the laparoscopy group Postoperative complications: 4 bleeding complications in the vNOTES group and 1 in the laparoscopy group. • vNOTES: 1 person needed revision and suturing and 3 had conservative treatment • Laparoscopy: 1 person had conservative treatment

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First author, date	Efficacy outcomes	Safety outcomes
	units in the laparoscopy arm. The mean difference is 5 units (95% CI 2 to 8) ($p < 0.001$). Longer-term pain/QoL: The risk difference of pelvic pain at 3 months was statistically significant with fewer people reporting pain in the vNOTES group (RD=24%, 95% CI 7% to 42%) ($p < 0.006$). The difference in median VAS score for pelvic pain at 3 months was higher in the laparoscopy group (1.5, 95% CI 0.5 to 2.4) ($p < 0.002$). All other pain and QoL differences were not statistically significant.	There were no cases of postoperative infection, readmission, lasting disability or death within 6 weeks after surgery.
Karkia, 2019	Procedure success: 33 people had vNOTES hysterectomy. 32/33 people had a planned and successful adnexectomy. Zero conversions were needed. Operation time: Mean operating time was 68.5 minutes (range 43 to 110). Estimated blood loss: Mean blood loss was 269ml (range 50 to 1,200). 15% of people had an estimated blood of 500 ml or more. Length of hospital stay: On average, people stayed in hospital for 1.4 nights after the procedure (range 1 to 2). Postoperative pain: The median VAS pain score at 6 hours after operation and at discharge was 0.	Postoperative: There were no major postoperative complications reported. 2 patients needed readmission and had conservative treatment.
Baekelandt, 2021b	Procedure success: 1,000 procedures were completed, including hysterectomy (73%), adnexal surgery (18%), salpingectomy (4%), ovarian	vNOTES hysterectomy complications in 730 procedures (38)

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First author, date	Efficacy outcomes	Safety outcomes
	cystectomy (3%), myomectomy (1%) and other indications (1%). 4 out of 1,000 procedures needed conversion (3 to conventional laparoscopy and 1 to laparotomy). Operation time: The mean operating time for the VNOTES hysterectomy group was 46 minutes (range 20 to 250) and 33 minutes (range 14 to 150) in the vNOTES other (non-hysterectomy) group.	• Intraoperative (10): 9 cystotomies and 1 case of bleeding requiring transfusion. • Postoperative (28): Complications included cystitis (6), haematoma (5), postoperative nausea and vomiting (2), wound infections (2), genital herpes (1), stress urinary incontinence (1), haematoma drainage (6), wound repair (4), and adhesiolysis (1). vNOTES other complications in 270 procedures (1) • Postoperative (1): cystitis (1).
Huang, 2022	Adnexal surgery Includes unilateral and bilateral forms of salpingectomies, ovarian cystectomies and adnexectomies. • Procedure success: 16 conversions were reported for 902 procedures. • Operation time: Mean operating times across adnexal surgeries ranged from 67.88 (plus or minus 25.99) to 115.74 (plus or minus 40.56) minutes. • Length of hospital stay: Mean hospital stays ranged from 3.26 (plus or minus 1.77) to 4.30 (plus or minus 2.68) days. • Estimated blood loss: Mean blood loss across adnexal surgeries ranged from	Complications: • Adnexal surgery: Complications occurred in 21 out of 902 procedures. • Myomectomy: Complications occurred in 4 out of 98 procedures. • Hysterectomy: Complications occurred in 2 out of 82 hysterectomy procedures. The nature of the complications for each type of surgery is unclear. Across all 5 vNOTES surgery types, 38 complications were reported in 1,147 procedures (3.31% complication rate). Complications were reported using the Clavien-Dindo classification. 27 were grade 1, 4 were

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First author, date	Efficacy outcomes	Safety outcomes
	23.47 ml (plus or minus 17.34) to 48.87 ml (plus or minus 57.53). • Postoperative pain: Mean VAS pain scores ranged from 2.85 (plus or minus 0.41) to 2.97 (plus or minus 0.18) at 12 hours. At 24 hours, the range was 2.26 (plus or minus 0.75) to 2.39 (plus or minus 0.65). Myomectomy • Procedure success: 2 conversions were needed out of the 98 procedures. • Operation time: Mean operating time was 103.31 (plus or minus 45.09) minutes. • Length of hospital stay: Mean stay was 3.92 (plus or minus 1.95) days. • Estimated blood loss: Mean blood loss was 81.53 ml (plus or minus 193.43). • Postoperative pain: Mean VAS pain scores were 2.91 (plus or minus 0.46) and 2.35 (plus or minus 0.56) at 12 and 24 hours, respectively. Hysterectomy • Procedure success: 0 conversions out of 82 procedures.	grade 2 and 7 were grade 3 (including rectal injury, bladder injury and mesh exposure).

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First author, date	Efficacy outcomes	Safety outcomes
	• Operation time: Mean operating time was 107.40 (plus or minus 39.54) minutes. • Length of hospital stay: Mean stay was 4.72 (plus or minus 1.91) days. • Estimated blood loss: Mean blood loss was 113.29 ml (plus or minus 182.22). • Postoperative pain: Mean VAS pain scores were 2.98 (plus or minus 0.44) and 2.46 (plus or minus 0.67) at 12 and 24 hours, respectively.	
Huang, 2021	No statistically significant difference in operation time or estimated blood loss between vNOTES and TU-LESS arms. Procedure success: No conversions to laparoscopy or laparotomy were needed. Length of hospital stay: Mean hospital stay was significantly shorter in the vNOTES group (3.39 days plus or minus 0.67) compared with the TU-LESS group (3.73 days plus or minus 0.97) ($p < 0.003$). Postoperative pain: Mean VAS score at 24 hours after surgery was 0.99 (plus or minus 0.80) in the vNOTES group compared with 2.35 (plus or minus 1.05) in the TU-LESS group ($p < 0.001$). Other: Time of flatus after surgery was significantly shorter in the vNOTES group (15.8	Complications • vNOTES: 2 cases of fever (CD-1) were treated with antipyretic drugs. • TU-LESS: 4 cases of fever (CD-1) were treated with antipyretic drugs and 1 case of postoperative anaemia (CD-2) was treated with blood transfusion. No complications of CD-3, -4 or -5 were observed in either procedure group.

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First author, date	Efficacy outcomes	Safety outcomes
	hours plus or minus 5.27) compared with the TU-LESS group (19.5 plus or minus 4.60) ($p < 0.001$). The mean cosmetic score in the vNOTES group was higher at 21.4 (plus or minus 1.39) compared with 19.1 (plus or minus 1.94) in the TU-LESS group ($p < 0.001$).	
Yan, 2022	Procedure success: 4 out of 232 vNOTES procedures needed conversion to TU-LESS because of multiple uterine myoma. 3 procedures failed because of the large size of myoma (up to 12 cm) and 1 because of adhesion between the uterus and pelvis. Operation time: Mean operation time was significantly shorter in the vNOTES group ($p < 0.001$). vNOTES hysterectomy took, on average, 78.21 minutes (plus or minus 30.79) compared with 112.09 (plus or minus 44.05) in the TU-LESS group. Estimated blood loss: There was no statistically significant difference in median blood loss between both groups. Length of hospital stay: Median hospital stay was shorter in the vNOTES group (2.31 days plus or minus 0.69) compared with the TU-LESS group (3.77 days plus or minus 1.57) ($p < 0.001$). Postoperative pain: 4.39% of vNOTES patients required postoperative analgesics compared with 15.50% in the TU-LESS group ($p < 0.001$).	Complications • vNOTES: No complications were seen in this group. • TU-LESS: Exudation occurred in the umbilicus wound in 2 women in this group. No readmissions were needed in either group after 6 weeks.

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First author, date	Efficacy outcomes	Safety outcomes
	Other: Duration of anal exhaust was statistically significant between groups. On average, this persisted for 18.80 hours (plus or minus 6.60) in the vNOTES group compared with 36.49 hours (plus or minus 13.71) in the TU-LESS group.	
Temtanakitpaisan, 2018	Procedure success: 2 out of 275 procedures could not be done successfully and conversions to conventional laparoscopy were needed. Operation time: The differences of operation times between groups was statistically significant ($p < 0.0001$). Group 1's mean operating time was 76.70 minutes (SE 0.68), group 2's was 99.99 minutes (SE 1.14) and group 3's was 152.88 minutes (SE 3.37). Estimated blood loss: Mean blood loss was statistically significant between groups ($p < 0.0001$). Mean estimated blood loss in group 1 was 180.85 ml (SE 4.61), 342.57 ml (SE 6.98) for group 2 and 532.35 ml (SE 11.85) for group 3. Length of hospital stay: Mean hospital stays in each group ranged between 1.34 to 1.47 days but this was not statistically significant.	Complications • Group 1 (n=191): 4 cases of postoperative bleeding, 2 pelvic infection and 2 bladder injury. • Group 2 (n=67): 1 case of pelvic infection. • Group 3 (n=17): No complications reported.
Kaya, 2022	Procedure success: No conversions were needed in the vNOTES group. *Operation time: Mean operating time in the vNOTES arm was 80 minutes (35 to 170) compared with 135 minutes (105 to 220) in the	Peri/postoperative blood transfusion: 6 transfusions needed in the TLH procedures and 7 in the vNOTES procedures. Not statistically significant.

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First author, date	Efficacy outcomes	Safety outcomes
	TLH arm – a statistically significant difference ($p < 0.001$). Estimated blood loss: 8 people in the TLH group and 7 in the vNOTES group had intraoperative blood loss of more than 300 ml. *Length of hospital stay: Mean stay was 48 hours (48 to 96) in the TLH arm and 48 hours (24 to 96) in the vNOTES arm. *Postoperative pain: Mean VAS pain score at 6 hours was 7 in TLH compared with 6 in vNOTES ($p < 0.01$). Mean VAS pain score at 24 hours was 3 and 4, respectively ($p < 0.01$). *Outcomes from the propensity score matched model (n=62)	Organ injury: 1 case of primary bladder injury in the TLH group and no other complications reported in the vNOTES group.

* Chaccour (2023) reports statistical significance, but the significance level is unclear.

Procedure technique

Of the 9 studies, 5 studies compared a gynaecological vNOTES procedure with its laparoscopic equivalent (Chaccour, 2023; Baekelandt, 2021a; Huang, 2021; Yan, 2022; Kaya, 2022). Karkia (2019) alone investigated vNOTES hysterectomy with adnexal surgery. The remaining 3 studies investigated vNOTES hysterectomy alone (Temtanakitpaisan, 2018), or outcomes for vNOTES hysterectomies and other vNOTES procedures (Baekelandt, 2021b; Huang, 2022).

The following multiple-instrument access ports were used across studies: GelPOINT mini advanced access platform (Baekelandt, 2021a; Baekelandt, 2021b), GelPOINT Alexis retractor or GelPOINT vPath (Karkia, 2019; Kaya 2022), HK-TH-60.4TY (Huang, 2022; Huang, 2021; Yan, 2022). Chaccour (2023) and Temtanakitpaisan (2018) described limited details of the procedure.

In some people with uterine weights greater than 1,000 g the uterus could not be removed, which was associated with BMI and limited vaginal space. Uterus retrieval can also be difficult when the shape of large uteri is disproportionate to the pelvis. The suggested way to overcome this during procedure is to opt for manual morcellation of the uterus (Temtanakitpaisan, 2018).

Efficacy

Procedure success

All 9 studies reported procedure success. There was variability across the studies in the reporting of procedure success, where some studies only had inferred procedural success (by lack of conversion) while others stated procedure success (rates) explicitly as the proportion of women who successfully had treatment with the intended approach without conversion to any other procedure or technique.

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The systematic review by Chaccour (2023) reported on 743 vNOTES procedures across the 7 studies and up to 1 conversion procedure per study. The case series of 1,000 people reported 4 conversion procedures: 3 to conventional laparoscopy and 1 to laparotomy (Baekelandt, 2021b). Huang (2022) reported 16 conversions in 902 adnexal surgery procedures, 2 conversions for the 98 myomectomies and 0 for the hysterectomies. Yan (2022) reported 4 conversions from vNOTES hysterectomy to TU-LESS hysterectomy because of myoma (3) and adhesion (1). The study on various uteri sizes reported 2 conversions to conventional laparoscopy out of 275 procedures (Temtanakitpaisan, 2018).

The Baekelandt (2021a) RCT, the Karkia (2019) study, and the study on people with obesity (Kaya, 2022) reported that no conversion procedures were needed.

Operation time

All 9 studies reported operation time.

Three studies reported comparisons of operating time between vNOTES and laparoscopy. Of the 7 studies in the systematic review, 5 reported statistically significant shorter operative times for vNOTES hysterectomy compared with laparoscopic hysterectomy and 1 reported a longer surgery time (Chaccour, 2023). vNOTES was, on average, quicker than laparoscopic hysterectomy by at least 16 minutes in the 5 studies. In 1 study, the vNOTES surgery took 17.1 minutes longer than laparoscopic surgery. The RCT by Baekelandt (2021a) estimated that vNOTES adnexectomy was, on average, 15 minutes (95% CI 11 to 19; $p < 0.001$) quicker than laparoscopy. In the obesity study (Kaya, 2022), the operation time was 80 minutes (35 to 170) in the vNOTES hysterectomy arm, compared with 135 minutes (105 to 220) in the total laparoscopic hysterectomy arm ($p < 0.0001$).

Karkia (2019) was the UK study of hysterectomy and adnexectomy, which had a mean operating time of 68.5 minutes (range 43 to 110). In the Baekelandt

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(2021b) case series, the mean operating time for vNOTES hysterectomy was 33 minutes (range 14 to 150) and 46 minutes (range 20 to 250) for other vNOTES procedures.

The Huang (2022) case series reported operation times for the various vNOTES procedures. Hysterectomy, adnexal and myomectomy were the 3 procedures of interest. The mean operation times for hysterectomies was 107.40 minutes (plus or minus 39.54) and 103.31 (plus or minus 45.09) for myomectomies. The mean operating times for adnexal surgeries ranged from 67.88 (plus or minus 25.99) to 115.74 (plus or minus 40.56) minutes.

Yan (2022) reported significantly shorter operation times in the vNOTES group of 78.21 minutes (plus or minus 30.79) compared with 112.09 minutes (plus or minus 44.05) in the TU-LESS group ($p < 0.001$). Whereas Huang (2021) reported no significant difference in operation times.

Temtanakitpaisan (2018) reported statistically significant differences in operating times for vNOTES hysterectomies across the 3 uterine weight groups. The mean operating time (in minutes) for uteri size less than 500 g was 76.70, for 500 g to 999 g was 99.99 and for 1,000 g or more was 152.88.

Length of hospital stay

Eight of the studies reported length of hospital stay.

Three studies compared length of hospital stay between vNOTES and laparoscopy. In the systematic review, 5 out of 7 studies reported statistically significantly shorter stays in the vNOTES group than in the control group (Chaccour, 2023). The mean length of stay was at least 0.3 days shorter in the vNOTES arms across studies. The RCT reported the number of people who were discharged from hospital on day 0 (Baekelandt 2021a). In both procedure arms, most of the people were discharged on day 0. There were 88% of laparoscopic

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adnexectomy people discharged on day 0 compared with 94% in the vNOTES arm, but there was no statistically significant difference. Kaya (2022) reported no difference between length of hospital stay between vNOTES hysterectomy and TLH.

The mean hospital stay was 1.4 nights (range 1 to 2) in the Karkia (2019) paper. Hospital stays of 1.34 to 1.47 days were reported in the Temtanakitpaisan (2018) paper. There was no statistically significant difference between groups of different uterine weights.

For vNOTES hysterectomy procedures in the Huang (2022) study, the mean length of hospital stay was 4.72 days (plus or minus 1.91). Mean stay for myomectomies was 3.92 days (plus or minus 1.95) and between 3.26 (plus or minus 1.77) and 4.30 (plus or minus 2.68) across the 6 variations of adnexal procedures.

Huang (2021) reported mean hospital stays of 3.39 days (plus or minus 0.67) in the vNOTES ovarian cystectomy group compared with 3.73 days (plus or minus 0.97) in the TU-LESS group ($p < 0.003$).

Yan (2022) reported median length of hospital stays for both hysterectomy groups. The median stay in the vNOTES group was significantly shorter at 2.31 days (plus or minus 0.69) compared with 3.77 days (plus or minus 1.57) in the TU-LESS group.

Postoperative pain

Seven studies reported postoperative pain.

Three of the studies in the systematic review reported on postoperative pain. One study reported statistically significantly lower pain in the vNOTES arm at 6 hours and 1 day after surgery. The mean VAS pain score at 6 hours was 3.4 in the vNOTES group compared with 4.9 in the TLH group. At 1 day, the mean pain

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score was 1.7 in the vNOTES group compared with 2.7 in the TLH group. Another study captured significant VAS scores differences at 4 timepoints and found lower mean pain scores in the vNOTES group at each time when compared with the TLH group. The vNOTES group in the RCT experienced a significant lower average VAS pain score over the 7 days after the procedure of 1.746 compared with 2.655 in the TLH group. The RCT also captured mean analgesics use postoperatively and found a significant difference of 8 in the vNOTES group and 14 in the TLH group.

The RCT by Baekelandt (2021a) captured postoperative pain by the average use of analgesics in each group. The mean analgesics use in the vNOTES group was 6 units compared with 11 in the laparoscopy group, which is a statistically significant mean difference of 5 units (95% CI 2 to 8; $p < 0.001$). People were asked whether they experienced pelvic or vaginal pain at 3 and 6 months after operation, and were asked to provide VAS pain scores. The only statistically significant difference was at 3 months, when fewer people reported pain in the vNOTES group, representing a risk difference of 24% (95% CI 7% to 42%; $p = 0.006$) compared with the laparoscopy group. The difference in median VAS score for pelvic pain at 3 months was higher in the laparoscopy group (median difference 1.5, 95% CI 0.5 to 2.4; $p = 0.002$).

Statistically significant differences in mean VAS pain scores were captured at 6 and 24 hours after operation in the study on people with obesity (Kaya, 2022). At 6 hours, the mean score in the TLH group was 7 compared with 6 in vNOTES ($p < 0.01$). At 24 hours, the respective mean VAS pain scores were 3 and 4 ($p < 0.01$).

In the UK study for vNOTES hysterectomy and adnexectomy, the median VAS pain score at 6 hours after operation and at discharge was 0 (Karkia, 2019).

The Huang (2022) study captured VAS pain scores at 12 and 24 hours after surgery. In the hysterectomy group, the mean VAS pain scores were 2.98 (plus or minus 0.44) at 12 hours and 2.46 (plus or minus 0.67) at 24 hours. In the adnexal surgeries group, the mean pain score ranged from 2.85 (plus or minus 0.41) to 2.97 (plus or minus 0.18) at 12 hours and then ranged from 2.26 (plus or minus 0.75) to 2.39 (plus or minus 0.65) at 24 hours. In the myomectomy group, the postoperative mean VAS pain score was 2.91 (plus or minus 0.46) at 12 hours and 2.35 (plus or minus 0.56) at 24 hours.

In the Huang (2021) study, postoperative pain was captured at 24 hours after surgery using the VAS score. The mean score was reported as 0.99 (plus or minus 0.80) in the vNOTES ovarian cystectomy group and 2.35 (plus or minus 1.05) in the TU-LESS group.

In Yan (2022), postoperative pain was indicated by the number of people who needed analgesics after the hysterectomy. A statistically significant difference was seen between groups, where 4% of people needed analgesics in the vNOTES group compared with 16% in the TU-LESS group.

Quality of life

Two studies reported quality-of-life measures.

One study in the systematic review (Chaccour, 2023) captured quality-of-life data at 3 and 6 months. There was no statistically significant difference between the 2 groups at each time interval.

Quality-of-life data was captured at 3 and 6 months after operation in the Baekelandt (2021a) RCT using the EQ-5D-3L. There was no statistically significant difference between the two groups at each time interval.

Safety

Readmissions

Three studies reported readmissions.

The Chaccour (2023) systematic review included 1 study that captured readmissions. The RCT study reported 1 readmission in the vNOTES arm and 6 readmissions in the TLH arms. This was not statistically significant.

In the Karkia (2019) paper, 2 out of 33 people had been readmitted and had conservative treatment.

No readmissions were needed in either vNOTES or TU-LESS hysterectomy groups at 6 weeks in the Yan (2022) study.

Intraoperative complications

Four studies reported intraoperative complications.

In the systematic review (Chaccour, 2023), 2 intraoperative complications were reported in the vNOTES arms and 5 were reported in the comparator arms, which was not a significant difference. The vNOTES complications were because of bleeding (1) and bladder trauma (2). Baekelandt (2021b) also reported 1 case of intraoperative bleeding that needed transfusion in the 730 vNOTES hysterectomies. Also, 9 cystotomies had to be done during these procedures.

One case of intraperitoneal spilling was reported in the vNOTES group of the Baekelandt (2021a) RCT. No intraoperative complications were reported for the laparoscopy group.

Postoperative complications

In the vNOTES arm of the systematic review, there were 24 postoperative complications from 743 procedures, compared with 54 in the 1027 laparoscopic

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procedures (Chaccour, 2023). One study, the RCT, reported a statistically significant difference between intervention arms with 4 postoperative complications in the vNOTES arm and 15 in the TLH arm.

In addition to the systematic review, 4 other studies reported postoperative bleeding complications. During the Baekelandt (2021a) trial, bleeding complications occurred in 4 out of 34 vNOTES adnexal procedures and in 1 out of 33 laparoscopy procedures. The person who had laparoscopy and 3 of the - people who had vNOTES had conservative treatment, while 1 person who had vNOTES needed revision and suturing. There were 4 people in the less than 500 g uterine weight group (n=191) who experienced bleeding after surgery (Temtanakitpaisan, 2018). Blood transfusion was needed in 7 out of 31 vNOTES hysterectomies in the cohort of people with obesity compared with 6 out of 31 in the laparoscopy control group (Kaya, 2022). No bleeding complications were seen in the vNOTES arm, but 1 person in the TU-LESS ovarian cystectomy needing a blood transfusion (Huang, 2021).

The Baekelandt (2021b) case series reported 28 postoperative complications in the vNOTES hysterectomy procedures (n=730) and 1 case of cystitis in the vNOTES other procedures (n=270). The complications in the hysterectomy group included cystitis (6), hematoma drainage (6), hematoma (5), wound repair (4), nausea and vomiting (2), wound infections (2), genital herpes (1), stress urinary incontinence (1) and adhesiolysis (1).

Huang (2022) reported 38 complications collectively for the 5 types of vNOTES procedures (n=1,147) for an overall complication rate of 3%. Complications occurred in 2 out of 82 hysterectomies, 21 out of 902 adnexal surgeries and 4 out of 98 myomectomies. The 38 complications (which includes unrelated surgeries) are reported using Clavien-Dindo classifications; 27 were grade 1, 4 were grade 2 and 7 were grade 3 (including rectal injury, bladder injury and mesh exposure).

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Fever was seen in 2 people in the vNOTES hysterectomy group and 4 people in the TU-LESS hysterectomy group of the Yan (2022) study. All had treatment with antipyretic drugs.

There were 3 cases of pelvic infection recorded by Temtanakitpaisan (2018). Two were in the less than 500 g uterine weight group (n=191) and 1 was in the 500 g to 999 g group (n=67).

Bladder injury was reported in 2 studies. There were 2 instances of bladder injury during the 191 vNOTES hysterectomies for the less than 500 g uterine weight group (Temtakitpaisan, 2018). There was 1 case in the laparoscopy control group of the cohort with obesity and no other organ injury complications were reported in the vNOTES group (Kaya, 2022).

Karkia (2019) reported no major postoperative complications in their study. No complications were seen in the vNOTES arm of the Yan (2022) study, while 2 women experienced exudation in the umbilicus wound in the TU-LESS arm.

Anecdotal and theoretical adverse events

Expert advice was sought from consultants who have been nominated or ratified by their professional Society or Royal College. They were asked if they knew of any other adverse events for this procedure that they had heard about (anecdotal), which were not reported in the literature. They were also asked if they thought there were other adverse events that might possibly occur, even if they have never happened (theoretical).

They listed the following anecdotal adverse events:

- Operative risks include infection, bleeding, conversion (to laparoscopy or laparotomy), cystotomy and organ injuries. Rates of injuries to the bladder, ureter and bowel are estimated at 1 to 2 per 100, 1 per 100 and 1 per 100, respectively.

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- Hip, pelvic or vaginal pain, and vaginal wound complications or dehiscence.
- Dyspareunia and impaired sexual function (both estimated to be uncommon), or problems with urinary retention.
- Deep venous thrombosis or pulmonary embolus.

They listed the following theoretical adverse events:

- Reduced ability to control unexpected haemorrhage.
- Difficulties from unexpected adhesions.
- Rectal injury from inadvertent placement of laparoscope in women with obliteration of pouch of Douglas.
- Risk of endometrial cancer cells spilled from the cervix.
- Risk of vesicovaginal fistula (very rare).

Thirteen professional expert questionnaires for this procedure were submitted. Find full details of what the professional experts said about the procedure in the [specialist advice questionnaires for this procedure](#).

Validity and generalisability

- Nine studies were included in the key evidence summary, including 1 systematic review, 1 RCT, 2 prospective case series and 5 retrospective cohort studies. Research was done in various countries worldwide (Belgium, UK, China, Taiwan, Turkey and South Korea), but only 1 was from a UK setting.
- The systematic review contained mostly retrospective comparative studies and only 1 single-blinded, non-inferiority RCT. The smallest study had a sample of 70 people. The RCT was assessed with the Cochrane RoB2 tool and deemed to have low risk of bias across the board. Four of the remaining papers' risk was assessed with the ROBINS-I tool and were all deemed to have moderate overall risk of bias. Mean ages in studies were quite representative.

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- The main direction of the efficacy and safety data across the 46 studies was either positive or comparable to conventional laparoscopic hysterectomy.
- The mean age across the key evidence (excluding the systematic review) tended to be around 50 or lower.
- Sample sizes varied considerably – from 29 people to 1,147 across studies. The only prospective UK analysis had only 33 people.
- There was variability across the studies in the outcomes they reported. For example, some studies only had inferred procedural success (by lack of conversion) while others stated procedure success (rates) explicitly.
- The studies were lacking long-term follow up. The only longer-term outcomes that were captured were self-reported pain or quality of life (up to 6 months) (Baekelandt, 2021).
- Mostly consistent, but some variability, in patient inclusion and exclusion criteria.
- Some variability in the procedure technique (where described) and access ports were often devices by 1 company (Applied Medical) or tended to be single-use, constructed-for-purpose ports or made by other companies (Beijing Aerospace Kadi Technology Development Institute).
- Some study authors are prominent (featured often) in the literature for this procedure and were involved in multiple studies that make up this overview.
- Disclosures included Jan Baekelandt (a prominent study author), Supuni Kapurubandara who have provided services for/been associated with Applied Medical.
- Ongoing trials include [NCT04886791](#), [NCT05150275](#), [NCT04324034](#), [NCT05031182](#), [KCT0004605](#).

Related NICE guidance

Interventional procedures

[NICE international procedures guidance on laparoscopic techniques for hysterectomy](#) (Recommendation: normal arrangements).

Professional societies

- Royal College of Obstetricians and Gynaecologists (RCOG)
- British Society of Urogynaecology (BSUG)
- British Society for Gynaecological Endoscopy
- Royal College of Anaesthetists.

Company engagement

NICE asked companies who manufacture a device potentially relevant to this procedure for information on it. NICE received 1 completed submission. This was considered by the IP team and any relevant points have been taken into consideration when preparing this overview.

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series of 33 patients. *European journal of obstetrics & gynecology and reproductive biology*, 242, 29-32.

4. Baekelandt, J., & Kapurubandara, S. (2021). Benign Gynaecological procedures by vaginal Natural Orifice Transluminal Endoscopic Surgery (vNOTES): Complication data from a series of 1000 patients. *European Journal of Obstetrics & Gynecology and Reproductive Biology*, 256, 221-224.
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Methods

NICE identified studies and reviews relevant to vaginal transluminal endoscopic hysterectomy and adnexal surgery for benign gynaecological conditions from the medical literature. The following databases were searched between the date they started to 13 June 2023: MEDLINE, PREMEDLINE, EMBASE, Cochrane Library and other databases. Trial registries and the internet were also searched (see the [literature search strategy](#)). Relevant published studies identified during IP overview: Vaginal transluminal endoscopic hysterectomy and adnexal surgery for benign gynaecological conditions

consultation or resolution that are published after this date may also be considered for inclusion.

The following inclusion criteria were applied to the abstracts identified by the literature search.

- Publication type: clinical studies were included with emphasis on identifying good quality studies. Abstracts were excluded if they did not report clinical outcomes. Reviews, editorials, and laboratory or animal studies, were also excluded and so were conference abstracts, because of the difficulty of appraising study methodology, unless they reported specific adverse events that not available in the published literature.
- Patients with benign gynaecological conditions.
- Intervention or test: vaginal natural orifice transluminal endoscopic surgery (vNOTES).
- Outcome: articles were retrieved if the abstract contained information relevant to the safety, efficacy, or both.

If selection criteria could not be determined from the abstracts the full paper was retrieved.

Potentially relevant studies not included in the main evidence summary are listed in the section on [other relevant studies](#).

Find out more about [how NICE selects the evidence for the committee](#).

Table 4 literature search strategy

Databases	Date searched	Version/files
MEDLINE (Ovid)	13/06/2023	1946 to June 12, 2023
MEDLINE In-Process (Ovid)	13/06/2023	1946 to June 12, 2023
MEDLINE Epubs ahead of print (Ovid)	13/06/2023	1946 to June 12, 2023
EMBASE (Ovid)	13/06/2023	1974 to 2023 June 12

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EMBASE Conference (Ovid)	13/06/2023	1974 to 2023 June 12
Cochrane Database of Systematic Reviews – CDSR (Cochrane Library)	13/06/2023	Issue 6 of 12, June 2023
Cochrane Central Database of Controlled Trials – CENTRAL (Cochrane Library)	13/06/2023	Issue 6 of 12, June 2023
International HTA database (INAHTA)	13/06/2023	-

The following search strategy was used to identify papers in MEDLINE. A similar strategy was used to identify papers in other databases.

MEDLINE search strategy

- 1 exp hysterectomy/ or exp hysterectomy, vaginal/
- 2 Ovariectomy/
- 3 Salpingectomy/
- 4 Salpingo-oophorectomy/
- 5 (Hysterectom* or ovariect* or salping*).tw.
- 6 (Adnex* adj4 disease*).tw.
- 7 adnexectom*.tw.
- 8 exp Adnexal Diseases
- 9 ((uter* or womb* or ovar* or (fallop* adj tube*)) adj4 (remov* or excis* or cut* or prolapse*).tw.
- 10 or/1-9
- 11 Natural Orifice Endoscopic Surgery/
- 12 (NOTES or vNOTES or VAHN or TVHN or VAMIS).tw.
- 13 ((vagin* or transvagin* or translumin*) adj4 (NOTES or endosc* surg*).tw.
- 14 (Natur* adj4 Orific* adj4 Endoscop* adj4 Surg*).tw.
- 15 or/11-14
- 16 10 and 15
- 17 GelPOINT-V-PATH.tw.
- 18 16 or 1
- 19 Animals/ not Humans/
- 20 18 not 19
- 21 limit 20 to ed=20221001-20230630

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Other relevant studies

Other potentially relevant studies to the IP overview that were not included in the main evidence summary (tables 2 and 3) are listed in table 5.

Table 5 additional studies identified

Article	Number of patients and follow up	Direction of conclusions	Reason study was not included in main evidence summary
Aharoni, S., Matanes, E., Lauterbach, R., Mor, O., Weiner, Z., & Lowenstein, L. (2021). Transvaginal natural orifice transluminal endoscopic versus conventional vaginal hysterectomy with uterosacral ligament suspension for apical compartment prolapse. <i>European Journal of Obstetrics & Gynecology and Reproductive Biology</i> , 260, 203-207.	Retrospective cohort n=135	Lower mean operative time ($p<0.005$), fewer intraoperative complications ($p<0.05$), less blood loss ($p<0.05$) and longer median hospital stay ($p<0.05$) in the vNOTES uterosacral ligament suspension group compared with the conventional group.	Prolapse not focal to this overview.
Anderson, D., & Duenas, O. F. (2022). 7369 Conventional Vaginal Hysterectomy vs vNOTES Hysterectomy: A Retrospective Cohort Analysis of Two Techniques. <i>Journal of Minimally Invasive Gynecology</i> , 29(11), S88.	Retrospective cohort n=78	vNOTES was quicker and with fewer complications, but non-significant difference.	Larger retrospective studies included.
Badiglian-Filho, L., Chaves Faloppa, C., Narciso de Oliveira Menezes, A., Mantoan, H.,	Retrospective cohort n=86	No statistically significant differences in complications, conversions, reoperations or	Studies with larger samples were included.

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Kumagai, L. Y., & Baiocchi, G. (2021). Vaginally assisted NOTES hysterectomy with adnexectomy (vNOTES) compared with conventional laparoscopy. A retrospective observational cohort study. International Journal of Gynecology & Obstetrics, 153(2), 351-356.		hospital stays between vNOTES hysterectomy (and adnexectomy) and conventional laparoscopy. 0 complications reported in both groups.	
Baekelandt, J. F., De Mulder, P. A., Le Roy, I., Mathieu, C., Laenen, A., Enzlin, P., ... & Bosteels, J. J. (2018). Transvaginal natural orifice transluminal endoscopic surgery (vNOTES) adnexectomy for benign pathology compared with laparoscopic excision (NOTABLE): a protocol for a randomised controlled trial. BMJ open, 8(1), e018059.	Study protocol		Study which was produced from this trial is included as the Baekelandt (2021) RCT.
Baekelandt, J., & Cavens, D. (2016). GelPOINT (Applied Medical) is a suitable port for transvaginal NOTES procedures. Journal of Gynecologic Surgery, 32(5), 257-262.	Retrospective cohort n=110	110 successful vNOTES hysterectomy (n=77) and adnexal (n=33) procedures. Evidence of vNOTES being efficacious and safe with the GelPOINT port.	Device-focused study.
Baekelandt, J., De Mulder, P. A., Le Roy, I., Mathieu, C., Laenen, A., Enzlin, P., ... & Bosteels, J. J.	Study protocol		Study which was produced from this trial is included in the Chaccour

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(2016). HALON—hysterectomy by transabdominal laparoscopy or natural orifice transluminal endoscopic surgery: a randomised controlled trial (study protocol). <i>BMJ open</i> , 6(8), e011546.			(2023) systematic review.
Basol, G., Cora, A. O., Gundogdu, E. C., Mat, E., Yildiz, G., Kuru, B., ... & Kale, A. (2021). Hysterectomy via transvaginal natural orifice transluminal endoscopic surgery versus single-port laparoscopy: Comparison of early outcomes. <i>Journal of Obstetrics and Gynaecology Research</i> , 47(9), 3288-3296.	Retrospective cohort n=60	vNOTES was significantly superior to single-port laparoscopy for length of hospital stay and pain at 1 and 18 hours after surgery. 0 complications in the vNOTES arm which was statistically significant (p=0.023).	Studies with larger samples were included.
Bouchez, M. C., Delporte, V., Delplanque, S., Leroy, M., Vandendriessche, D., Rubod, C., ... & Giraudet, G. (2023). vNOTES Hysterectomy: What about Obese Patients?. <i>Journal of Minimally Invasive Gynecology</i> .	Retrospective cohort n=200	Operative time was longer for obese patients (n=54) than non-obese patients (n=146). No significant difference in conversions, complications or ability to have the procedure as a day-case.	Kaya (2022), is included which focusses on a larger cohort of obese patients (n=83).
Corcoran, C., Taylor, L., Thomas, L., Mason, A., Bush, S., & Bush, S. (2021). Vaginal Natural Orifice Transluminal Endoscopic Surgery: A Pilot Study in a Residency Training	Retrospective pilot study n=29	2 out of 29 vNOTES adnexal surgeries alongside hysterectomy were converted to traditional surgery. 1 readmission required for a vaginal cuff hematoma.	Studies with larger samples were included.

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Program. Journal of Gynecologic Surgery, 37(3), 232-235.		0 intraoperative complications occurred.	
Farah, S., Albaini, O., Al Jardali, M., Daccache, A., & Jallad, K. (2023). The Feasibility and Safety of vNOTES Hysterectomy and Uterosacral Ligament Suspension: A Case Series. Journal of Minimally Invasive Gynecology, 30(5), 414-417.	Prospective case series n=23	Supports safety/efficacy of vNOTES.	Larger prospective studies included.
Housmans, S., Noori, N., Kapurubandara, S., Bosteels, J. J., Cattani, L., Alkatout, I., ... & Baekelandt, J. (2020). Systematic review and meta-analysis on hysterectomy by vaginal natural orifice transluminal endoscopic surgery (vNOTES) compared to laparoscopic hysterectomy for benign indications. Journal of clinical medicine, 9(12), 3959.	Systematic review n=718	Low conversions across studies. Pooled analysis indicates vNOTES is a shorter procedure than TLH by 16.73 minutes ($p<0.001$). vNOTES leads to shorter length of stay than TLH ($p<0.001$) and a small signal that vNOTES leads to less postoperative pain.	Replaced by Chaccour (2023) which includes this paper.
Huang, L., He, L., Huang, L., Gan, X., Lin, Y., & Xiong, Z. A. (2022). Learning curve analysis of transvaginal natural orifice transluminal endoscopic hysterectomy combined under the standard operating procedure. International Journal	Retrospective cohort n=79	No conversions. Surgical competence can be grasped after 8 cases.	Learning curve analysis.

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of Gynecology & Obstetrics, 159(3), 689-695.			
Huang, L., Yu, J., Li, Y., Gong, Z. L., Feng, D., He, L., & Lin, Y. H. (2023). Transvaginal natural orifice transluminal endoscopic surgery versus conventional vaginal surgery for sacrospinous ligament fixation of apical compartment prolapse: a retrospective analysis. BMC surgery, 23(1), 24.	Retrospective cohort n=82	Higher success and shorter post-operative stay in vNOTES group. No statistical difference for operation time, pain, blood loss, complications or bilateral salpingectomy rate.	Larger retrospective studies included.
Interdonato, M. L., Scollo, P., Bignardi, T., Massimello, F., Ferrara, M., Donatiello, G., ... & Simoncini, T. (2022). Hysterectomy by transvaginal natural orifice transluminal endoscopic surgery: An Italian initial experience. Frontiers in Medicine, 9, 1018232.	Retrospective cohort n=46	vNOTES is a feasible option. 2 (4.3%) conversions and 2 (4.3%) post-operative complications.	Larger retrospective studies included.
Jung, J., Noh, J. J., Jeon, J., Chang, C. S., & Kim, T. J. (2022). Comparison of Surgical Outcomes of Adnexectomy by Vaginal Natural Orifice Transluminal Endoscopic Surgery (vNOTES) Versus Single-Port Access (SPA) Surgery. Journal of Personalized	Retrospective cohort n=67	vNOTES adnexectomy is comparable to laparoscopic adnexectomy. vNOTES version led to lower pain 12 hours post-operative with less post-operative analgesics use.	Larger retrospective studies included.

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Medicine, 12(12), 1996.			
Kale, A., Mat, E., Başol, G., Gündoğdu, E. C., Aboalhasan, Y., Yildiz, G., ... & Demirhan, R. (2022). A new and alternative route: transvaginal natural orifice transluminal endoscopic scarless surgery (vaginal natural orifice transluminal endoscopic surgery) for class 2 and class 3 obese patients suffering from benign and malignant gynecologic pathologies. Surgical Innovation, 29(6), 730-741.	Retrospective cohort n=81	55 surgeries performed for benign indications. All procedures completed. Supports vNOTES in benign and malignant indications.	Larger retrospective studies included.
Kaya, C., Alay, I., Cengiz, H., Yıldız, G. O., Baghaki, H. S., & Yasar, L. (2021). Comparison of hysterectomy cases performed via conventional laparoscopy or vaginally assisted natural orifice transluminal endoscopic surgery: a paired sample cross-sectional study. Journal of Obstetrics and Gynaecology, 41(3), 434-438.	Cross-sectional study n=99	After matching, n=30 in vNOTES hysterectomy and 30 in total laparoscopic hysterectomy. Mean vNOTES operative time is 44 minutes shorter than laparoscopy (p<0.001). Mean vNOTES hospital stay is 15 hours shorter than laparoscopy (p=0.004).	Included in the Housmans (2020) systematic review.
Kaya, C., Yıldız, Ş., Alay, İ., Karakaş, S., Durmuş, U., Güraslan, H., & Ekin, M. (2022). Comparison of	Cross-sectional study n=78	115-minute shorter operative time (p<0.001) and 24-hour shorter hospitalisation (p<0.001) and lower	Studies with larger samples focussing on uterine size were included.

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surgical outcomes of total laparoscopic hysterectomy and vNOTES hysterectomy for undescended-enlarged uteri. Journal of Investigative surgery, 35(4), 918-923.		median 24-hour VAS pain score ($p=0.003$) with vNOTES hysterectomy than total laparoscopic hysterectomy.	
Kim, M. S., Noh, J. J., & Kim, T. J. (2021). Hysterectomy and adnexal procedures by vaginal natural orifice transluminal endoscopic surgery (VNH): initial findings from a Korean surgeon. Frontiers in Medicine, 7, 583147.	Prospective cohort n=34	Complications occurred in 3 out of 34 people. 2 cases of bladder injury and 1 person needed transumbilical single-port surgery because of late-onset postoperative bleeding on the thirteenth postoperative day. Statistically significant correlation between longer port-installation time and greater pain (4+ VAS pain score) ($p=0.013$).	Surgeon experience/learning curve focus.
Kim, T. J., & Noh, J. J. (2022). 8154 Comparison of Surgical Outcomes of Hysterectomy by Vaginal Notes Versus Single-Port Access (SPA) Surgery. Journal of Minimally Invasive Gynecology, 29(11), S117.	Prospective study N=73	vNOTES was comparable to TLH. vNOTES port installation took longer but the total operation time was shorter than for TLH. Lower 12 hour pain in the vNOTES arm.	Larger prospective studies included.
Koythong, T., Thigpen, B., Sunkara, S., Erfani, H., Delgado, S., & Guan, X. (2021). Surgical outcomes of hysterectomy via robot-assisted versus traditional transvaginal natural orifice	Retrospective cohort n=114	Robotically assisted vNOTES seems like a safe and feasible option. None of the R-vNOTES procedures needed conversion (but not a statistically significant difference).	Robotic assistance not focal to this overview.

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transluminal endoscopic surgery. Journal of minimally invasive gynecology, 28(12), 2028-2035.		No difference between traditional or robotic vNOTES for operative time, blood loss, length of hospital stay or pain at 1, 2 and 3 weeks after surgery.	
Li, C. B., & Hua, K. Q. (2020). Transvaginal natural orifice transluminal endoscopic surgery (vNOTES) in gynecologic surgeries: a systematic review. Asian journal of surgery, 43(1), 44-51.	Literature review	vNOTES is a promising procedure across many indications. Many small studies with disparate cohorts and procedures. Many studies reported no, or low, complications.	Review of literature. Many studies with small samples and no (pooled) analysis.
Liu, J., Tan, L., Thigpen, B., Koythong, T., Zhou, X., Liu, Q., ... & Guan, X. (2022). Evaluation of the learning curve and safety outcomes in robotic assisted vaginal natural orifice transluminal endoscopic hysterectomy: a case series of 84 patients. The International Journal of Medical Robotics and Computer Assisted Surgery, 18(3), e2385.	Retrospective cohort n=84	2 out of 84 R-vNOTES hysterectomy procedures needed conversion to robotic assisted laparoscopy. 15.48% (13/84) complication rate including 2 CD-I, 9 CD-II and 2 CD-III grade complications. Mean hospital stay is 0 days. Mean postoperative pain VAS score was reduced by 2.36 (p=0.001) at 2 weeks and by 4.36 (p=0.001) at 3 weeks, when compared with preoperative pain.	Learning curve and robotic-assistance focus.
Mei, Y., He, L., Zhang, Q., Chen, Y., Zheng, J., Xiao, X., & Lin, Y. (2023). The comparison of gasless and traditional robot-assisted transvaginal natural orifice transluminal	Retrospective cohort n=14	Comparable performance in both hysterectomy arms.	Larger retrospective studies included.

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endoscopic surgery in hysterectomy. Frontiers in Medicine, 10, 1117158.			
Merlier, M., Collinet, P., Pierache, A., Vandendriessche, D., Delporte, V., Rubod, C., ... & Giraudet, G. (2022). Is V-NOTES hysterectomy as safe and feasible as outpatient surgery compared with vaginal hysterectomy?. Journal of Minimally Invasive Gynecology, 29(5), 665-672.	Retrospective cohort n=100	No statistical difference in intra- or postoperative complications, length of hospital stay and conversions between groups. 0 readmissions in the vNOTES group and 2 in the vaginal group but not a statistically significant difference.	Studies with larger samples were included.
Noh, J. J., Kim, M. S., Kang, J. H., Jung, J. H., Chang, C. S., Jeon, J., & Kim, T. J. (2022). Comparison of surgical outcomes of hysterectomy by vaginal natural orifice transluminal endoscopic surgery (vNOTES) versus single-port access (SPA) surgery. Journal of Personalized Medicine, 12(6), 875.	Prospective cohort n=73	VAS pain score was significantly lower in the vNOTES group than the laparoscopy group. Average port installation was 13 minutes longer in the vNOTES group ($p<0.001$) but time for vaginal closure and total operative time were shorter ($p<0.001$). 1 complication reported which was injury to the distal ureter in the vNOTES group. No conversion procedures needed.	Studies with larger samples were included.
Nulens, K., Bosteels, J., De Rop, C., & Baekelandt, J. (2021). vNOTES hysterectomy for large uteri: a retrospective cohort study of 114 patients. Journal of	Retrospective cohort n=114	4 complications in 114 procedures; 3 postoperative bleeding complications and 1 minor late complication.	Studies with larger samples were included.

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Minimally Invasive Gynecology, 28(7), 1351-1356.		1 conversion to laparotomy needed. Operative time positively associated with uterine size.	
Ozceltik, G., Hortu, I., Itil, I. M., & Yeniel, A. O. (2022). Vaginal approach versus laparoscopy for hysterectomy in transgender men. Journal of Gynecology Obstetrics and Human Reproduction, 51(2), 102286.	Retrospective cohort n=90	No intraoperative complications or conversions in the vNOTES hysterectomy group. 1 reoperation in the vNOTES group because of late-onset intraabdominal bleeding. Median operative time was 25 minutes shorter and mean hospital stay was shorter in the vNOTES arm ($p<0.001$). Lower VAS pain scores at 12 and 24 hours after surgery ($p<0.001$), but no difference at 2, 6 or 48 hours. 1 complication in the laparoscopy group.	Studies with larger samples were included.
Puisungnoen, N., Yantapant, A., & Yanaranop, M. (2020). Natural orifice transluminal endoscopic surgery-assisted vaginal hysterectomy versus total laparoscopic hysterectomy: a single-center retrospective study using propensity score analysis. Gynecology and Minimally Invasive Therapy, 9(4), 227.	Retrospective cohort n=100	No difference between vNOTES hysterectomy and total laparoscopic hysterectomy for operative time, complications or requirement of blood transfusion. Statistically significant difference for less pain and shorter length of stay for vNOTES.	Included in Chaccour (2023).

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Tekin, A. B., Yassa, M., Kaya, C., Budak, D., Ilter, P. B., Mutlu, M. A., ... & Tug, N. (2023). Implementing the transvaginal natural orifice transluminal endoscopic surgery (vNOTES) "first" strategy in benign gynecological surgeries. Archives of Gynecology and Obstetrics, 307(4), 1007-1013.	Retrospective cohort n=105	Supports vNOTES as a first choice with low pain scores, high patient satisfaction and no or better change in sexual life.	Larger retrospective studies included.
Wang, C. J., Go, J., Huang, H. Y., Wu, K. Y., Huang, Y. T., Liu, Y. C., & Weng, C. H. (2019). Learning curve analysis of transvaginal natural orifice transluminal endoscopic hysterectomy. BMC surgery, 19, 1-7.	Retrospective cohort n=240	239 out of 240 procedures completed successfully. 1 procedure was converted to laparoscopy. Blood transfusion in 5.4% of procedures. Complications in 5 procedures. Transfusion, complications and uteri size had statistically significant impacts on operation time.	Learning curve focus.
Wang, C. J., Huang, H. Y., Huang, C. Y., & Su, H. (2015). Hysterectomy via transvaginal natural orifice transluminal endoscopic surgery for nonprolapsed uteri. Surgical endoscopy, 29, 100-107.	Retrospective cohort n=512	vNOTES hysterectomy leads to less blood loss ($p<0.001$) and fewer blood transfusions ($p=0.004$) compared with laparoscopically assisted vaginal hysterectomy. Efficiency: vNOTES hysterectomy is on average a 21-minute quicker procedure ($p<0.001$) and leads to	Included in the Chaccour (2023) systematic review.

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		shorter stays in hospital ($p < 0.001$).	
Wang, X., Arikawa, K., Li, J., Hua, K., & Chen, Y. (2023). Transvaginal natural orifice transluminal endoscopic surgery for presacral–uterosacral ligament compound suspension in apical compartment prolapse. <i>International Urogynecology Journal</i> , 34(1), 301-304.	Retrospective cohort N=15	vNOTES technique may be feasible for apical prolapse and has desirable short-term outcomes.	Larger retrospective studies included.
Wang, X., Li, J., Hua, K., & Chen, Y. (2020). Transvaginal natural orifice transluminal endoscopic surgery (vNOTES) hysterectomy for uterus weighing ≥ 1 kg. <i>BMC surgery</i> , 20, 1-7.	Retrospective cohort n=39	Blood transfusion in 5.1% of procedures. 3 out of 39 (7.7%) procedures needed a conversion to laparoscopy because of being unable to posterior colpotomy. Statistically significant improvements in operation time, blood loss and hospital stay following first 20 procedures (learning curve).	Studies with larger samples were included.
Weerakiet, S., Uckara, W., Soimongkol, K., Daungroedeeswas, R., Pongphonkit, J., Chanasabaeng, S., & Sutjaritphong, P. (2021). Comparison of surgical outcomes between natural orifice transluminal endoscopic surgery for hysterectomy and conventional total laparoscopic hysterectomy. <i>JOURNAL OF THE</i>	Retrospective cohort n=65	Lower operative time ($p < 0.0001$) and lower median VAS pain scores at 6, 24 and 48 hours ($p < 0.001$) in the vNOTES hysterectomy group compared with total laparoscopic hysterectomy. Statistically significant lower need for added analgesics in the vNOTES group ($p = 0.001$).	Studies with larger samples were included.

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MEDICAL ASSOCIATION OF THAILAND, 104(8), 1255-62.			
Yang, C. Y., Shen, T. C., Lin, C. L., Chang, Y. Y., Huang, C. C., & Lin, W. C. (2020). Surgical outcomes of hysterectomy by transvaginal natural orifice transluminal endoscopic surgery (vNOTES) compared with laparoscopic total hysterectomy (LTH) in women with non-prolapsed and benign uterine diseases. Taiwanese Journal of Obstetrics and Gynecology, 59(4), 565-569.	Retrospective chart analysis n=183	No difference between vNOTES hysterectomy and total laparoscopic hysterectomy for operative time, blood loss, uterine weight, decrease in haemoglobin level on postoperative day 1, complications, hospital stay and readmission rate. Statistically significantly less pain in vNOTES group for postoperative pain.	Included in the Chaccour (2023) systematic review.
Yang, E., Nie, D., & Li, Z. (2019). Comparison of major clinical outcomes between transvaginal notes and traditional laparoscopic surgery: a systematic review and meta-analysis. Journal of Surgical Research, 244, 278-290.	Systematic review and meta-analysis n=1,340	No difference between vNOTES and laparoscopy for risk of complications. Positive findings regarding pain and recovery for people having vNOTES.	Most studies did, or patients had, cholecystectomy – 2 out of 13 studies pertinent.

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