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REVIEW

What's New in Operative Gynaecology? An Introduction to Vaginal Natural Orifice Transluminal Endoscopic Surgery (vNOTES)

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Abstract

Vaginal Natural Orifice Transluminal Endoscopic Surgery (vNOTES) is a novel minimal invasive technique which uses the vagina for operative entry, after which fibreoptic and endoscopic instruments are introduced to perform surgery. This approach avoids external skin incisions and has attracted the attention of both clinicians and patients. Further, compared to conventional laparoscopic surgery, patients undergoing vNOTES have lower morbidity, better cosmesis and reduced length of postoperative stay. Initially limited to hysterectomy and adnexectomy, its role has now expanded to include indications such as urogynaecology, oncology and fertility. The aim of this review is to narrate to a general medical readership what the vNOTES approach means and how this can be adopted to hysterectomy, adnexectomy and other gynaecological indications. We also assess some of the reported outcomes and highlight that further randomised control trials will help decide if this indeed becomes the preferred surgical approach. Lastly, it is crucial to stress that clinicians wishing to implement vNOTES need to undergo appropriate training and appreciate judicious governance.

Key words: vaginal natural orifice transluminal endoscopic surgery; posterior colpotomy; hysterectomy; adnexectomy

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Introduction

Natural Orifice Transluminal Endoscopic Surgery (NOTES) is a novel minimal access technique that uses natural openings such as the mouth, bladder and vagina for operative entry, after which fibreoptic and endoscopic instruments are introduced, thus avoiding external skin incisions (Yoong et al, 2023). It was first described in a porcine model, as an extension of laparoendoscopic single-site surgery (LESS) as opposed to the more conventional multiport laparoscopy (Lerner et al, 2023). The most commonly used natural orifice access is through the vagina (thus, vaginal Natural Orifice Transluminal Endoscopic Surgery (vNOTES))—this utilises a vaginal incision, followed by creation of a pneumoperitoneum with carbon dioxide and insertion of fibreoptic and endoscopic instruments for surgery through the

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vagina (Fig. 1). The vNOTES approach has attracted attention of clinicians and patients alike due to its reduced morbidity, absence of external incisions and shorter postoperative stay compared with conventional laparoscopic (CL) surgery (Yoong et al, 2023). In fact, vNOTES was originally used by general surgeons for appendectomies (Palanivelu et al, 2008) and cholecystectomies (de Sousa et al, 2009) and the first vNOTES case for gynaecological adnexal surgery was only reported in 2012 (Ahn et al, 2012). The earliest feasibility study describing vNOTES hysterectomies was published (Su et al, 2012) and the procedure started gaining wider traction in Europe as a result of work by Jan Baekelandt, a gynaecological oncologist in Belgium (INTREC, 2023).

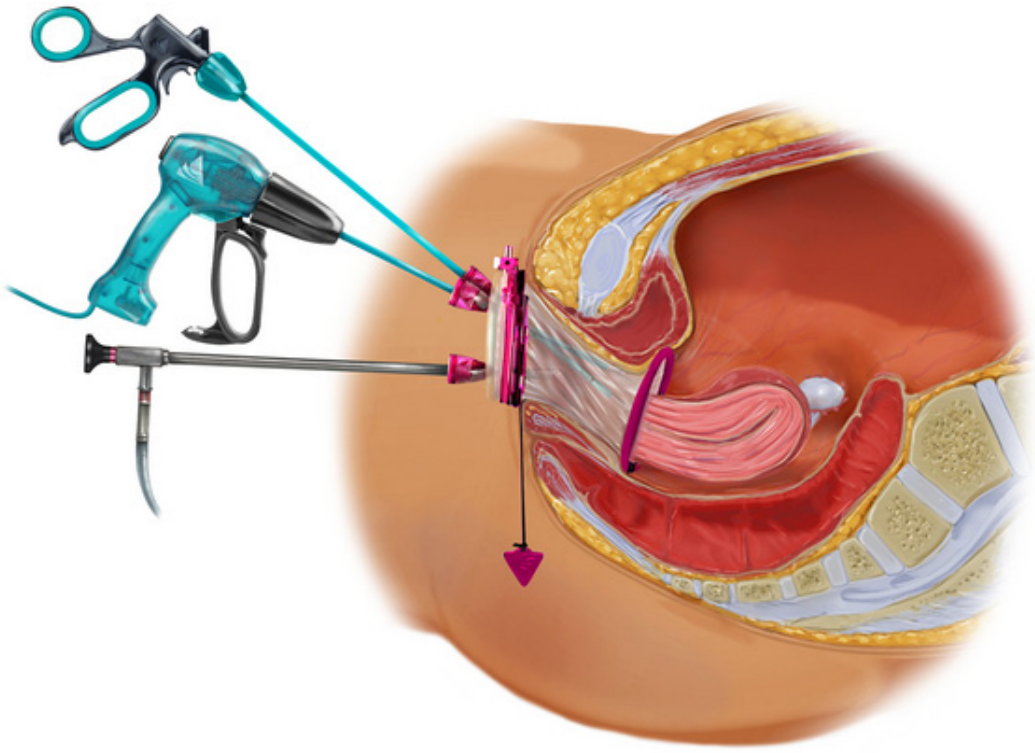

Fig. 1. Graphic illustration of vNOTES approach using endoscopic instruments, laparoscope and GelPOINT®V-Path, a commercially available kit which provides a seal around the vagina. This illustration shows a transvaginal operative route which avoids conventional abdominal laparoscopic incisions (Image courtesy of Applied Medical Resources Corporation. All rights reserved). vNOTES, vaginal Natural Orifice Transluminal Endoscopic Surgery.

While the traditional transvaginal approach epitomises truly minimally invasive "no abdominal cuts" surgery, poor visualisation and restricted space for manipulation are significant limiting factors. Vaginal NOTES overcomes these limitations by combining the conventional vaginal entry with excellent fibreoptic views and use of single port endoscopic instruments. Early innovators such as Su et al (2012) originally operated with self-constructed transvaginal ports (usually a surgical glove rolled over a retractor with standard trocars inserted into the finger ends)

but most surgeons currently employ commercially available access platforms, for example, GelPOINT®V-Path (Applied Medical UK Ltd., Oxford, UK) (Fig. 2).

Fig. 2. GelPOINT®V-Path kit for insufflation of carbon dioxide and introduction of fibreoptic and endoscopic instruments (Image courtesy of Applied Medical Resources Corporation. All rights reserved).

When compared to CL surgery, patients undergoing the vNOTES approach almost universally report many advantages such as shorter operative duration, less pain and reduced length of stay, in addition to better cosmesis (Baekelandt et al, 2021; Kaya et al, 2021; Yoong et al, 2025). The lack of visible laparoscopy scars is an important cosmetic benefit for transgender patients undergoing hysterectomy or other patients who want to conceal salpingectomy for sterilisation or hysterectomy for personal or cultural reasons (Lerner et al, 2023). The shorter duration of surgery is attributed to less swapping of endoscopic instruments, lower insufflation volume needed for optimal endoscopic view and only one incision to repair (Yoong et al, 2025). The lower pain scores and reduced need for analgesics could be partly explained by the shorter surgical time and lower carbon dioxide pressure as well as by the fact that the posterior fornix is innervated by visceral autonomous fibres (which causes a more diffuse, poorly localised sensation) whereas the somatic nociceptive pain from the abdominal trocar site insertion tends to be acute, sharp and localised (Baekelandt et al, 2021).

The aim of this review is to narrate to a general medical readership what the vNOTES approach entails, together with its evolvement and benefits. In the following sections, we discuss how vNOTES can be applied to hysterectomy (Baekelandt et al, 2019; Housmans et al, 2020), adnexal surgery (salpingectomy, oophorectomy and ovarian cystectomy) (Baekelandt et al, 2021; Kaya et al, 2021) and other gynae-

cological indications. We also assess some of the reported outcomes and summarise our experiences and opinions with the technique. Lastly, vNOTES is a relatively new development and we acknowledge the relative paucity of Canadian Task Force on Preventative Health Care (CTFPHC) level I evidence—it is therefore imperative that clinicians intending to perform the procedure are appropriately trained and be transparent about the need to evaluate its long-term safety and efficacy.

vNOTES Surgical Technique for Hysterectomy and Adnexectomy (Modified From (Baekelandt et al, 2019; Baekelandt et al, 2021))

The procedure begins in dorsal lithotomy, and a standardized intravenous antibiotic regime with Co-Amoxiclav 1.5 g (Augmentin, GlaxoSmithKline Plc, London, UK) is commenced at induction of anaesthesia. Bladder is drained using a Foley catheter which is removed at the end of the procedure. After infiltration with 20 mls 0.5% w/v (1:200,000) Bupivacaine and Adrenaline solution, a circumferential incision is made around the cervix, followed by anterior and posterior colpotomy to allow access to the uterovesical space in front and Pouch of Douglas at the back. The uterosacral complex is then secured and a 9.5 cm *GelPOINT* V-Path transvaginal access platform (Applied Medical Resource Corporation, Rancho Santa Margarita, CA, USA) is inserted. Carbon dioxide is introduced into the peritoneal cavity to a maximal intraperitoneal pressure of 12 mm Hg. The patient is then tilted in the Trendelenberg position and a 10 mm 0° Karl Stortz laparoscope (Karl Stortz, Tuttlingen, Germany) is used for visualisation. Hysterectomy is performed by dissecting caudally to cranially using Voyant Advanced Bipolar Device (Applied Medical Resource Corporation, Rancho Santa Margarita, CA, USA) and the specimen later retrieved through the vagina. The vaginal cuff is closed similar to conventional vaginal surgery. In the case of adnexectomy, a 3 cm posterior colpotomy incision was made using curved Mayo scissors to allow access to the Pouch of Douglas. A 7 cm *GelPOINT* V-Path transvaginal access platform is placed into the pouch of Douglas and peritoneal cavity insufflated to a maximal intraperitoneal pressure of 12 mm Hg. The patient is similarly tilted in the Trendelenberg position and a 10 mm 0° Karl Stortz laparoscope together with Johan atraumatic endoscopic graspers and Voyant Advanced Bipolar Device are used for the adnexectomy. The specimen is retrieved through the posterior colpotomy incision which is repaired using polyglactin Vicryl 1 (Ethicon Ltd., Edinburgh, UK) sutures in continuous fashion.

vNOTES Hysterectomy

The first vNOTES hysterectomy was performed by Su and colleagues (2012) to assess its feasibility and safety. A 2021 review of five retrospective cohort studies comparing vNOTES with either total laparoscopic hysterectomy (TLH) or laparoscopically assisted vaginal hysterectomy (LAVH) revealed similar efficacy, complications, rates of readmission and postsurgical pain scores but women undergoing the former procedure had shorter surgery and postoperative stay and less blood loss (Housmans et al, 2020). The only randomised control trial (RCT) on vNOTES hysterectomy comprised 70 women allocated to the either vNOTES (n = 35) and

TLH (n = 35) arms: duration of procedure (41 *vs* 75 min; $p < 0.001$) and inpatient stay (0.8 *vs* 1.3 days; $p = 0.004$) were significantly reduced in the vNOTES group, although intraoperative complications, postoperative infection readmission rates in the two groups were similar (Baekelandt et al, 2019). Retrospective case control data from Anderson and Duenas (2022) comparing vNOTES (n = 33) to conventional vaginal hysterectomy (n = 45) demonstrated that the vNOTES route was quicker and had lower complication, although the data were only presented as an abstract at an international congress and the analysis did not appear to render statistical significance.

Overall, the pooled data indicate that compared to CL approach, vNOTES hysterectomy was quicker to perform and patients were more likely to be discharged on the same day but post-operative pain scores and other outcome measures were similar between the two groups.

vNOTES Adnexectomy

The first paper to describe vNOTES adnexectomy was published by Lee and colleagues (2012) when they reported nine out of 10 successful cases patients—these were six salpingectomies for female sterilisation/ectopic pregnancy and four ovarian cystectomies. Several case series and case reports similarly concluded that vNOTES offered a safe and feasible approach to adnexal surgery for non-malignant indications such as ectopic pregnancy and benign ovarian tumours (Feng et al, 2023; Ferro et al, 2023; Ozceltik et al, 2022). Two larger retrospective cohort studies by Li et al (2017) (n = 66) and Kaya et al (2021) (n = 114) comparing vNOTES and CL adnexectomy showed that surgical duration, postoperative stay and blood loss were significantly lower in the former group. Baekelandt and colleagues (2021) published the only RCT (n = 67) of vNOTES *vs* laparoscopy for benign adnexal pathology which revealed shorter duration of surgery, lower pain scores and less analgesic requirements with vNOTES. While there was a trend for more perioperative complications (intraoperative spillage and postoperative bleeding) in the vNOTES group, this was not statistically significant ($p > 0.05$).

Specific to salpingectomy for ectopic pregnancy, a RCT (Xu et al, 2014) comparing vNOTES (n = 18) *vs* conventional laparoscopy (n = 20) revealed lower pain scores in the former group but similar duration of surgery, with the former approach having superior patient satisfaction with cosmesis (VAS: 9.17 *vs* 8.47; $p = 0.03$). Further cohort studies (Karakaş et al, 2022; Li et al, 2017; Liu et al, 2020; Yoong et al, 2025) have all shown shorter operative durations and less postoperative pain in vNOTES compared to the CL salpingectomy in the surgical management of ectopic pregnancy.

In summary, data from RCT and cohort studies suggest that patients who undergo vNOTES compared to CL adnexectomy have shorter operative durations, less postoperative pain and superior cosmesis with statistically similar adverse events.

Other Novel Indications of vNOTES

Systematic reviews by Li and Hua (2020) and Vacca et al (2024) described more novel uses of vNOTES inspecialised procedures such as sacrocolpopexy (Liu et al, 2019), myomectomy (Liu et al, 2018), sentinel node biopsy dissection (Lee et al, 2022), pelvic lymph nodes dissection (Leblanc et al, 2016), uterosacral ligament suspensions (USLS) (Lu et al, 2021), sacrospinous ligament fixation (SSLF) (Huang et al, 2023) and anterior longitudinal ligament suspension (ALLS) (Wang et al, 2023). The former review (Li and Hua, 2020) again highlighted that the vNOTES resulted in lower pain scores than standard laparoscopic methods, while Vacca and colleagues (2024) reminded us that the vNOTES procedure was effective and safe in patients with pelvic organ prolapse, in particular, the USLS procedure. Both reviews strongly encourage high quality studies to further determine the feasibility and efficacy of vNOTES in urogynaecological surgery. In oncology, vNOTES can be used in sentinel lymph node dissection in endometrial cancer surgery (Lee et al, 2022) and Comba et al (2024) proved similar outcomes in women with endometrial cancer following vNOTES vaginal hysterectomy and sentinel lymph node biopsy when compared to CL method. Surgeons have also pioneered the concept of vaginal natural orifice transluminal endoscopic surgery (RvNOTES), where the robotic manoeuvrability is combined with the vaginal endoscopic approach. Initial case reports (Guan et al, 2022) and case series (Baekelandt, 2016; Guan et al, 2024) are promising, with low conversion to laparotomy or laparoscopic surgery and minimal blood loss and postsurgical pain. So far, there have been no direct studies comparing conventional vNOTES *vs* RvNOTES, but the additional cost and learning curve means that it only has limited application in selected patients such as severe endometriosis (Guan et al, 2022).

Contraindications of vNOTES Approach

In a 2021 consensus statement agreed upon by 39 international vNOTES experts on vNOTES (Kapurubandara et al, 2021), absolute contraindication (where is >80% agreement by the 39 experts) for this approach included rectovaginal endometriosis (94.9% agreement), previous severe pelvic inflammatory disease (87.2% agreement) and history of pelvic radiotherapy (94.9% agreement). Prior rectal surgery (71.8%), previous hysterectomy (59%) and mesh sacrocolpopexy (76.9%) would be considered relative contraindications as there was <80% agreement between the experts. vNOTES procedures can be performed in women with high body mass index (>30) or past multiple pelvic-abdominal surgeries but there is obviously an increased risk of surgical complications due to difficulty in ventilation, restricted view and adhesions (Moufawad et al, 2021). In patients with a high likelihood of adhesions in the posterior cul-de-sac, judicious bimanual rectovaginal examination together with the transvaginal sonographic “sliding sign” can help assess the safety of vNOTES access through the Pouch of Douglas (Hurni et al, 2022).

Lastly, current evidence (Canadian Task Force on Preventative Health Care levels I and II) only supports its use for benign gynaecological indications as there

is insufficient data on the widespread role of vNOTES in an oncology except for in the hands of expert vNOTES surgeons in a trial setting.

Complications of vNOTES

The reported complications of vNOTES from the largest pooled vNOTES hysterectomy study (Stuart et al, 2025) was recently published and intraoperative and postoperative complication rates were 3.2% and 2.5%, respectively. Intraoperative complications include bladder (1.3%) and other organ injury (0.44%), while postoperative complications reported were haemorrhage, infected vault haematoma, urinary tract and other non-specific infections. These data should be interpreted in relation to laparoscopic hysterectomy (LH) and vaginal hysterectomy (VH), the most relevant comparators for vNOTES: the bladder injury rate of 1.3% in vNOTES is less than that quoted for VH (1.6–1.9%) (Marchand et al, 2024) but slightly higher than that reported in systemic reviews of cystotomies associated with LH (1%) (Wei et al, 2023). National Institute of Clinical Excellence (2023) in the United Kingdom viewed vNOTES to have similar complication and readmission rates to other routes of gynaecological surgery.

Training, Learning Curve and Governance

While the learning curve for vNOTES skill acquisition is unclear, Wang et al (2019) suggested that 20 cases may be sufficient for a surgeon experienced in both laparoscopic and vaginal surgery. The current lack of experienced surgical proctors to supervise training may delay interested gynaecologists from adding vNOTES to their repertoire.

In 2023, NICE in the United Kingdom issued an Interventional Procedure Guidance (IPG 774) on vNOTES, which provides direction for clinicians considering the implementation of this innovative surgical method. Additionally, IPG 774 advises that surgeons intending to perform vNOTES should possess specialized training and expertise in both endoscopic and vaginal surgical techniques to minimize potential risks and enhance patient safety. NICE considers the technique a novel emerging procedure and advocates that it can only be performed provided "special arrangements" are in place. A "special arrangements" recommendation states that clinicians must inform their trust clinical governance lead, counsel patients appropriately regarding the safety and efficacy of the procedure and collect further data by means of audit or research. Additionally, vNOTES surgeons are encouraged by the International NOTES Society (iNOTESs) to register the outcomes of their cases onto an anonymized online intraoperative and postoperative case registry in order to pool collective data for analysis (International NOTES Society - iNOTESs (https://www.notesurgery.org)).

Conclusion

In conclusion, vNOTES procedures have gained traction worldwide, with over 4000 cases submitted to the iNOTESs case registry to date. The technique can overcome certain limitations of vaginal and laparoscopic surgery, i.e., better view and

access in the case of vaginal surgery and absence of abdominal incisions in the case of laparoscopic surgery. Despite obvious advantages such as improved cosmesis, shorter recovery and lower morbidity, there is still a relative paucity of Canadian Task Force on Preventative Health Care (CTFPHC) level I evidence. The shortage of experienced surgical mentors limits available training opportunities and the learning curve of vNOTES needs to be fully assessed. While the approach has expanded to include urogynaecology, oncology and fertility indications, appropriate training and judicious governance is crucial when implementing this technique. The NICE IPG 774 highlights the promising outcomes associated with vNOTES, while also emphasising the importance and necessity of further research to assess its safety and efficacy. Further randomised controlled trials will allow us to determine if this novel technique will offer well-evidenced outcomes and become the preferred surgical approach for the future.

Key Points

- The vNOTES combines the skills of vaginal and laparoscopic surgery, as it allows a "no abdominal cuts" approach though a natural orifice (vagina) while offering excellent vision.
- Advantages of vNOTES include shorter duration of surgery, less pain, reduced length of stay and better cosmesis.
- Its initial early use in hysterectomy and adnexectomy has expanded to include urogynaecology, oncology and fertility.
- Surgeons need appropriate training and judicious governance (which include maintaining a log of cases) when implementing this technique.
- National Institute for Health and Care Excellence (NICE) has issued an Interventional Procedure Guidance (IPG 774) on vNOTES, which provides direction for clinicians considering the implementation of this technique.

Availability of Data and Materials

Data and materials from this study can be obtained from the corresponding author upon reasonable request.

Author Contributions

HS performed literature search, coordinated and reviewed the manuscript. KH, LN, HY, JH and PP contributed to analysis and interpretation of data. HS and WY coordinated and wrote the first draft. WY provided substantial contribution to conception of work and co-wrote the paper. All authors contributed to important editorial changes in the manuscript. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

Not applicable.

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Conflict of Interest

Wai Yoong teaches on vNOTES course and has received remuneration from Applied Medical UK Ltd. All other authors declare no conflict of interest.

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