



Safety and Efficacy of Transvaginal Natural Orifice Transluminal Endoscopic (vNOTES) Right Colectomy: A Systematic Review

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ABSTRACT

Background/Objectives: We aim to provide pooled data on the safety and efficacy of Transvaginal Natural Orifice Transluminal Endoscopic (vNOTES) right colectomy. **Methods:** This systematic review was conducted according to the Cochrane Handbook and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The primary endpoint was the overall complication rate. Quality assessment was based on the NHLBI quality assessment tools. **Results:** Overall, six studies were included in this review. Overall morbidity rate was 21.9% (95% CI: 10.7–33.2%, $p < 0.001$), while intraoperative adverse events were noted in 19.9% ($p < 0.001$) of cases. Mean operation duration was 176.42 ($p < 0.001$) minutes. Overall hospital stay was 8.68 days ($p = 0.002$). **Conclusions:** Our analyses confirm the safety and efficacy of the approach. Given several study limitations, further large-scale and high-quality trials are required.

Keywords: transvaginal; right; colectomy; notes; cancer

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INTRODUCTION

The advent of minimally invasive techniques marked a paradigm shift in surgical practice that resulted in improved cosmesis, reduced postoperative pain, and enhanced aspects of postoperative recovery. In addition to laparoscopic and robotic surgeries, single-incision approaches were also described as a means of further minimizing total transabdominal entrance points to one. Natural Orifice Transluminal Endoscopic Surgery (NOTES) is another alternative that is considered by many as the natural sequelae of single-incision techniques. However, the combination of technical challenges and a steep learning curve have prohibited a wider adoption of NOTES. Similarly, in the domain of colorectal surgery, natural orifice approaches have been utilized for specific procedural steps, such as dissection and specimen retrieval, or the completion of the operation in total. Typical examples are the trans-anal total mesorectal excision (TaTME) and the transvaginal extraction of colectomy specimens (natural orifice specimen extraction (NOSE)).

METHODS AND MATERIALS

This systematic review was conducted in accordance with the Cochrane Handbook and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Guidelines (Figure 1). A comprehensive search strategy was applied across major databases to identify eligible studies. Screening was performed in PubMed, Scopus, and Cochrane databases from inception until March 2025. The following keywords were used, combined with Boolean logic nexuses: "vaginal", "transvaginal", "natural orifice", "notes", "right colectomy", "right colon". Reference screening was also performed in the eligible articles. The primary endpoint of our study was the overall complication rate. Secondary outcomes included specific intraoperative (i.e., hemorrhage, blood loss, bladder injury, conversion) and postoperative adverse events (hematoma, ileus, vaginal infection, bacteremia, anastomotic bleeding). Further analyses were performed in efficacy (operation duration, length of hospital stay, mobilization, and time to first flatus) and oncological (recurrence rates and lymph node yield) points of interest. The following exclusion criteria were considered: (1) non-human studies, (2) studies not reporting data on outcomes of interest, (3) pediatric population, (4) articles in the form of editorials, letters, or conference abstracts, and (5) studies in which transvaginal access was used for specimen extraction only (NOSE). data regarding study characteristics (first author, date of publication, type of study, country, number of involved centers, study period, number of patients, body mass index (BMI), age, and follow up period), patient and tumor characteristics (previous operations, American Society of Anesthesiologists (ASA) score, Tumor Node Metastasis (TNM) status, and tumor location), and technical operative details (preoperative bowel preparation, patient position, pneumoperitoneum, access, number of trocars, anastomosis technique, approach, number of surgeons, and access closure) were extracted. All statistical analyses were performed in IBM SPSS version 29 and Open Meta Analyst. Continuous and categorical data were provided as mean (standard deviation (SD)) and N, respectively. In the case that these were not provided, they were estimated from the respective data (median, range, interquartile range (IQR)). Pooled continuous outcomes were reported as mean, with the corresponding 95% confidence interval (95% CI). The effect size of binary outcomes was the raw proportion (RP), with the 95% CI. For the identification of publication bias, the respective funnel plot of the primary endpoint was provided. Statistical analysis was based on the DerSimonian-Laird method. Heterogeneity was estimated through the calculation of I², while Cochran Q test results confirmed the significance. The random-effect (RE) and fixed-effect (FE) models were applied based on the estimated significance. Statistical significance was considered at the level of $p < 0.05$.

RESULTS

An initial literature search (Figure 1) identified 869 records. After the removal of 310 duplicates, 559 titles and abstracts were screened. During the first screening step, 550 records (25 reviews and 525 irrelevant studies) were excluded. Subsequently, nine manuscripts were retrieved and underwent a full-text assessment. One study was excluded due to reporting on NOSE procedure, and two for providing data on hybrid NOTES. Two studies were identified to be conducted in the same research center with similar methodology, as well as inclusion and exclusion criteria. Overall, six studies were included in this review. Overall, 49 patients that underwent vNOTES right colectomy were included in this review (Table 1). In total, five studies were performed in a single institution, and one [9] in multiple centers. Most eligible studies reported on performed vNOTES right colectomies in the form of individual case reports or case series. Study periods ranged from 2006 to 2024. BMI and age allocation of included patients is also provided in Table 1. Mean postoperative follow-up ranged from 1 to 60 months. **Primary Endpoints** The pooled complication rate of vNOTES right colectomy (Table 2, Figure 2), was 21.9% (95% CI: 10.7–33.2.0%, $p < 0.001$). No significant heterogeneity was noted ($I^2 = 0\%$). Statistical significance of the pooled results and the heterogeneity levels were retained in all cases, respectively.

RESULTS

Secondary Endpoints Similarly, the intraoperative complication rate (Figure 3) was 19.9% (95% CI: 0.9–30.3%, $p < 0.001$). Of these, the most common was intraoperative bladder injury with an overall risk of 10.4% (95% CI: 2.2–18.5%, $p = 0.013$). Although significant hemorrhage was reported in 9.7% (95% CI: 2–17.5%, $p = 0.014$) of cases, the mean intraoperative blood loss was 29.9 mL (95% CI: 26.42–33.57 mL, $p < 0.001$). Conversion due to technical difficulties was required in 5.3% (95% CI: -0.6–11.2%, $p = 0.076$) of the procedures; however, this was not significant. Furthermore, an insignificant 6.2% 95%CI: -3.2–15.5%, $p = 0.196$) rate of tumor recurrence was estimated. Mean lymph node yield was 20.6 (95% CI: 15.2–25.9, $p < 0.001$). Mean operation duration was 176.42min (95% CI: 170.76–182.08, $p < 0.001$). The reported overall mean hospital stay was 8.68 days (95% CI: 3.29–14.07, $p < 0.001$). Data regarding patient mobilization and the time to first flatus were scarce and, thus, no further analysis was performed. More specifically, patients mobilized at 18 to 24 h; while regarding the latter, first flatus was achieved at 24 to 40 h postoperatively. **Publication Bias** To evaluate potential publication bias, we generated the primary outcome funnel plot (Figure 4). Visual inspection of the plot revealed a symmetrical distribution of the eligible studies, thus minimizing the risk of publication bias.

DISCUSSION

It becomes apparent that the safety of vNOTES right colectomy should be carefully examined prior to its widespread adoption. We estimated a pooled overall complication rate of vNOTES right colectomy of 21.9%, with bladder injury being the most common. In an 8257-patient meta-analysis, compared the two most prominent minimally invasive techniques for right colonic surgery and estimated the mean morbidity rates of the laparoscopic and robotic approaches to be 23.4% and 21.4%, respectively. To tackle the previously mentioned technical difficulties, and to facilitate proper exposure of the embryological planes, assistant ports or hybrid vNOTES approaches may be utilized. Our pooled analysis estimated an insignificant 5.3% overall conversion rate of vNOTES. Comparably, according to previous publications, the conversion rate of single-incision right colectomy may reach the level of 7.4%. In terms of oncological efficacy, we estimated that the average lymph node yield of vNOTES colectomy was 20.06. In addition to this, the estimated recurrence rate during the analyzed follow-up was 6.2%; however, this was not statistically significant. These results are consistent with the current literature regarding the oncological endpoints of minimally invasive right colectomies. Through laparoscopic and robotic resections, incision wounds were minimized to port placement and specimen extraction, thus decreasing postoperative pain compared to open resections. In our review, pooled postoperative pain estimates were not provided, due to the scarcity of data. Visual analog scale scores during the first postoperative days were reported in some cases and never exceeded the 4-point threshold. This systematic review is the first to provide overall estimates for vNOTES right colectomy performance. Our analyses assessed multiple clinical parameters that represent aspects of safety, perioperative efficiency, and oncological efficacy. The utilization of a standardized methodology allowed us to combine the data from the current literature reports and provide an accurate overall estimate on these endpoints. These indicators could act as guidance for clinicians evaluating the potential role of vNOTES techniques in right colon cancer. Finally, our review highlighted the lack of evidence in several clinical parameters, thus promoting further research in this field.

CONCLUSIONS

To the best of our knowledge, this study is the first attempt to provide pooled evidence regarding the safety and efficacy of vNOTES right colectomy. Our study highlighted an acceptable safety rate of overall and intraoperative complications. Additionally, the results of our analyses on several efficiency markers, including the operation duration, the length of hospital stay, and postoperative recovery endpoints, validated the efficacy of the approach. However, due to several study limitations, further high-quality trials are required to standardize the surgical technique and provide comparative data with other minimally invasive approaches.

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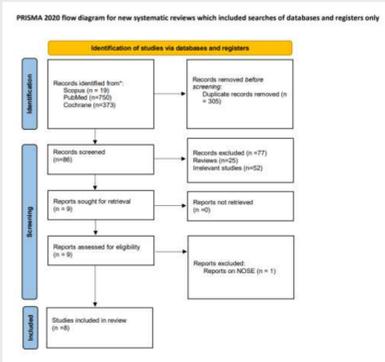


Figure 1. PRISMA flow diagram.

First Author	Published on Date	Type Of Study	Country	Single/Multi Center	Study Period	Number of Patients	BMI	Age	Follow Up (months)
Saeou-en et al.	2024	case report	Philippines	single	2024	1	32(0)	59(0)	60(0)
Xiao et al.	2023	retrospective	China	single	2019-2022	30	22(3.1)	n/a	n/a
Song et al.	2021	case report	China	single	2021	1	18.4(0)	65(0)	1(0)
Xiao et al.	2020	prospective	China	single	2018-2020	12	n/a	70 (7.5)	30(0)
Moloney et al.	2016	case series	Australia	single	2016	3	21.8(2.8-5)	49.6(11.7)	n/a
Bullian et al.	2014	prospective	Germany	multi	2008-2013	4	26 (2.75)	63.5 (5.5)	n/a
Park et al.	2010	prospective	Korea	single	2007	14	23.6 (2.6)	66 (7.5)	34(1.75)
Burghardt et al.	2008	case report	Germany	single	2008	1	22(0)	66(0)	n/a

Table 1. Main Characteristics.

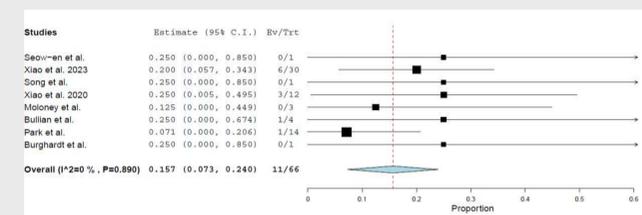


Figure 2. Overall complication forest plot.

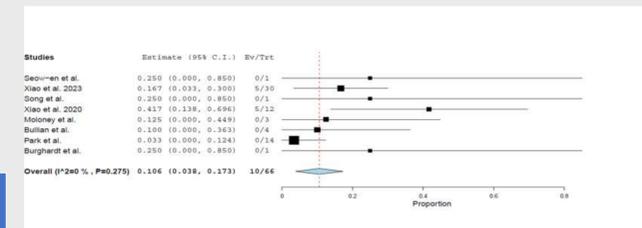


Figure 3. Intraoperative complication forest plot.

Overall Complications	Model	Metric	Estimate	Lower Bound	Upper Bound	95% Error	p-Value	Exp ²	Q	het. p-Value	I ²
Overall Complications	BE	Proportion	0.219	0.107	0.332	0.05	<0.001	0	0.18	0.99	0
Secondary outcome											
Intraoperative Hemorrhage	BE	Proportion	0.097	0.02	0.175	0.04	0.014	0	2.69	0.287	0
Intraoperative Blood Loss (mL)	CFE	Mean	29.9	26.42	33.57	1.826	<0.001	0	0.001	0.972	0
Intraoperative Bladder Injury	BE	Proportion	0.104	0.022	0.185	0.042	0.013	0	0.755	0.96	0
Conversion	BE	Proportion	0.053	-0.006	0.112	0.03	0.076	0	2.84	0.225	0
Hemostasis	BE	Proportion	0.049	-0.008	0.106	0.029	0.062	0	1.93	0.609	0
Ileus	BE	Proportion	0.062	-0.052	0.175	0.048	0.196	0	1.806	0.483	0
Vaginal Infection	BE	Proportion	0.100	-0.036	0.234	0.064	0.088	0	0.744	0.946	0
Bacteremia	BE	Proportion	0.100	-0.036	0.234	0.064	0.088	0	0.744	0.946	0
Anastomotic Bleeding	BE	Proportion	0.062	-0.052	0.175	0.048	0.196	0	1.806	0.483	0
Recurrence	BE	Proportion	0.062	-0.052	0.175	0.048	0.196	0	1.806	0.483	0
Operation Duration (minutes)	CFE	Mean	176.42	170.76	182.08	2.88	<0.001	0	1.548	0.510	0
Length of Hospital Stay (days)	CFE	Mean	8.68	3.29	14.07	2.74	0.002	14.7	37.2	<0.001	97.3
Lymph Node Yield	CFE	Mean	20.6	15.2	25.9	2.74	<0.001	14	13.8	<0.001	92.8

Table 2. Statistical analysis of primary and secondary outcomes.

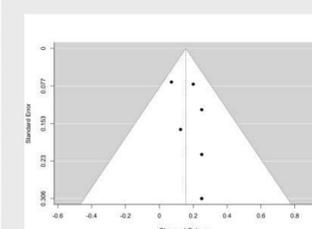


Figure 4. Overall complication funnel plot.