Original Article

Transvaginal Natural Orifice Specimen Extraction (NOSE) in Laparoscopic Colorectal Surgery: A Single Institute Experience

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Key Words
Laparoscopic;
Colorectal;
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Purpose. Transvaginal natural orifice specimen extraction (NOSE) in laparoscopic colorectal surgery has been attracting attention as a minimally invasive surgery for colorectal cancer recently. The objective of this study was to evaluate the feasibility and short-term clinical outcomes of transvaginal NOSE.

Methods. We retrospectively analyzed patient records in our registry database who underwent transvaginal NOSE in laparoscopic colorectal surgery between 2011-2020. We included female patients with diverticulitis, colon polyp, and colon tumor size less than 6 cm. Patients with intact hymen, pregnancy, advanced tumor, middle/low rectal tumor, and disagreement of transvaginal NOSE were excluded. Patients characteristics, short-term surgical outcome, intraoperative and postoperative complications were analyzed.

Results. Transvaginal natural orifice specimen extraction (NOSE) in laparoscopic colorectal surgery was performed in 38 patients. The mean duration of surgery was 255.79 ± 80.35 mins, for right-sided colon was 253.57 ± 78.67 minutes and 258.53 ± 84.73 minutes for left-sided colon. The mean duration of hospital stay was 5.82 ± 2.93 days, 6.33 ± 3.22 days for right-sided colon surgery and 5.18 ± 2.48 days for left-sided colon surgery. The mean time to first flatus was 1.42 ± 0.68 days, 1.48 ± 0.81 for right-sided colon and 1.35 ± 0.49 for the left-sided colon. Post-operative complications were recorded, included 2 cases (5.26%) anastomosis leakage, 1 case (2.63%) postoperative ileus, 1 case (2.63%) intra-abdominal wound infection, 1 case colon perforation (2.63%), 1 case (2.63%) colovaginal fistula. There was no intraoperative complication, post-operative urinary tract infection, wound incision hernia, sexual dysfunction or dyspareunia reported.

Conclusion. From our preliminary results show transvaginal NOSE in laparoscopic colorectal surgery is an alternative choice for selected cases. But this surgical technique requires more clinical evidence and long-term follow-up.

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Laparoscopic surgery is a well-established surgical method with greater advances than open surgery for the treatment of patients with colorectal diseases.[1] Laparoscopic surgery resulted in faster postop-

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erative recovery, reduces postoperative morbidity, and shortens hospital stay when compared to open surgery.[2] With the development of minimally invasive surgery, surgeons are pursuing scarless abdominal surgery to avoid wound-related morbidity and for better cosmesis.[3] However, conventional laparoscopic colorectal surgery requires mini-laparotomy for specimen extraction. Studies have shown that the majority of laparoscopic wound complications occurred at the specimen extraction site, such as postoperative pain, wound infection, and incisional hernia.[4,5]

In recent years, natural orifice specimen extraction has been attracting attention as a minimally invasive surgery for colorectal cancer, not only for better cosmetic results but also for reducing pain and fewer wound-related complications.[6,7] Although transrectal specimen extraction is wildly used in laparoscopic colorectal surgery, it is frequently performed in sigmoid colon or rectum due to relatively easy access to the peritoneal cavity via the resected distal side of the colon or rectum, whilst transvaginal natural orifice specimen extraction (NOSE) can be performed for right- or left-sided colectomy and extraction of larger specimen.[8]

The objective of this study was to evaluate the technical feasibility and short-term clinical outcomes of transvaginal natural orifice specimen extraction (NOSE) in laparoscopic colorectal surgery.

Materials and Method

We identified 38 patients who underwent elective transvaginal NOSE in laparoscopic colorectal surgery between January 2011 and December 2020 in our prospectively registered patient database at China Medical University Hospital. The indication for transvaginal NOSE was female patients without an intact hymen and with tumor size less than 6 cm, measured by preoperative computer tomography. We excluded patients with disagreement of transvaginal NOSE, pregnancy, advanced tumor, and tumor located at middle or lower rectum. Patient demographics, short-term surgical outcome, intraoperative and postoperative complications were evaluated.

All patients were operated on by the same surgical team. This study was approved by the Institutional Review Board of the China Medical University Hospital (CMUH-REC-02).

Surgical technique of transvaginal NOSE

Patients were placed in lithotomy position. The abdomen, perineum, and vagina were prepared antiseptically. The tumor-specific mesenteric excision was performed in standard surgical technique.

For transvaginal NOSE in right-sided colectomy (included tumors located at appendix, cecum, ascending colon, and proximal transverse colon), after mesenteric excision was performed, the colon was resected intracorporeally using articulating linear staplers, then the anastomosis was performed by firing one 60 mm linear stapler in an isoperistaltic or antiperistaltic side-to-side manner, then the enterostomy was closed with Albert-Lembert method. Next, the vagina was washed with 10% povidone-iodine and the uterus was retracted using 33 mm circular sizer (Fig. 1). Then, a 4 to 5 cm transverse posterior colpotomy was performed using laparoscopic monopolar scissors (Fig. 2). A wound protector (Fig. 3) was carefully inserted into the abdominal cavity through the colpotomy and the specimen was grasped out by Babcock clamp (Figs. 4 and 5) then the wound protector was gently removed by using Babcock clamp grasping the edge of the wound protector (Fig. 6). Two wet gauzes were inserted into the vagina to prevent air leak (Fig. 7). The colpotomy was closed laparosco-

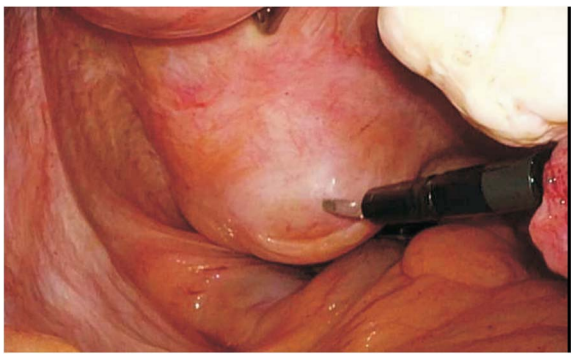

Fig. 1. The uterus was retracted using 33 mm circular sizer and posterior colpotomy was performed using laparoscopic monopolar scissors.

Fig. 2. A 4 to 5 cm transverse posterior colpotomy was performed.

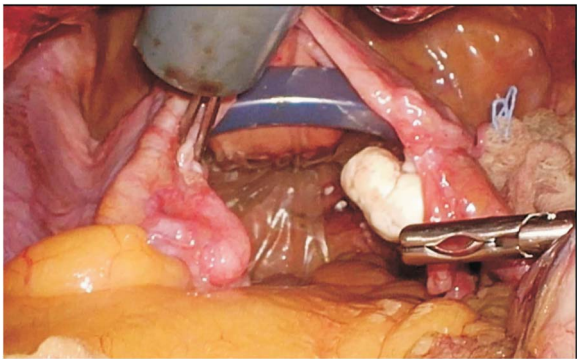

Fig. 3. Insertion of wound protector.

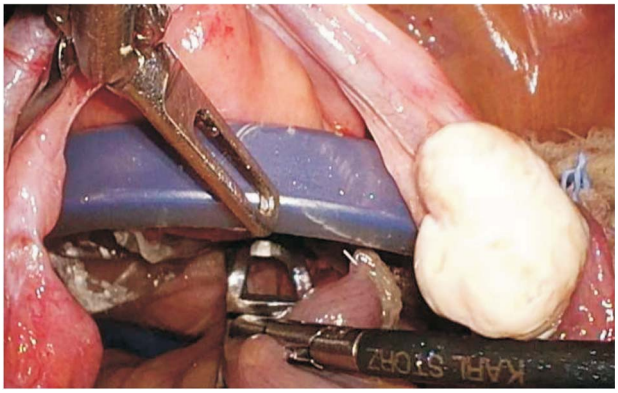

Fig. 4. Insertion of Babcock forceps through the wound protector.

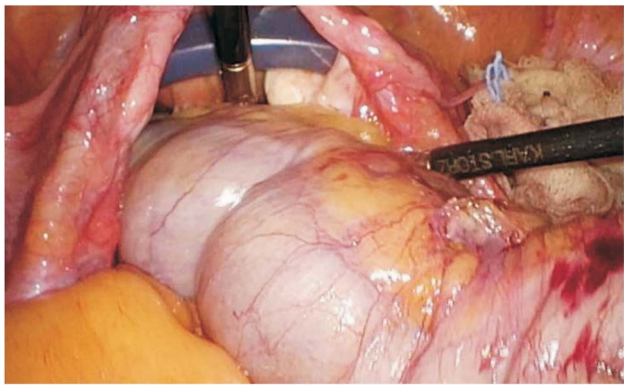

Fig. 5. Extraction of specimen via wound protector.

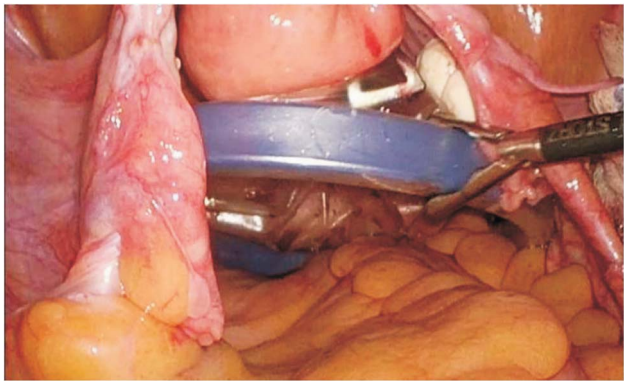

Fig. 6. Removal of wound protector by using a Babcock clamp by grasping the edge of wound protector.

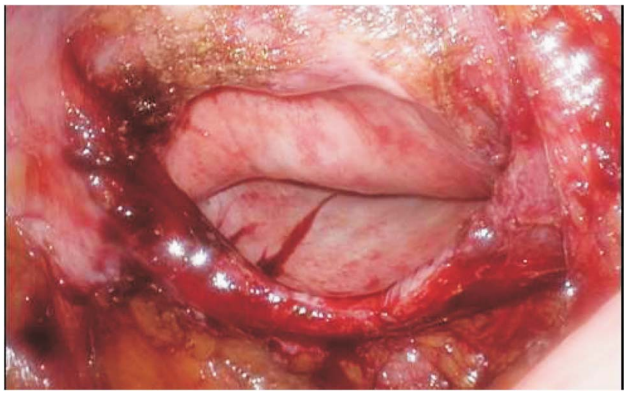

Fig. 7. No air leak was noted by packing two wet gauzes into the vagina.

pically using a running barbed absorbable suture[9] (Fig. 8). Only three trocar sites were noticeable on the abdomen (Fig. 9).

For transvaginal NOSE in left-sided colectomy, after mesenteric excision was performed and the colon was resected intracorporeally using articulating linear staplers. The vagina was washed with 10% povidone-iodine and the uterus was retracted using 33 mm circular sizer (Fig. 1). A 4 to 5 cm transverse posterior colpotomy was performed using laparoscopic monopolar scissors (Fig. 2). A wound protector was carefully inserted into the abdominal cavity through

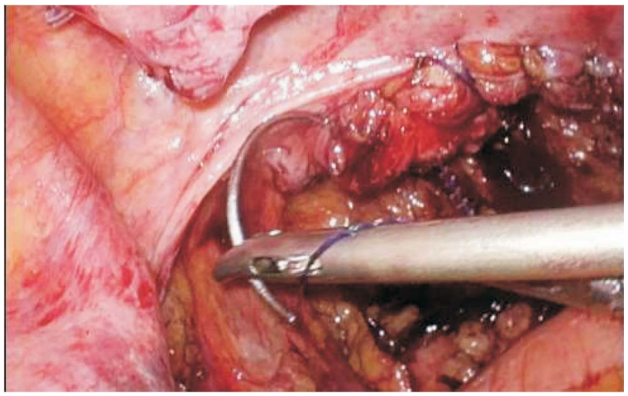

Fig. 8. Closure of posterior fornix using barbed suture.

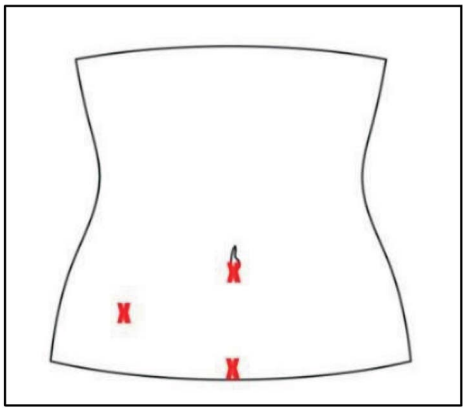

Fig. 9. Trocars site for right-sided laparoscopic colorectal surgery.

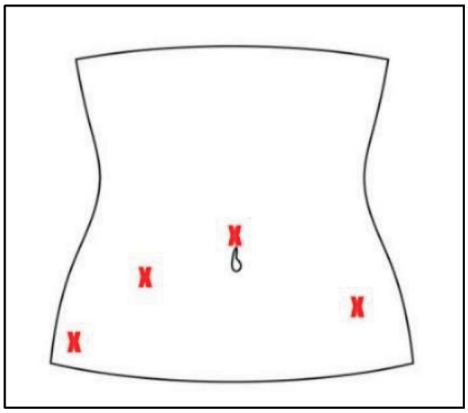

Fig. 10. Trocars site for left-sided laparoscopic colorectal surgery (including left hemicolectomy, anterior resection, and low anterior resection).

the colpotomy (Fig. 3) and the specimen was grasped out by a Babcock clamp (Figs. 4, 5). For left hemicolectomy, the wound protector was removed once the specimen was extracted out from the abdominal cavity (Fig. 6). Two wet gauzes were inserted into the vagina to prevent air leak (Fig. 7). The anastomosis was performed by firing one 60 mm linear stapler in an isoperistaltic side-to-side manner, then the enterostomy was closed with Albert-Lembert method, and lastly, the colpotomy was closed laparoscopically using a running barbed absorbable suture (Fig. 8). For anterior resection or low anterior resection, the anvil was inserted into the abdominal cavity through the vagina once the specimen was extracted out from the abdominal cavity, then the wound protector was removed (Fig. 6). Two wet gauzes were inserted into the vagina to prevent air leak (Fig. 7). The colpotomy was then closed laparoscopically using a running barbed absorbable suture (Fig. 8). The proximal stump was sutured with a purse-string suture using 2-0 Prolene, the anvil was inserted into the stump and tied. The circular endostapler was introduced through the anus, either end-to-end or side-to-end anastomosis was performed. Only four trocar sites were noticeable on the abdomen (Fig. 10).

Statistical analysis

Statistical analysis was performed using IBM SPSS 16.0 software. Continuous variables between the transvaginal NOSE in right-sided colectomy and transvaginal NOSE in left-sided colectomy groups were reported as mean with standard deviations (SD). Categorical variables were presented as numbers with percentages.

Results

Patient characteristics are indicated in Table 1, while the operative and postoperative outcomes of patients who underwent transvaginal NOSE are summarized in Table 2. The mean duration of surgery was 255.79 ± 80.35 min, for transvaginal NOSE in right-sided colectomy was 253.57 ± 78.67 min while the transvaginal NOSE in left-sided colectomy was 258.53 ± 84.73 min. The mean estimated blood loss was 41.45 ± 47.01 mL, transvaginal NOSE in right-sided colec-

tomy was 47.14 ± 54.05 mL while the transvaginal NOSE in left-sided colectomy was 34.41 ± 37.08 mL. The mean size of the tumor retrieved via the transvaginal route was 3.27 ± 1.27 cm, transvaginal NOSE in right-sided colectomy was 3.16 ± 1.31 cm while the transvaginal NOSE in left-sided colectomy was 3.40 ± 1.24 cm (the largest tumor was 6 cm). The mean number of lymph nodes harvested for malignant was 19.29 ± 9.94, for the right colon specimen was 21.86 ± 10.72 while the left colon specimen was 16.12 ± 8.11. The mean number of days of the first flatus was 1.42 ± 0.68 day, for transvaginal NOSE in right-sided colectomy was 1.48 ± 0.74 day) while the transvaginal NOSE in left-sided colectomy was 1.35 ± 0.49 day. The mean duration of hospitalization was 5.82 ± 2.93 day, for transvaginal NOSE in right-sided colectomy was 6.33 ± 3.22 day while transvaginal NOSE in left-sided colectomy was 5.18 ± 2.48 day.

Table 1. Patient characteristics

Characteristic	Transvaginal NOSE (n = 38)
Age, year (mean ± SD)	68.58 ± 10.11
BMI, kg/m^2 (mean ± SD)	24.16 ± 3.86
ASA score	
I	2 (5.26%)
II	20 (52.63%)
III	15 (39.47%)
IV	1 (2.63%)
Previous abdominal surgery	10 (26.32%)
Disease	
Benign	
Polyp	2 (5.26%)
Diverticulitis	3 (7.89%)
Colonic ulcer with active bleeding	1 (2.63%)
Malignant	32 (84.21%)
Location of tumor	
Right sided colon	18 (47.37%)
Transverse colon	3 (7.89%)
Descending colon	5 (13.16%)
Sigmoid colon	11 (28.95%)
Upper rectum	1 (2.63%)

In our transvaginal NOSE series, the operative and postoperative outcome of transvaginal NOSE which includes operation time, estimated blood loss, tumor size, number of lymph node harvested, time to first flatus, and postoperative hospital stay showed no statistical difference in the subgroup analysis between the transvaginal NOSE in right-sided colectomy and transvaginal NOSE in left-sided colectomy.

The intraoperative and postoperative complications of patients undergoing transvaginal NOSE in right-sided and left-sided colectomy are summarized in Table 3. There were no intraoperative complications such as injury to surrounding viscera during transvaginal NOSE or ruptured of the specimen during transvaginal NOSE. Postoperative complications included anastomosis leak were noted in two cases of transvaginal NOSE in left-sided colectomy (11.76%) and there was one case of intra-abdominal abscess in transvaginal NOSE in left-sided colectomy (5.88%). There was one case (4.76%) each in the category of

Table 2. Operative and postoperative outcome of transvaginal natural orifice specimen extraction (NOSE) in laparoscopic colorectal surgery

Parameters	Transvaginal NOSE (n = 38)	Subgroup analysis		*p* value
Operation time, min	255.79 ± 80.35	Right-sided	253.57 ± 78.67	0.946
		Left-sided	258.53 ± 84.73	
Estimated blood loss, ml	41.45 ± 47.01	Right-sided	47.14 ± 54.05	0.474
		Left-sided	34.41 ± 37.08	
Tumor size	3.27 ± 1.27	Right-sided	3.16 ± 1.31	0.987
		Left-sided	3.40 ± 1.24	
Number of lymph node harvested	19.29 ± 9.94	Right-sided	21.86 ± 10.72	0.832
		Left-sided	16.12 ± 8.11	
Time to first flatus, day	1.42 ± 0.68	Right-sided	1.48 ± 0.81	0.917
		Left-sided	1.35 ± 0.49	
Postoperative hospital stay, day	5.82 ± 2.93	Right-sided	6.33 ± 3.22	0.626
		Left-sided	5.18 ± 2.48	

Table 3. Intraoperative and postoperative complications of transvaginal natural orifice specimen extraction (NOSE) in laparoscopic colorectal surgery

Parameters	Transvaginal NOSE (n = 38)	Right-sided transvaginal NOSE (n = 21)	Left-sided transvaginal NOSE (n = 17)
Intraoperative complications (injury to surrounding viscera/specimen ruptured during extraction)	-	-	-
Postoperative complications			
Anastomosis leakage	2 (5.26%)	-	2
Postoperative ileus	1 (2.63%)	1	-
Abdominal wound infection	1 (2.63%)	1	-
Intra-abdominal abscess	1 (2.63%)	-	1
Colon perforation	1 (2.63%)	1	-
Colovaginal fistula	1 (2.63%)	1	-
Urinary tract infection	-	-	-
Incisional hernia	-	-	-
Sexual dysfunction	-	-	-
Dyspareunia	-	-	-
Re-admission within 30 days	-	-	-
Local recurrence (for malignant disease)	-	-	-
Mortality	-	-	-

post-operative ileus, abdominal wound infection, colon perforation, and colovaginal fistula in transvaginal NOSE in right-sided colectomy. There was no readmission within 30 days, local recurrence (for malignant disease), and mortality reported in both transvaginal NOSE in right-sided and left-sided colectomy group.

Discussion

Laparoscopic colorectal surgery is ideal for the implementation of natural orifice extraction of specimens. Redwine et al. reported the first series of transvaginal specimen retrieval in five women with sigmoid endometriosis in 1996 but the results have not been widely accepted. The main reluctance of the surgeon back then was due to the fear of rectovaginal fistula.[10] With constant innovations and significant improvements in minimally invasive instruments and techniques, the complication rate of transvaginal natural orifice specimen extraction (NOSE) in laparoscopic surgery is low.[1,11]

In our study, the size of the tumors extracted via the transvaginal route ranged from 0.9 to 6 cm. If the tumor is not a advanced tumor, via the transvaginal route is an alternative choice, regardless of the size. As a advanced tumor invaded the visceral peritoneum or adhered to an adjacent organ, transvaginal NOSE could be a possible risk for tumor seeding near the pelvic area or the posterior fornix. There are a few reasons to perform a transvaginal NOSE when tumor located at left-sided colon such as large tumor size, a bulky mesocolon, or a narrow pelvis, which makes it difficult to be extracted transanally, but it can be possibly done via transvaginal fashion. The largest tumor we have extracted out was 6 cm in size. According to Stipa et al., the largest retrieved tumor size via transvaginal was 8.5 cm.[9,12-14] However, there was a lack of data reporting the appropriate mesocolon size to perform transvaginal NOSE, further studies are needed to determine the suitable size.

Secondly, the long distal stump especially for descending or proximal sigmoid tumors, makes it hard for the specimen to be pulled out via transanal fashion, it might tear the distal stump during extraction of the specimen. Thus, transvaginal NOSE could be performed in addition to laparoscopic colectomy when there is a long distal stump.

There were no intraoperative complications such

as injury to surrounding viscera or specimen ruptured during extraction. However, there were two cases (5.26%) of anastomosis leakage in our transvaginal NOSE in left-sided colectomy group but there were none in the transvaginal NOSE in right-sided colectomy group. The two anastomosis leakage cases did not require re-operation and were successfully managed by conservative treatment. There was one case of intra-abdominal abscess in the transvaginal NOSE in left-sided colectomy group which was successfully managed by percutaneous abscess drainage and empirical antibiotic was used for at least 10 days.

There was each one case of postoperative ileus, abdominal wound infection, and splenic flexure colon perforation in the transvaginal NOSE in right-sided colectomy group. The case of postoperative ileus was managed by conservative treatment. The one case of abdominal wound infection was managed by removing the sutures, debridement of the wound, and administration of empirical antibiotic, as we do not routinely administered prophylaxis antibiotic postoperatively. The splenic flexure colon perforation was due to the thermal effect caused by the energy device while performing the splenic flexure mobilization, re-operation and primary closure of the perforated bowel was performed. There was one case of colovaginal fistula in the transvaginal NOSE in right-sided colectomy group. In this case, the posterior colpotomy wound was closed via transvaginal route, which might accidentally suture to the nearby colon or rectum, and thus the occurrence of colovaginal fistula.[15] From this case onwards, we performed the closure of posterior colpotomy laparoscopically and no further colovaginal fistula occurrence was noted.

Other surgical morbidities which include anastomosis bleeding, urinary tract infection, incisional hernia, readmission within 30 days, sexual dysfunction, and dyspareunia were not reported.[5,8] Studies showed posterior colpotomy does not increase postoperative morbidities such as urinary tract infection, dyspareunia, and sexual dysfunction.[2,5,16] There was no local recurrence in our malignant tumor patient during follow up period. There was also no mortality in all the patients.

This technique may be an alternative for lowering the incidence of incisional hernia and abdominal wound infection, facilitating a shorter time to the return of bowel function, shorter length of hospital stays, and better cosmetic results.[4] Furthermore, transvaginal NOSE could also be performed by retrieving specimens from both the right- and left-sided colon,[16] especially in patients with large tumors (< 6 cm), a bulky mesocolon, or a narrow rectum.[9]

However, there are limitations of this study that must be noted, including the small number of patients, the lack of long-term outcomes, and comparative studies. The retrieval of specimens via the vagina may not be appropriate for patients with vaginal anomalies.[17]

Nevertheless, further studies with long-term outcomes and follow-up are required to establish whether transvaginal natural orifice specimen extraction (NOSE) in laparoscopic colorectal surgery offers advantages to patients.

Conclusion

In conclusion, from our preliminary results show transvaginal natural orifice specimen extraction (NOSE) in laparoscopic colorectal surgery is an alternative choice for selected cases. This procedure is also feasible for some selected patients with larger tumor size, bulky mesocolon, and narrow pelvis. However, further studies are needed to assess the long-term outcomes of this technique.

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原　著

腹腔鏡結直腸手術後經陰道標本提取術 (transvaginal NOSE)：單一機構之經驗

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前言　近年來，腹腔鏡結直腸手術後經陰道標本提取術式 (transvaginal NOSE) 已引起關注。這項研究的目為評估腹腔鏡結直腸手術後經陰道標本提取術式的可行性，安全性和短期臨床結果。

方法　我們回顧性分析了數據庫中 2011 年至 2020 年間行腹腔鏡結直腸手術後經陰道標本提取術式的患者記錄。我們納入了罹患憩室炎、結腸息肉和結腸腫瘤小於 6 cm 的女性患者。我們也排除了處女膜完整、妊娠、晚期腫瘤、中/低位直腸腫瘤和不同意進行腹腔鏡結直腸手術後經陰道標本提取術式的患者，並且針對患者的特徵、短期手術結果、術中和術後併發症進行回顧性分析。

結果　共 38 位患者行腹腔鏡結直腸手術後經陰道標本提取術式。平均手術時間為 255.79 ± 80.35 分鐘，次分析右側結腸為 253.57 ± 78.67 分鐘，左側結腸為 258.53 ± 84.73 分鐘。平均住院時間為 5.82 ± 2.93 天，次分析右側結腸手術為 6.33 ± 3.22 天，左側結腸手術為 5.18 ± 2.48 天。第一次排氣的平均時間為 1.42 ± 0.68 天，次分析右側結腸為 1.48 ± 0.81，左側結腸為 1.35 ± 0.49。記錄術後併發症，包括吻合口漏 2 例 (5.26%)，術後腸梗阻 1 例 (2.63%)，腹腔內感染 1 例 (2.63%)，結腸穿孔 1 例 (2.63%)，1 例 (2.63%) 陰道直腸瘻管。無術中併發症、術後尿路感染、切口疝氣、性功能障礙、性交痛等併發症。

結論　從我們的初步結果來看，腹腔鏡結直腸手術後經陰道標本提取手術對於部分病患可以是另一種替代選擇。但這種手術技術需要更多的臨床證據和長期隨訪。

關鍵詞　腹腔鏡、大腸直腸科、手術、經陰道、經自然孔標本摘除術。