Original Article

Short-term Oncological Outcomes after Natural Orifice Specimen Extraction Surgery for Colorectal Cancer

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Key Words
Natural orifice specimen extraction;
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Purpose. To investigate the short-term oncological outcomes in colorectal cancer patients who have undergone the natural orifice specimen extraction (NOSE) procedure.
Methods. A total of 63 colorectal cancer patients underwent curative surgery with the intention of extracting specimen via a natural orifice. We assessed surgical quality, operative outcomes, and short-term oncological outcomes. We compared successful extractions to failed cases. Additionally, we evaluated tumor volume as an indicator of successful extraction.
Results. Among the patients assessed, 33 (out of 63) underwent successful extraction, while the remaining 30 experienced failure. The successful group benefits from less post operative pain and faster normalization of bowel activities. Although the tumor diameters in the two groups were not significantly different, the tumor volume is significantly larger in the failure group. 5 patients in total experienced local recurrence or distant metastasis. The successful group's median disease-free survival (17.8 months) was no different than that of the failure group (19.8 months). The disease-free survival of the two groups had no statistically significant difference.
Conclusion. Our study observed that NOSE procedure is safe, effective, and can provide comparable oncological outcomes for colorectal cancer patients, compared to conventional approaches. Additionally, we observed that failed NOSE attempts do not significantly or adversely impact short-term oncological outcomes.

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Minimally invasive surgery (MIS), including laparoscopic and robotic approaches, has become the gold standard for the surgical treatment of colorectal cancers.[1-5] Efforts continue to refine these surgical techniques further to minimize post-surgery trauma and to potentially improve both short- and long-term surgical outcomes. A key area of focus is the natural orifice specimen extraction (NOSE) technique.

The NOSE technique utilizes existing orifices, such as the anus or vagina, for specimen extraction to avoid mini-laparotomy. In theory, this approach can reduce postoperative pain and promote bowel recovery. However, there are several disadvantages associated with the NOSE procedure. First, it is technically more challenging than conventional techniques. Additionally, there are bacteriological and oncological concerns associated with the procedure. At various stages of the procedure, the boundary between the aseptic peritoneal

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cavity and the contaminated rectum, vagina, or bowel lumen is inevitably breached. This maneuver can potentially lead to the spreading of malignant cells into the peritoneal cavity or to healthy bowel segments.[6-8] The technical difficulty and success rates of NOSE remain challenging to predict. Furthermore, the extent to which failed NOSE attempts impact safety, pathology, and oncology is not yet fully understood. We present data from our institute to address these questions.

Materials and Methods

Patients

Patients who underwent elective minimally invasive colorectal cancer surgery with the intent to receive NOSE were selected at a single institution between September 2016 and November 2024. The included patients were diagnosed with clinical stage I, II, or III colon cancer. Patients whose final pathology reports revealed the absence of cancer or those with distant metastases at the time of diagnosis were excluded. Among the 83 patients selected, 63 were eligible for final analysis and enrolled in the study. Among the enrolled patients, 33 underwent successful NOSE, and 30 required conventional laparoscopic surgery due to failed NOSE attempts (Fig. 1).

Surgical procedure

All patients undergoing minimally invasive colorectal cancer surgery received a liquid diet for bowel preparation the day prior to the procedure. A prophy-

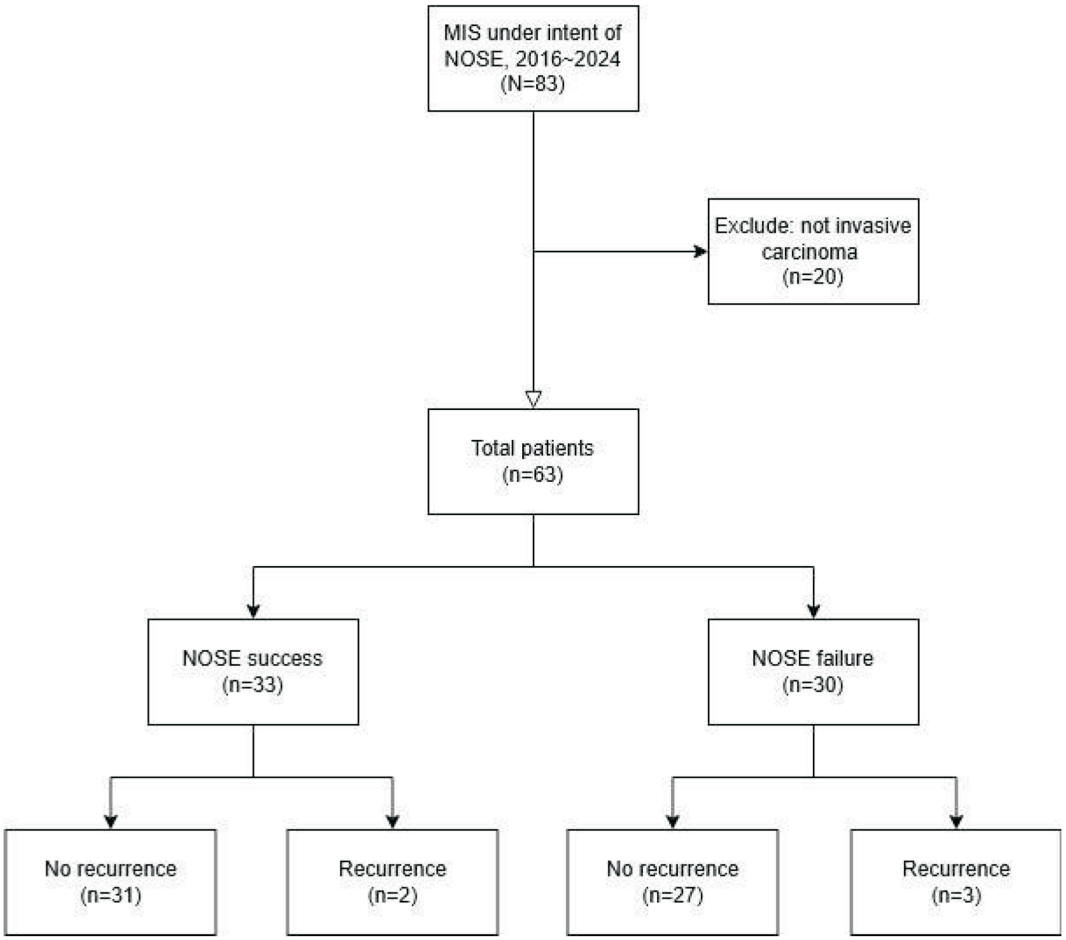

Fig. 1. Flow chart showing the proportion of patients receiving successful and failed NOSE procedures and their long-term oncological outcomes. MIS, minimally invasive surgery; NOSE, natural orifice specimen extraction.

lactic second-generation cephalosporin was administered to the patients within 60 minutes before the skin incision. For patients receiving laparoscopic colorectal cancer surgery, the patients were positioned in a modified lithotomy position, and 12 mm trocars were inserted into the umbilicus, the right upper and lower quadrants, and the left upper and lower quadrants. D3 mesocolonic lymph node dissection was routinely performed. For the NOSE procedure, the rectum was transected distal to the tumor using an endoscopic stapling device. The rectal stump staple line was then excised, and the specimen was extracted via the anus. The circular stapler anvil was introduced into the abdomen through the anus. Subsequently, the rectal stump was closed using an endoscopic stapling device. The circular stapler anvil was placed in the colonic stump and secured with purse-string sutures. Finally, the circular stapler staple housing and the anvil were connected, and an end-to-end anastomosis was performed.

If the NOSE procedure was determined to be unfeasible during laparoscopic surgery, the specimen was extracted by extending the left lower quadrant trocar wound. In this circumstance, the case will be categorized into the NOSE-failure group. In contrast, if the specimen can be successfully extracted completely via the anus, the case will be categorized into the NOSE-success group.

For patients undergoing robotic surgery, 8-mm trocars were inserted in the right lower quadrant, the umbilicus, and two in the left upper quadrant. An additional 12-mm assistant port was placed in the right upper quadrant. Colonic resection and the NOSE procedure are similar to the laparoscopic approach. However, if the NOSE procedure was deemed unfeasible during robotic surgery, the specimen was extracted by creating an auxiliary incision in the left lower quadrant along the Pfannenstiel line.

Data collection and follow-ups

All patient characteristics and treatment-related information were obtained from the medical record system of the National Taiwan University Hospital. The length of hospital stay was defined as the time from the day of the operation to the day of discharge, as some patients may be admitted several days earlier for additional examinations. Postoperative pain was defined as the highest reported pain score on the visual analogue scale (VAS) within 72 hours following the operation. The tumor volume was determined through pathological review and measurement of the surgical specimen. The tumor's length, width, and height were recorded, and the tumor volume was calculated as the product of these three dimensions divided by 2. The largest dimensions measured on preoperative cross-sectional images were recorded as the largest tumor diameter.

The patients were followed up at our institution every three months for two years after the operation. Subsequently, follow-ups were conducted every six months until the patient either died, lost to follow-up, or until the conclusion of the study in November 2024. Recurrence was defined as local recurrence confirmed by endoscopic biopsies or distant metastases verified by fluorodeoxyglucose-positron emission tomography (FDG-PET) scans or surgical biopsies.

Statistical analysis

The data obtained were summarized using descriptive statistics. The characteristics of NOSE-successful group and NOSE-failure groups were compared using analytical statistics. The continuous variables were compared with Student's t-tests, the categorical variables were compared with Chi-squared tests. Categorical variables were compared with Fisher's exact tests if the cell counts were too small to meet the assumption for Chi-squared tests. The means of survival data were compared with Student's t-tests, and the medians of the survival data were compared with Mann-Whitney U tests. The survival curve was plotted using the Kaplan-Meier method, and the two groups were compared using log-rank tests. Statistical analysis was conducted using the SPSS Statistics software version 25 (IBM Corp, Armonk, NY).

Results

A total of 63 patients were enrolled in the study.

Among them, 33 patients (52.4%) underwent successful NOSE, while 30 (47.6%) experienced failed attempts. Additionally, 28 patients (44.4%) received laparoscopic surgery, while 35 (55.6%) had robotic surgery. The average tumor location was found to be 19.45 centimeters from the anal verge, with a mean tumor volume of 12.28 cubic centimeters. On average, the maximum tumor diameter estimated before the operation on cross-sectional images was 3.62 centimeters. The results showed a significant difference in tumor diameter measured on pre-operative cross-sectional image, however, there was a significant difference in the actual tumor volume measured on pathologic review after surgery (Table 1). No patient required an elective diverting enterostomy; however, 3 patients required diverting enterostomies due to postoperative leakage. The NOSE procedure performed by robotic approach had higher success rate compared to laparoscopic approach, and the difference was significant statistically (Table 2).

Short-term outcomes were favorable. The mean operation time was 275.24 minutes, with an average estimated blood loss of 125.71 milliliters and a mean distal margin of 6.43 centimeters. On average, patients were hospitalized for 14.73 days following the operation and began to experience normal flatus on day 3.83 post-surgery. There was no difference in operation time, blood loss and distal margin. Postoperative pain was minimal, with an average maximum pain score of 2.56 points on the visual analogue scale. Patients in the NOSE-successful group had lower post operative pain, and earlier bowel activity normalization. Additionally, the differences were statistically significant. Five patients experienced postoperative leakage, representing 7.9% of the study population. Among the patients who suffered post operative leakage, three required a diverting enterostomy, representing 4.8% of the total study population. The percentage of patients suffered postoperative leakage that required a diverting enterostomy was 3.0% and 6.7% in the NOSE-success and NOSE-failure group, respectively. The difference was not statistically significant (Table 2).

Table 1. Demographic and baseline patient characteristics

Characteristic	All (N = 63)	NOSE		*p*-value
		Successful (N = 33)	Failure (N = 30)	
Age – yr (SD)	61.30 (11.84)	61.12 (12.51)	61.50 (11.27)	0.900
Gender				
Male – no. (%)	25 (39.7)	16 (48.5)	9 (30.0)	0.134
Female – no. (%)	38 (60.3)	17 (51.5)	21 (70.0)	
ASA score				
1/2 – no. (%)	42 (66.7)	20 (60.6)	22 (73.3)	0.285
3/4 – no. (%)	21 (33.3)	13 (39.4)	8 (26.7)	
ECOG				
0 – no. (%)	22 (34.9)	13 (39.4)	9 (30.0)	0.270
1 – no. (%)	39 (61.9)	20 (60.6)	19 (63.3)	
2 – no. (%)	2 (3.2)	0 (0.0)	2 (6.7)	
BMI – (SD)	24.46 (4.04)	24.28 (4.04)	24.66 (4.10)	0.708
Tumor distance from AV – cm (SD)	19.45 (7.65)	17.91 (7.28)	21.35 (7.80)	0.089
Tumor size – cm (SD)	12.28 (15.51)	6.22 (6.78)	18.95 (19.39)	0.001
Largest diameter – cm (SD)	3.62 (1.73)	3.27 (1.67)	4.01 (1.73)	0.090
nCRT – no.	1 (1.6)	1 (3.00)	0 (0.00)	0.336
Surgical approach				
Laparoscope – no. (%)	28 (44.4)	4 (12.1)	24 (80.0)	< 0.001
Robot – no. (%)	35 (55.6)	29 (87.9)	6 (20.0)	

NOSE, natural orifice specimen extraction; yr, year-old; no., number; SD, standard deviation; ASA, American Society of Anesthesiologists; ECOG, Eastern Cooperative Oncology Group performance status scale; BMI, body mass index; AV, anal verge; nCRT, neoadjuvant chemoradiotherapy.

Table 2. Short-term postoperative outcomes

Outcome	All (N = 63)	NOSE		*p*-value
		Successful (N = 33)	Failure (N = 30)	
Diverting stoma – no. (%)	3 (4.8)	1 (3.0)	2 (6.7)	0.498
Distal margin – cm (SD)	6.43 (3.64)	6.05 (3.91)	6.85 (3.33)	0.389
Operation time – min (SD)	275.24 (55.45)	273.76 (42.61)	276.93 (67.95)	0.829
Estimated blood loss – mL (SD)	125.71 (185.34)	96.97 (145.20)	157.33 (219.54)	0.199
Length of hospitalization – days (SD)	14.73 (10.88)	14.21 (8.28)	15.30 (13.29)	0.695
Time to flatus – days (SD)	3.83 (2.17)	3.21 (1.16)	4.50 (2.52)	0.018
Postoperative pain – pts (SD)	2.56 (0.93)	2.15 (0.83)	3.03 (0.82)	< 0.001
Clavien-Dindo classification				
0 – no. (%)	41 (65.1)	24 (72.7)	17 (56.7)	0.305
1 – no. (%)	2 (3.2)	1 (3.0)	1 (3.3)	
2 – no. (%)	11 (17.5)	3 (9.1)	8 (26.7)	
3 – no. (%)	8 (12.7)	5 (15.2)	3 (10.0)	
4 – no. (%)	1 (1.6)	0 (0.0)	1 (3.3)	
Major complications – no. (%)	9 (14.3)	5 (15.2)	4 (13.3)	0.837
Leakage – no. (%)	5 (7.9)	2 (6.1)	3 (10.0)	0.563

NOSE, natural orifice specimen extraction; no., number; SD, standard deviation; min, minutes; mL, milliliters; pts, points; Major complication, Clavien-Dindo classification 3 and 4.

Pathological analysis indicated that 34 patients (54.0%) had early-stage colorectal cancer, classified as stages 0 to 2, while 29 (46.0%) had advanced colorectal cancer, classified as stages 3 and 4. There is no difference across two groups in their stagings (Table 3).

The mean follow-up duration was 755.92 days (25.2 months), with a median of 632.0 days (21.1 months). Five patients experienced cancer recurrence, accounting for 7.9% of the total population. These patients included two with both local recurrence and distant metastasis, and three with only distant metastasis. Among the five patients experienced cancer recurrence, two were from the NOSE-successful group and three from the NOSE-failure group. The mean disease-free survival was 688.46 days (22.9 months), and the median disease-free survival was 543.0 days (18.1 months) for the whole study population. For the disease-free survival in the NOSE-successful group, the mean was 602.85 days (20.1 months), and the median was 535.0 (17.8 months). For the disease-free survival in the NOSE-failure group, the mean was 782.63 days (26.1 months), and the median was 594.0 days (19.8 months). There was no difference in follow up time and disease-free survival between the two groups (Table 4). These two groups were compared using a Kaplan-Meier survival curve and log-rank tests. There was no significant difference in disease-free survival between the groups (Fig. 2).

Table 3. Pathological status

Outcome	All (N = 63)	NOSE		*p*-value
		Successful (N = 33)	Failure (N = 30)	
pT				
pT0 – no. (%)	3 (4.8)	3 (9.1)	0 (0.0)	
pT1 – no. (%)	12 (19.0)	10 (30.3)	2 (6.7)	
pT2 – no. (%)	12 (19.0)	5 (15.2)	6 (23.3)	
pT3 – no. (%)	31 (49.2)	14 (42.4)	17 (56.7)	
pT4 – no. (%)	5 (7.9)	1 (3.0)	4 (13.3)	
pN				
pN0 – no. (%)	34 (54.0)	21 (63.6)	13 (43.3)	
pN1 – no. (%)	22 (34.9)	9 (27.3)	13 (43.3)	
pN2 – no. (%)	7 (11.1)	3 (9.1)	4 (13.3)	
Stage				0.268
0-II	34 (54.0)	20 (60.6)	14 (46.7)	
III-IV	29 (46.0)	13 (33.4)	16 (53.3)	

NOSE, natural orifice specimen extraction; no., number; SD, standard deviation.

Discussion

The NOSE procedure is widely accepted and prac-

Table 4. Short-term oncological outcomes

Outcome	All (N = 63)	NOSE		*p*-value
		Successful (N = 33)	Failure (N = 30)	
Recurrent disease – no. (%)	5 (7.94)	2 (6.06)	3 (10.00)	0.662
Local recurrence – no. (%)	2 (3.17)	1 (3.03)	1 (3.33)	1.000
Follow-up				
Mean – days (SD)	755.92 (404.93)	713.00 (360.83)	803.13 (499.99)	0.382
Median – days	632.0	663.0	599.5	0.630
Disease free survival				
Mean – days (SD)	688.46 (409.40)	602.85 (347.49)	782.63 (455.60)	0.082
Median – days	543.0	535.0	594.0	0.283

NOSE, natural orifice specimen extraction; no., number; SD, standard deviation.

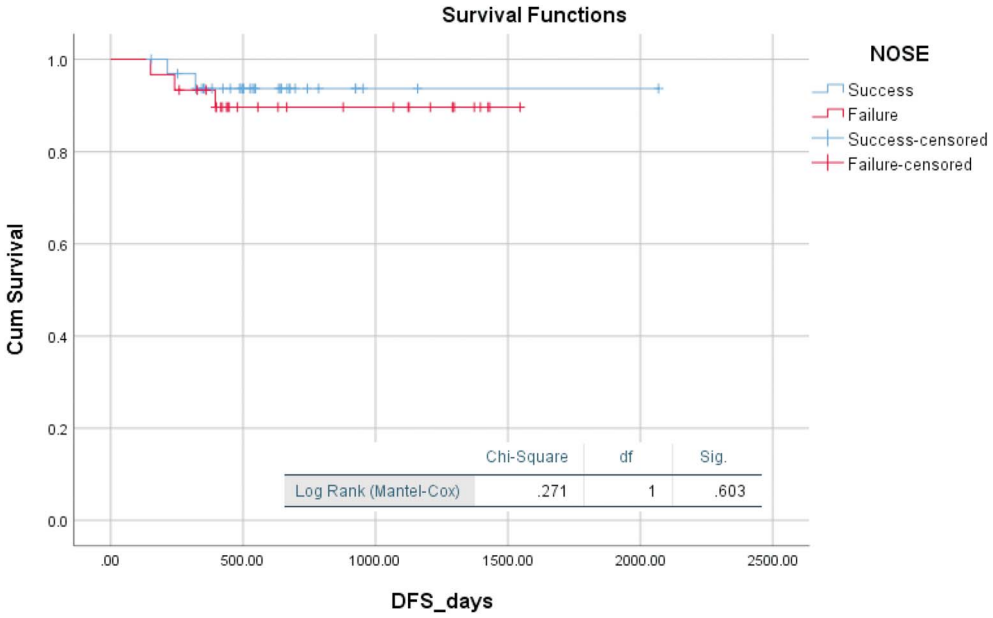

Fig. 2. The Kaplan-Meier survival curve showing the disease-free survival rates of the NOSE-successful group and NOSE-failure group. NOSE, natural orifice specimen extraction.

ticed in clinical settings globally. Various studies have demonstrated its benefits, including reduced postoperative pain, shorter hospital stays, and earlier normalization of bowel activity. The surgical quality of NOSE is comparable to those of traditional methods, as evidenced by the number of lymph nodes harvested. Regarding its safety, studies have shown no significant differences in major complications or postoperative hemorrhage compared to other methods.[9-11]

However, NOSE is associated with oncological concerns. Some researchers argue that the specimen extraction process of NOSE may involve excessive manipulation and traumatization of the tumor, leading to tumor leakage and unfavorable oncological outcomes.[6] To date, there are only a few reports on the long-term oncological outcomes of patients receiving NOSE. For example, Park et al. reported no statistically significant difference in the 5-year disease-free survival rate between NOSE and conventional laparoscopic-assisted surgery.[12]

In our study, the basic characteristics of NOSE-successful and NOSE-failure group were comparable. The age, gender, ASA score, baseline performance status, and tumor location had no significant differences. The actual tumor volume measured in pathologic review after curative surgery was significantly larger in the NOSE-failure group, reflecting that larger tumor size might pose difficulty in specimen ex-

traction via natural orifice. The influence of tumor size on NOSE will be discussed in later discussions.

In our study, there was a significant difference in surgical approach in the two groups. In the NOSE-successful group, more patients received robotic surgery, while in the NOSE-failure group, more patients received laparoscopic surgery. Several possibilities might contribute to this result. First, the robotic system provides a more precise and stable platform, facilitating NOSE procedure. During specimen extraction, in our experience, the rectal cuff should be tented to expand the exit and prevent rectal cuff kinking during specimen extraction. On the robotic platform, the procedure can be done easily and stably. Furthermore, on the robotic platform, the rectal cuff tenting and specimen extraction procedure can be executed by a single surgeon. On the contrary, in the laparoscopic platform, it requires an experienced assistant to tent the rectal cuff while the surgeon extracts the specimen. Inexperienced assistants may hinder the success of NOSE. Secondly, in the robotic platform, it is easier for surgeons to trim the mesocolon properly for a smooth specimen extraction. Finally, there may be potential bias in selecting surgical platforms. Due to higher cost for robotic platforms, the surgeon may be unwilling to provide robotic surgery, if the tumor size is borderline for a successful NOSE procedure. Also, the surgeon may adopt a higher threshold for converting NOSE to conventional trans-abdominal extraction procedure, if the patient already paid for costly robotic surgery.

The operation time was slightly longer in the NOSE-failure group; however, the difference was not statistically significant. Despite it might take extra time attempting several times to extract the specimen in the NOSE-failure group, the anastomosis procedure was less technically challenging and less time consuming. This compensated for the time consumed in repeated extraction attempts, resulting in similar operation time between the two groups. Also, the NOSE-successful group had more cases performed in the robotic platform, which required additional docking time. Docking time might have an influence on operational time but was not recorded in our study. A detailed break-down of time consumed in each surgical step is needed, for future studies focusing on surgical time in a NOSE procedure.

Our study showed that the normalization of bowel activity was about 1.3 days faster in the NOSE-successful group, and the difference was statistically significant. The post operative pain was also less in the NOSE-successful group on visual analogue scale, and the difference was statistically significant. The faster normalization of bowel activity and less post operative pain in the NOSE-successful group might be attributed to the absence of laparotomy wound for specimen extraction. In our NOSE-failure group, we routinely extract specimens via a Pfannenstiel incision, which causes less pain. However, our study demonstrated that a successful NOSE procedure will further minimize post operation pain.

In terms of post-operative complications, the NOSE-successful and failure groups were comparable. There were 5 major complications (Clavien-Dindo Classification class 3 and 4) in the successful group, and 4 major complications in the failure group. There were 2 leakage cases in the successful group, which represented 6.1% leakage rate. There were 3 leakage cases in the NOSE-failure group, which represented 10.0% leakage rate. Among the patients suffering leakage, 1 out of 2 patients in the successful group required a diverting enterostomy, while 2 out of 3 patients in the failure group required a diverting enterostomy. In terms of post operation complications, a failed NOSE attempt would not increase the likelihood of post operative complications and leakage. Previous studies on anastomosis leakage following anterior resection range from 6.50% to 13.68%.[13-15] Compared to previous studies, our study demonstrated that under proper patient selection, the NOSE procedure will not increase the likelihood of major complications and leakage.

The final pathology staging of the two groups were comparable. The distance to closest margin in both groups had no statistically significant difference. Pathology review reported that early-stage patients comprised of 60.6% and 46.7% in the NOSE-successful and failure groups respectively. There was no statistically significant difference in pathology staging between the two groups. The mean and median follow-up time in the successful group was slightly shorter compared to the failure group, but the difference was

not statistically significant. The difference in mean and median follow-up time may be due to an increase in success rate over the study period. In earlier years of our institution, the experience in NOSE procedure was inadequate, resulting in more failure cases. These cases contributed to a slightly longer follow-up time in the failure group. During the follow up period, regarding cancer recurrence including either local recurrence, distant metastasis or both, there were two patients in the NOSE-success group, and three patients in the failure group who developed cancer recurrence. Regarding local recurrence, there was one patient in the NOSE-success group, and one patient in the failure group. Notably, both patients with local recurrence also suffered distant metastasis upon detection of cancer recurrence. Regarding isolated distant metastasis, there was one patient in the NOSE-success group, and there were two patients in the failure group. There was no statistically significant difference in mean and median disease-free survival between the two groups. There was also no statistically significant difference between the disease-free survival curve of the two groups.

Among the cases with cancer recurrences (either local recurrence, distant metastasis or both), most recurrence occurred within one year after the operation. In the NOSE-successful group, the 2-year disease-free survival rate was 93.9%, while in the NOSE-failure group, the 2-year disease-free survival rate was 90.0%. All cancer recurrences in the successful group occurred within 1 year after the operation, and 2 out of 3 cancer recurrences occurred within 1 year in the NOSE-failure group. The oncological outcomes of sigmoid and rectosigmoid cancer patients receiving minimally invasive surgery reported 2-year disease free survival ranging from 79.5% to 92.9%, and local recurrence rate ranging from 0.9% to 4.6%, while distant metastasis ranging from 5.4% to 14.6%.[16-18] Our study demonstrated that, with proper case selection and routine execution of D3 mesocolonic lymph node dissection, the NOSE procedure will not have a negative oncological impact on the patient, whether the NOSE procedure attempt was successful or not. This result encourages surgeons to attempt a NOSE procedure whenever it may be possible.

Despite the popularity of NOSE, there is a lack of consensus on the selection of suitable cases, with decisions largely dependent on the surgeon's personal experience. The most critical factor to consider for NOSE is the size of the primary tumor.[19,20] In our study, all patients were deemed suitable for NOSE prior to the operation and underwent curative surgery with the intent to receive a NOSE procedure. The largest tumor diameter measured on pre-operative cross-section study showed no difference between the two groups. However, the tumor volume measured during pathology review after the operation showed that the tumor volume in the failure group was significantly larger than that of the successful group (18.95 cubic centimeters vs. 6.22 cubic centimeters). This finding highlights the need for a better tool to evaluate likelihood of a successful NOSE procedure before the operation. The largest tumor diameter measured on cross-sectional images is not a good predictor for a successful NOSE procedure. Modern technologies may allow pre-operative estimation of tumor volume, which may improve selection of appropriate patients for NOSE procedure.

Limitations

This study has several limitations. First, the patients were recruited from a single hospital, and the study population was relatively small. A study involving multiple institutions and a larger study population should be conducted to strengthen the conclusion.

Second, the study may also be biased due to the nature of retrospective study and lack of randomization. The reported disease-free survival may be biased, because the study only included patients who underwent the operation under the intention of NOSE procedure. These patients are selected by surgeons, and may have more favorable oncological characteristics, such as tumor size, lymph node status, and patient performances. This may result in a biased disease-free survival, post operative recovery, and surgical complication rates.

Thirdly, this study enrolls patients who received NOSE procedure attempts in early periods in our institution. The lack of experience in surgical technique and patient selection in the earlier NOSE attempts may potentially bias the surgical and oncological outcomes.

Finally, the null result comparing the successful group and the failure group should be interpreted with caution due to the limited follow-up period and relatively small sample size, which may result in insufficient statistical power for analysis. A multi-institution study with proper randomization, enrolling more cases, and a longer follow-up of oncological outcomes should be conducted for more in-depth data and analysis.

Conclusions

Our study observed that NOSE procedure is safe, effective, and can provide comparable oncological outcomes for colorectal cancer patients, compared to conventional approaches. Tumor volume is identified as a better indicator than tumor diameter measured on cross-sectional images for assessing the likelihood of a successful NOSE procedure. Further research on pre-operative tumor volume estimation could provide better means for predicting appropriate candidate for a NOSE procedure. A successful NOSE procedure will significantly reduce post operative pain and facilitate normalization of bowel activities. In our study, we noted that failed NOSE attempts will not adversely increase the likelihood for major complications. Also, we observed that failed NOSE attempts do not significantly or adversely impact oncological outcomes. Therefore, NOSE can be more broadly offered to colorectal cancer patients receiving minimally invasive surgery with curative intent. To conclude the safety and the long-term oncologic result of the NOSE procedure, further multi-institution investigation with a prospective, randomized study design, with longer follow-up period is still required.

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References

1. Morgan E, Arnold M, Gini A, Lorenzoni V, Cabasag CJ, Laversanne M, Vignat J, Ferlay J, Murphy N, Bray F. Global burden of colorectal cancer in 2020 and 2040: incidence and mortality estimates from GLOBOCAN. *Gut* 2023;72:338-44.
2. Braga M, Vignali A, Gianotti L, Zuliani W, Radaelli G, Gruarin P, Dellabona P, Di Carlo V. Laparoscopic versus open colorectal surgery: a randomized trial on short-term outcome. *Ann Surg* 200;236:759-66; disscussion 767.
3. Colon Cancer Laparoscopic or Open Resection Study Group; Buunen M, Veldkamp R, Hop WC, Kuhry E, Jeekel J, Haglind E, Påhlman L, Cuesta MA, Msika S, Morino M, Lacy A, Bonjer HJ. Survival after laparoscopic surgery versus open surgery for colon cancer: long-term outcome of a randomised clinical trial. *Lancet Oncol* 2009;10:44-52.
4. Bonjer HJ, Deijen CL, Abis GA, Cuesta MA, van der Pas MH, de Lange-de Klerk ES, Lacy AM, Bemelman WA, Andersson J, Angenete E, Rosenberg J, Fuerst A, Haglind E; COLOR II Study Group. A randomized trial of laparoscopic versus open surgery for rectal cancer. *N Engl J Med* 2015;372:1324-32.
5. Schwenk W, Haase O, Neudecker J, Müller JM. Short term benefits for laparoscopic colorectal resection. *Cochrane Database Syst Rev* 2005;2005:CD003145.
6. Ngu J, Wong AS. Transanal natural orifice specimen extraction in colorectal surgery: bacteriological and oncological concerns. *ANZ J Surg* 2016;86:299-302.
7. Brincat SD, Lauri J, Cini C. Natural orifice versus transabdominal specimen extraction in laparoscopic surgery for colorectal cancer: meta-analysis. *BJS Open* 2022;6:zrac074.
8. Guan X, Liu Z, Longo A, Cai JC, Tzu-Liang Chen W, Chen LC, Chun HK, Manuel da Costa Pereira J, Efetov S, Escalante R, He QS, Hu JH, Kayaalp C, Kim SH, Khan JS, Kuo LJ, Nishimura A, Nogueira F, Okuda J, Saklani A, Shafik AA, Shen MY, Son JT, Song JM, Sun DH, Uehara K, Wang GY, Wei Y, Xiong ZG, Yao HL, Yu G, Yu SJ, Zhou HT, Lee SH, Tsarkov PV, Fu CG, Wang XS; International Alliance of NOSES. International consensus on natural orifice specimen extraction surgery (NOSES) for colorectal cancer. *Gastroenterol Rep (Oxf)* 2019;7:24-31.
9. He J, Hu JF, Shao SX, Yao HB, Zhang XF, Yang GG, Shen Z. The comparison of laparoscopic colorectal resection with natural orifice specimen extraction versus mini-laparotomy specimen extraction for colorectal tumours: a systematic review and meta-analysis of short-term outcomes. *J Oncol* 2020; 2020:6204264.
10. Ma B, Huang XZ, Gao P, Zhao JH, Song YX, Sun JX, Chen XW, Wang ZN. Laparoscopic resection with natural orifice specimen extraction versus conventional laparoscopy for colorectal disease: a meta-analysis. *Int J Colorectal Dis* 2015; 30:1479-88.
11. Zhou S, Wang X, Zhao C, Pei W, Zhou H, Liu Q, Liang J, Zhou Z, Wang X. Comparison of short-term and survival outcomes for transanal natural orifice specimen extraction with conventional mini-laparotomy after laparoscopic anterior resection for colorectal cancer. *Cancer Manag Res* 2019:11: 5939-48.
12. Park JS, Kang H, Park SY, Kim HJ, Lee IT, Choi GS. Long-

term outcomes after natural orifice specimen extraction versus conventional laparoscopy-assisted surgery for rectal cancer: a matched case-control study. *Ann Surg Treat Res* 2018; 94:26-35.

13. Krarup PM, Jorgensen LN, Andreasen AH, Harling H; Danish Colorectal Cancer Group. A nationwide study on anastomotic leakage after colonic cancer surgery. *Colorectal Dis* 2012;14: e661-7.
14. Degiuli M, Elmore U, De Luca R, De Nardi P, Tomatis M, Biondi A, Persiani R, Solaini L, Rizzo G, Soriero D, Cianflocca D, Milone M, Turri G, Rega D, Delrio P, Pedrazzani C, De Palma GD, Borghi F, Scabini S, Coco C, Cavaliere D, Simone M, Rosati R, Reddavid R; Collaborators from the Italian Society of Surgical Oncology Colorectal Cancer Network Collaborative Group. Risk factors for anastomotic leakage after anterior resection for rectal cancer (RALAR study): a nationwide retrospective study of the Italian Society of Surgical Oncology Colorectal Cancer Network Collaborative Group. *Colorectal Dis* 2022;24:264-76.
15. Kang CY, Halabi WJ, Chaudhry OO, Nguyen V, Pigazzi A, Carmichael JC, Mills S, Stamos MJ. Risk factors for anastomotic leakage after anterior resection for rectal cancer. *JAMA Surg* 2013;148:65-71.
16. Moloo H, Mamazza J, Poulin EC, Burpee SE, Bendavid Y, Klein L, Gregoire R, Schlachta CM. Laparoscopic resections for colorectal cancer: does conversion survival? *Surg Endosc* 2004;18:732-5.
17. Fleshman J, Branda ME, Sargent DJ, Boller AM, George VV, Abbas MA, Peters WR Jr, Maun DC, Chang GJ, Herline A, Fichera A, Mutch MG, Wexner SD, Whiteford MH, Marks J, Birnbaum E, Margolin DA, Larson DW, Marcello PW, Posner MC, Read TE, Monson JRT, Wren SM, Pisters PWT, Nelson H. Disease-free survival and local recurrence for laparoscopic resection compared with open resection of stage II to III rectal cancer: follow-up results of the ACOSOG Z6051 randomized controlled trial. *Ann Surg* 2019;269:589-95.
18. Peng J, Li W, Tang J, Li Y, Li X, Wu X, Lu Z, Lin J, Pan Z. Surgical outcomes of robotic resection for sigmoid and rectal cancer: analysis of 109 patients from a single center in China. *Front Surg* 2021;8:696026.
19. Han FH, Hua LX, Zhao Z, Wu JH, Zhan WH. Transanal natural orifice specimen extraction for laparoscopic anterior resection in rectal cancer. *World J Gastroenterol* 2013;19: 7751-7.
20. Yagci MA, Kayaalp C, Novruzov NH. Intracorporeal mesenteric division of the colon can make the specimen more suitable for natural orifice extraction. *J Laparoendosc Adv Surg Tech A* 2014;24:484-6.

原　著

大腸直腸癌自然孔洞標本取出術的長期腫瘤學預後：病例系列與亞組分析

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目的　探討大腸直腸癌患者接受自然孔洞標本取出術後的短期腫瘤學預後。

方法　共有 63 例大腸直腸癌的患者接受了根治性手術，並計劃通過自然孔洞取出標本。研究中呈現了手術品質、術後短期預後和短期腫瘤學預後。結果另外進行分組分析，比較自然孔洞標本取出的成功與否，兩組術後恢復及短期腫瘤學預後的比較。此外，還比較了了腫瘤大小與成功取出與否的關聯性。

結果　在 63 例患者中，33 例成功通過自然孔洞取出標本，30 例失敗。成功組患者術後疼痛及術後排氣時間均優於失敗組。成功組和失敗組術前腫瘤最大直徑並無差異，但術後測量失敗組的腫瘤體積大於成功組。在追蹤期間共有五位病人發生局部復發或遠端轉移。成功組的無病生存期中位數為 17.8 個月，而失敗組中位數為 19.8 個月，並無差異。兩組的無病存活曲線，未觀察到統計學上的顯著差異。

結論　我們的分析表明，對於大腸直腸癌患者，與一般微創手術相比，自然孔洞標本取出術是一種安全、有效的手術方式，並可提供相當的短期腫瘤學預後。此外，自然孔洞標本取出嘗試失敗，並未顯著對患者的短期腫瘤學預後產生不良影響。

關鍵詞　自然孔洞標本取出術、大腸直腸癌、腫瘤學預後、微創手術。