



Complications and management of natural orifice specimen extraction in colorectal cancer: a narrative review

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Background and Objective: Surgery is the principal treatment for colorectal cancer today. As minimally invasive surgical approaches develop, the mini-laparotomy has been used for specimen extraction. To reduce the pain and incision-related complications associated with mini-laparotomy incisions, the technique of natural orifice specimen extraction (NOSE) has been developed and gained popularity over the years. In colorectal surgery, depending on the tumor location and gender of the patient, transanal, transrectal, transcolonic or transvaginal (TV) NOSE routes can be chosen as an addition to laparoscopic surgery. While the advantages of the NOSE technique are well documented, complications, the management of complications and postoperative outcomes can still be challenging. The purpose of this review article is to analyze complications of nose in colorectal cancer surgery and their treatment.

Methods: A literature review of the last 11 years in English was researched using PubMed and Google Scholar databases to identify articles on NOSE complications in colorectal cancer surgery.

Key Content and Findings: Perioperative complications of NOSE in colorectal cancer surgery include anastomotic leakage, fecal incontinence, intra-abdominal contamination, intraoperative iatrogenic organ injuries, dysperonia, rectovaginal fistula (RVF), and recurrence at the specimen extraction site.

Conclusions: To minimize complications, an experienced surgical team is essential. Also, patient selection is of utmost importance. Other important steps to consider are the diameter of the tumor, depth of invasion, and physical characteristics of the patient, as well as strict compliance to the rules of intraoperative asepsis, irrigation of the tissue with the appropriate solution before opening the distal rectal/colonic stump, and the use of a protective specimen sheath before removing the specimen.

Keywords: Natural orifice; leakage; haemorrhage; dyspareunia; incontinence; malignancy

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Introduction

According to global statistics, colorectal cancer ranks third among all cancers (1) and surgery is still the only definitive treatment (2). During laparoscopy, a mini-laparotomy is required to remove the specimen and complete the anastomosis. Despite keeping the incision to a minimum, there are often complications such as pain, infection, hematoma, seroma, adhesion, and hernia (3). Therefore, to reduce pain, wound-related complications and accelerate the healing process, natural orifice specimen extraction (NOSE) technique has become a popular option (4). With NOSE, the surgical specimen can be removed from the colon, rectum, or vagina after laparoscopic colorectal surgery (5) without the need for additional abdominal incision, thus maximizing the advantages of the transpiring laparoscopic surgery (6). Our aim in this article is to present current information from the literature on the complications and management of NOSE. We present the following article in accordance with the Narrative Review reporting checklist (available at <https://ales.amegroups.com/article/view/10.21037/ales-22-18/rc>).

Methods

We searched published journal articles between 2011–2022 years in the English language on PubMed and Google Scholar using combinations of the following terms: “NOSE AND (colon OR colorectal OR rect*)”, “Natural orifice AND (colon OR colorectal OR rect*)”, and “NOSE AND transvaginal (colon OR colorectal)”. Then selected only more relevant about colorectal surgery and NOSE and full text articles for our narrative review (Table 1). This manuscript did not require Research Ethics Board approval as it does not clinical research study.

Considerations in choice of patient for NOSE

NOSE is recommended for tumors with a depth of invasion at T2–3, and a maximum circumferential diameter of 3 cm for transrectal extraction, and 3–5 cm for transvaginal (TV) extraction. Advanced stage and large tumors, narrow pelvis and obesity are among the relative contraindications for NOSE (7).

Vagina is an ideal specimen extraction site with well recovery owing to its elastic and vascular supply (7). In this way, it can be considered as a primary extraction site in

bulky tumors and especially in right hemicolectomy cases. However, TV extraction is not suitable for male gender, teenagers, virgins and female of childbearing age (8). In their 2014 study, Yagci *et al.* (9) claimed that whole specimen diameter was more significant than tumor diameter when performing TV extraction; they proposed a partial dividing of the mesocolon to facilitate easier extraction through the vagina. Meanwhile, the literature includes reports of the successful removal of tumors with a diameter of 9 cm via the TV (9) and transrectal (6) route.

It has been reported that for transanal extraction, the lesion should be in the distal part of the colon, no serosal invasion in computed tomography (CT), no bulky mesorectum, and no large metastatic lymph nodes (10,11). Kayaalp *et al.* (12) stated that they tried transcolonic extraction for bulky tumor located in the right colon (diameter of size is 12 cm) but they have failed. In the study of Cheng *et al.* (13) stated that the tumor located in the right colon was successfully removed transrectally. However, their study was not selected for NOSE surgery if the tumor diameter was >4 cm on CT scanning for malignancies.

Most surgeons expect technical difficulties when reoperating on patients with a history of previous abdominal surgery (14). However, Awad *et al.* (15) reported completing TV specimen extraction without any problems, even in patients with a previous history of hysterectomy. In the 3-case series of Kayaalp *et al.* (12), all patients had a history of previous open abdominal surgery. In these cases, the history of previous surgery did not constitute an obstacle to specimen extraction. In addition, contrary to the assumption that obese patients pose a greater risk for postoperative complication and mortality (16). Kayaalp *et al.* (6) reported obesity not to be a contraindication in their systematic review on TV specimen extraction after laparoscopic right hemicolectomy.

Complications of NOSE and their management

Anastomotic leakage

Technical difficulties caused by a narrow male pelvis during transanal, transrectal or transcolonic (TARC) specimen removal may damage the blood vessels and tissues around the anastomosis line, while a low level tumor may cause the anastomosis to be tight, in turn adversely affecting the blood flow at the anastomosis line. These problems complicate

Table 1 The search strategy summary

Item	Specification
Date of search	June, 2022
Databases and other sources searched	PubMed and Google Scholar
Search terms used	NOSE AND (colon OR colorectal OR rect*), Natural orifice AND (colon OR colorectal OR rect*), NOSE AND transvaginal (colon OR colorectal)
Timeframe	2011–2022
Inclusion and exclusion criteria (study type, language restrictions etc.)	Only more relevant about colorectal surgery and; NOSE and full text articles in English language selected
Selection process	The selection process was conducted with all authors independently. Only chosen associated to NOSE and colorectal surgery with their complications' articles

NOSE, natural orifice specimen extraction.

TARC specimen extraction, prolong the operation time and increase the incidence of anastomotic leakage (17). In a study by Zhou *et al.* (12,17), leakage was observed in 21 out of 208 patients. Extended operation time was also found to be an independent risk factor. In cases of protracted surgery, distal rectal irrigation before NOSE is recommended, to minimize the risk of contamination by washing the rectum.

There are reports in the literature of anastomotic leakage in cases where TARC extraction was performed (17–23). There are various approaches to manage anastomotic leakage, from diversion ostomy (17,18) to transanal drainage and administration of antibiotherapy (20).

Intra-abdominal contamination

It seems likely that the risk of abdominal contamination increases during TARC NOSE (17). In a study conducted by Costantino *et al.* (19) on patients who underwent TARC NOSE for diverticulitis, a 100% rate of contamination was found in peritoneal fluid samples. However, when compared to the non-NOSE group, the difference was statistically insignificant and had no effect in terms of clinical results. Similarly, in a study by Liu *et al.* (22) on patients with colorectal cancer undergoing NOSE, there were no cases of abdominal infection. In order to reduce intra-abdominal contamination during TARC NOSE, preoperative bowel cleansing, intraoperative washing of the rectum with disinfectant solution, and placing of a sterile plastic cover in the anal canal are all recommended preventative measures (23).

Fecal incontinence

The question of possible fecal incontinence after TARC NOSE is also a matter for concern (21,22). In a meta-analysis, it was reported that there was no difference in defecation functional outcomes between patients who preferred transabdominal extraction and NOSE (24). In a study by Liu *et al.* (22), fecal incontinence was observed in one patient after transrectal extraction, although this resolved spontaneously in the third postoperative month. On the other hand, Franklin *et al.* (21) refuted the idea that the postoperative fecal incontinence seen in three of their patients was associated with direct specimen extraction, explaining that this complaint could have multifactorial causes.

Meanwhile, based on follow up data from 69 patients over a period of 112 months, Zhang *et al.* (25) reported that transanal extraction caused fecal incontinence by impairing anal function in the early period. At the end of their two-year follow-up period, anal function had not returned to preoperative level in either the NOSE or non-NOSE groups. However, incontinence resolved spontaneously within one year in the NOSE group. In addition, in a study carried out by Wolthuis *et al.* (26), no difference was found between preoperative resting and maximum anal canal squeezing pressures and those measured at the postoperative 6th and 12th weeks. Han *et al.* (20) stated that be care of preserving anal sphincter function during resection to prevent fecal incontinence. If the tumor is large or the mesorectum is hypertrophied, it should be gently removed

from the fully dilated anus. Risk of NOSE procedure to damage anal function and fecal incontinence should be analyzed.

Intraoperative organ injury

Organ injuries such as iatrogenic colon perforation (4,21,27) and bladder injury (28) may be encountered during TV specimen extraction. In their study, Franklin *et al.* (21) reported the rate of sigmoid colon and rectum injury to be 7.7% during TV NOSE. They stated that a decrease in the field of vision when the specimen was in the pouch of Douglas increased the risk of accidental injury to adjacent organs such as the sigmoid colon or rectum when placing forceps through the posterior colpotomy to remove the specimen. They recommended the preference of instruments suitable for this operation in order to prevent such complications.

Karagul *et al.* (4) stated that they performed intracorporeal colpotomy by using external tamponage if the vagina was deep, the patient was obese, or the posterior fornix was difficult to reach. They even reported that the vaginal incision could be left open after the specimen was removed if there were difficulties during TV NOSE. A further complication seen with TV NOSE is bleeding from the colpotomy incision line (15). Awad *et al.* (15) applied eight sutures in order to prevent this.

Recurrence in specimen extraction site

The use of sterile specimen bags during NOSE is known to be effective in preventing tumor implantation or recurrence (22,27). In 2017, Karagul *et al.* (4) explained that while performing TV NOSE, the TV route was washed with povidone iodine but sterile specimen bags were not used. In a 2019 case report from the same team, they reported vaginal recurrence in the same patient (29). During a 23-month follow-up by Park *et al.* (30), no TV recurrence or posterior colpotomy-related complications were seen.

Rectovaginal fistula (RVF)

RVF occur in 1.6% of cases after pelvic surgery (18). Bokor *et al.* (31) reported that they placed a tension-free omental flap on the anastomosis to prevent RVF in patients with colorectal endometriosis, who preferred TARC NOSE. Zhao *et al.* (18) reported RVF on the 11th postoperative day

in a patient who underwent simultaneous hysterectomy and laparoscopic rectal resection-TV NOSE for malignancy. They recommend routine rectal digital examination after surgery, especially for low level rectal cancers, to ensure early diagnosis. A diversion ostomy is recommended when postoperative RVF is detected (31).

Dysperonia and other minor complications

There were also no changes in postoperative sexual satisfaction or complaints of dysperonia. In a study by Awad *et al.* (15), no incidents of dysperonia or incisional hernia were observed during a mean follow-up of 17.8 months in 14 patients who underwent TV extraction. In a study by Tarantino *et al.* (32), a decrease in dysperonia in the TV NOSE group was noticed at the postoperative 6th week, although it was not statistically significant. While no RVF was observed in the study, colpitis occurred in one patient, one patient had ulceration in the vaginal wall, and there was dehiscence in the colpotomy incision in one patient. These minor complications were managed conservatively.

All of the above-mentioned TARC-TV NOSE complications are summarized and listed in *Table 2*.

The limitations of this narrative review are the need for large multicenter randomized clinical trials to determine for the NOSE procedure complications, and the risk of damage to anal and vaginal function, fecal incontinence has not been widely researched.

Conclusions

Perioperative complications of NOSE in colorectal cancer surgery include anastomotic leakage, fecal incontinence, intra-abdominal contamination, intraoperative iatrogenic organ injuries, dysperonia, RVF, and recurrence at the specimen extraction site.

In view of the information from the literature, what is the best way to prevent NOSE complications? Without doubt, the experience of the surgical team is an important criterion, as is appropriate patient selection. The diameter of the tumor, the depth of invasion and the physical characteristics of the patient are all important deciding factors. During the NOSE procedure, compliance with the rules of intraoperative asepsis, irrigation of the tissue with an appropriate solution before opening the rectal/colonic distal stump, and the use of a protective specimen sheath before removing the specimen are all crucial steps to

Table 2 Extraction site complications and their prevention

Extraction site	Complication	Prevention
TARC	Intra-abdominal contamination	Preoperative bowel cleansing Intraoperative washing of the rectum with disinfectant solution Placing of a sterile plastic cover in the anal canal are recommended
	Fecal incontinence	Tumoral lesion should be gently removed from the fully dilated anus More research is needed
TARC or TV	Intraoperative organ injury	Priority of instruments suitable for the operation If the vagina was deep, the patient was obese, or the posterior fornix is difficult to reach, perform intracorporeal colpotomy by using external tamponage
	Recurrence in specimen extraction site	Use of sterile specimen bags during extraction with NOSE
	RVF	Tension-free omental flap on the anastomosis to prevent RVF Routine rectal digital examination after surgery, especially for low level rectal cancers, to make sure early diagnosis
TV	Dysperonia	More research is needed

TARC, trans-anal/rectal/colonic; TV, transvaginal; RVF, rectovaginal fistula; NOSE, natural orifice specimen extraction.

achieving a successful outcome.

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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