Brief Insight about Natural Orifice Specimen Extraction in Management of Colorectal Cancer

Ashraf Samir Mohamed Ahmed Ashry, Nawel El-Sayed Hussen Matar, Mohamed Ibrahim Abdelhamid El-Sayed, Hassan Rabiaa Galal Ashour
General Surgery and Surgical Oncology Department, Faculty of Medicine - Zagazig University, Egypt
Corresponding author: Ashraf Samir Mohamed Ahmed Ashry
E-mail: Ashrafashry89@gmail.com, ASAshry@medicine.zu.edu.eg
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Abstract

Surgical treatment for colorectal cancer has advanced rapidly within recent years. Changes to minimally invasive surgery include the addition of natural orifice specimen extraction (NOSE) to conventional laparoscopic approaches to further limit the incisional burden on the patient. Traditionally, with laparoscopic surgery for right-sided colon cancers, specimen extraction is performed through an additional abdominal incision. With the pronounced effort to reduce these incisions, NOSE became prominent in the recent decade. Previous studies have shown favorable postoperative outcomes and short-term oncologic outcomes in the setting of sigmoid and rectal cancer removal. Additionally, transvaginal NOSE was also shown to be beneficial for removal of right-sided colon cancers but was limited to female patients. Natural orifice specimen extraction surgery (NOSES) is an actively developing approach for extracting specimens and performing non-incisional colorectal cancer surgery. Previous studies have shown that its effectiveness and safety in the surgical treatment of rectal cancer are similar to those of conventional laparoscopic surgery. NOSES was demonstrated to be a possible alternative approach to conventional laparoscopy, for which a mini-laparotomy is used to extract the specimen, as there were no differences in surgical characteristics and short-term outcomes.

Keywords: Natural orifice specimen extraction, Colorectal Cancer

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Introduction

Colorectal cancer (CRC) is a common malignant tumor. The global malignant tumor statistics for 2018 show that CRC morbidity ranks fourth among cancers, accounting for 10% of all malignant tumors, and that CRC mortality ranks second, accounting for 9% of cancer deaths [1].The main treatment for CRC is still surgical resection. A large number of studies have confirmed that compared

with open surgery, laparoscopic-assisted colorectal cancer surgery has obvious advantages in short-term efficacy, and there is no significant difference in long-term efficacy [2].

At present, laparoscopic-assisted CRC surgery has been widely used in clinical practice and is extremely important in the field of CRC surgery. However, laparoscopic-assisted mini-laparotomy for CRC requires a micro-incision of approximately 5 cm in the abdomen during the removal of colorectal specimens and the reconstruction of the digestive tract. With the development of technology and concepts, natural orifice specimen extraction (NOSE) surgery has been proposed and applied to the clinical treatment of CRC. It avoids abdominal auxiliary incisions and has better short-term efficacy, including a quick postoperative recovery time, relief of postoperative pain, improved cosmetic outcomes, and a low rate of postoperative incision-related complications (incisional hernia and incision infection), which are welcomed by most surgeons [3,4].

Despite the many advantages of the NOSE operation, this method requires opening the intestine in the abdominal cavity; removing the specimen through the distal intestinal cavity, as well as gastrointestinal reconstruction and other specific procedures, which may increase the ectopic intestinal bacteria in the abdominal cavity. Contamination and squeezing of tumor specimens when taking specimens may increase the risk of ectopic implantation of tumor cells into the abdominal cavity [2].

Great advances in minimally invasive surgery over the last decade have led to the development of various techniques extending the benefits of minimal access surgery to patients with colorectal cancer. However, the current laparoscopic approach requires an extra incision at the abdominal wall for specimen extraction, which is associated with postoperative pain, increased wound complications including infection, hernia formation, and scarring [1].

The definition of NOSES ‘Natural Orifice Specimen Extraction Surgery’ is as follows: the surgical specimen resection is performed intra-abdominally, then the specimen is extracted by opening a hollow organ that communicates with the outside of the body, including the anus, vagina, or mouth. The main features of NOSES for colorectal surgery involve specimen extraction from a natural orifice and complete intra-abdominal digestive tract reconstruction, which avoids the additional incision on the abdominal wall [2].

The potential benefits of NOSES include a reduction in postoperative pain and wound complications, less use of postoperative analgesics, faster recovery of bowel function, shorter length of hospital stay, and better cosmetic and psychological effects [3].

Despite the significant decrease in surgical trauma observed with NOSES, the potential pitfalls of this technique have been demonstrated. Particularly, several issues including bacteriological concerns, oncological outcomes, and patient selection have been raised with this new technique [4].

According to the routes for specimen extraction in colorectal surgery, NOSES is divided into two categories: transanal- and transvaginal-NOSES [5].

A large amount of research literature and clinical practice have fully confirmed that the anus is the most ideal orifice to extract colorectal specimens, which is more in line with the basic requirements of minimally invasive surgery [6].

The vagina has also been considered another ideal option to remove more bulky colorectal specimens when compared with the anus, presenting several properties including good elasticity, adequate blood supply, healing ability, and easy access [7].

However, transvaginal specimen extraction presents the following limitations: firstly, this technique is only confined to female patients; secondly, opening the vaginal wall may increase the risk of postoperative complications and sexual dysfunction; thirdly, transvaginal-NOSES is also limited by ethics, so the orifice selection for specimen extraction is mainly based on the size of the specimen, especially the maximum circumferential diameter (CDmax) [6].

Transanal NOSES is mainly applicable to patients with small tumors, and transvaginal-NOSES is available for female patients with a bulky specimen that cannot be removed through the anus. Furthermore, gynecologic tumor resection can also be completed simultaneously by transvaginal specimen extraction [5].

According to the procedures of specimen extraction, NOSES can be classified into three categories: a) Transanal specimen eversion and extra-abdominal resection technique (mainly used for lower rectal resection); b) Translumenal specimen extraction and extra-abdominal resection technique (mainly used for middle rectal resection); c) Intra-abdominal specimen resection and transluminal extraction technique (mainly used for upper rectal resection and colectomy) [8]. Because NOTES also involves specimen extraction through a natural orifice, it should be considered part of NOSES. Furthermore, the recently developed transanal total mesorectal excision (TaTME) is also a type of NOTES and therefore belongs to NOSES [9].

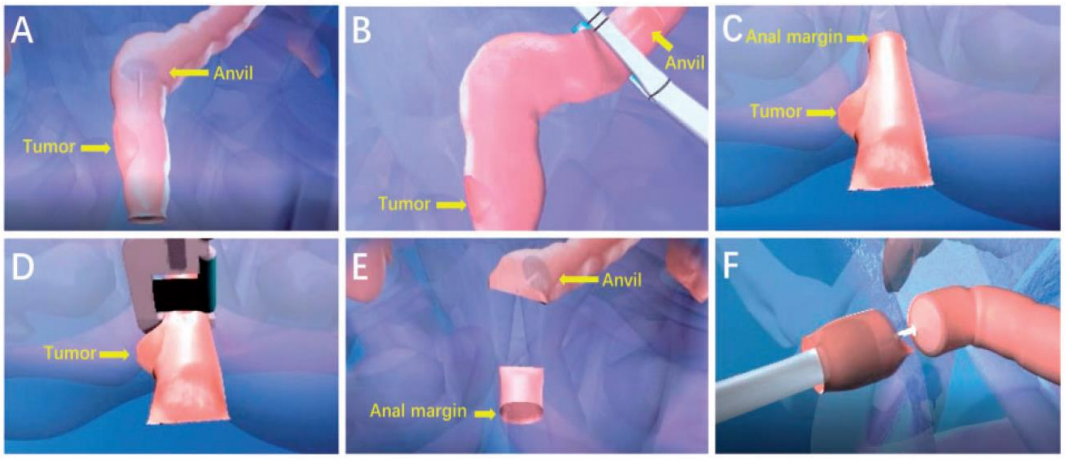


Figure 1. Transanal specimen eversion and extra-abdominal resection technique. (A) The anvil is introduced into the bowel lumen of rectum till to the proposed resection line of sigmoid colon. (B) Proximal bowel division is performed using linear stapler, leaving the anvil inside of sigmoid colon. (C) The rectal stump is everted out transanally. (D) The distal rectal resection is performed extraabdominally. (E) The rectal stump is delivered back to pelvic cavity. (F) The circular stapler is introduced transanally and an end-to-end anastomosis is performed

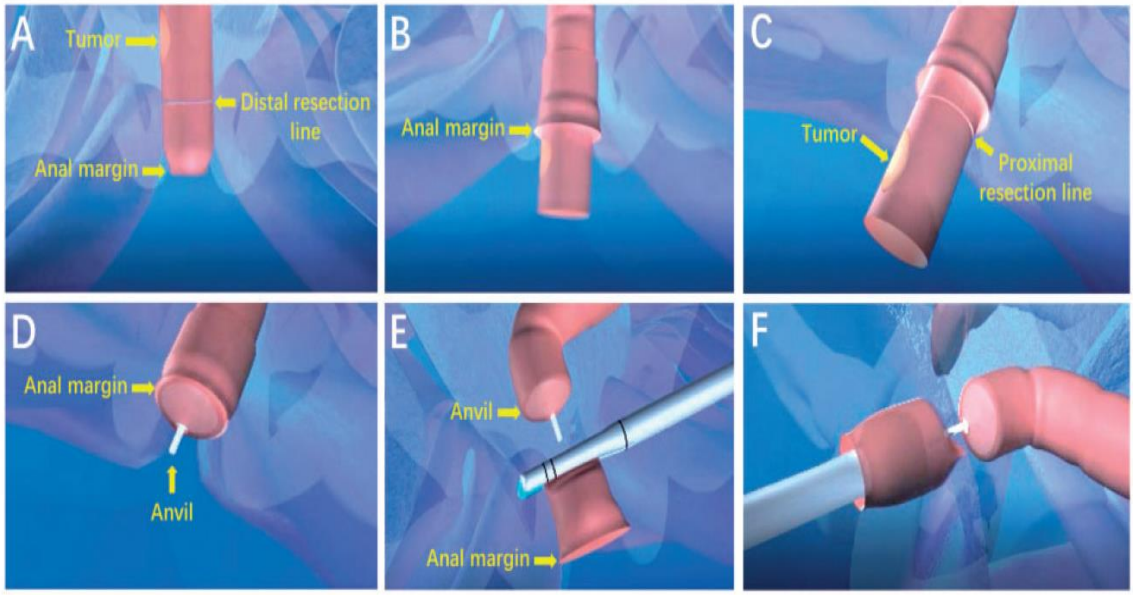


Figure 2. Translumenal specimen extraction and extra-abdominal resection technique. (A) The rectal wall is cut off at the distal resection line. (B) The distal side of specimen is gently pulled outside of the patient body transanally. (C) The proximal rectal resection is performed extraabdominally. (D) The anvil is introduced into the bowel lumen and closed with a purse string, and the sigmoid colon is delivered back to pelvic cavity. (E) The open rectal stump is closed by using linear stapler. (F) The circular stapling device is introduced into the rectum, and an end-to-end anastomosis is performed

To further refine the classification, ten different NOSES approaches, from NOSES I to NOSES X, were proposed for the treatment of colorectal neoplasms. Five approaches were used for rectal resection, and five approaches were used for colectomy (Table 1) [10].

Table (1): classification of NOSES for rectal and colon cancer

Abbreviation	Orifice	Tumor location
NOSES I	Anus	Lower rectum
NOSES II	Anus	Middle rectum
NOSES III	Vagina	Middle rectum
NOSES IV	Anus	Upper rectum/distal sigmoid colon
NOSES V	Vagina	Upper rectum/distal sigmoid colon
NOSES VI	Anus	Left colon/proximal sigmoid colon
NOSES VII	Vagina	Left colon/proximal sigmoid colon
NOSES VIII	Anus	Right Colon
NOSES IX	Anus	Total colon
NOSES X	vagina	Total colon

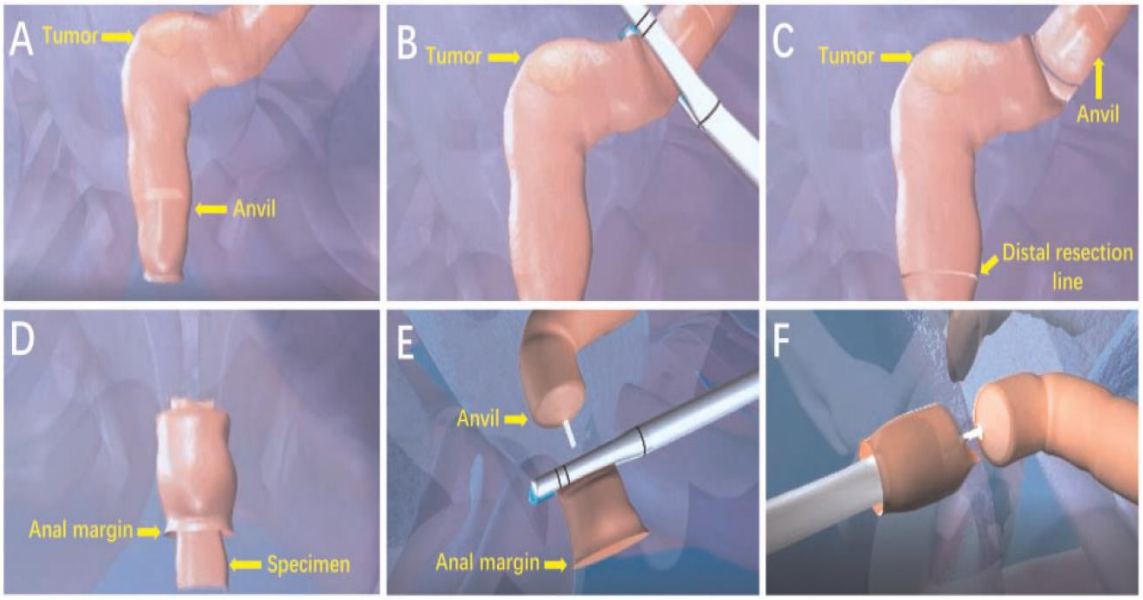


Figure 3. Intra-abdominal specimen resection and translumenal extraction technique. (A) The anvil is introduced into the bowel lumen of rectum till to the proposed resection line of sigmoid colon. (B) The proximal bowel division is performed using linear stapler, leaving the anvil inside of sigmoid colon. (C) The rectal wall is cut off at the distal resection line. (D) The specimen is extracted through the anus. (E) The open rectal stump is closed with a linear stapler. (F) The circular stapling device is introduced into the rectum, and an end-to-end anastomosis is performed

Indications:

According to existing literature and current clinical practice, the indication of NOSES directly contributes to the feasibility of this technique. Many requirements should be carefully considered before implementing NOSES in colorectal surgery. Firstly, experienced surgeons with expertise in conventional laparoscopic colorectal surgery are a prerequisite. A more experienced laparoscopic surgeon may achieve a shorter learning curve for NOSES. Secondly, the indication of NOSES should follow the indication of conventional laparoscopic colorectal resection. Locally advanced tumors, acute bowel obstruction, and perforation from cancer are not recommended for laparoscopy. Thirdly, NOSES also has specific indication requirements, including: the depth of tumor invasion should be T2 or T3; the CDmax of the specimen should be less than 3 cm for transanal-NOSES and 3–5 cm for transvaginal-NOSES; body mass index (BMI) should be less than 30 kg/m ^{2} for transanal-NOSES and less than 35 kg/m ^{2} for transvaginal NOSES. Fourthly, NOSES is also recommended for benign tumors, Tis, and T1 tumors when local excision is not indicated for whatever reason. Finally, transvaginal-NOSES is best avoided in young women who have not completed their family.[8].

Table(2): indication for NOSES [8].

Indication requirements	Transanal-NOSES	Transvaginal-NOSES
Basic requirements for surgeon	Surgeon should have experience of conventional laparoscopic colorectal surgery	Surgeon should have experience of conventional laparoscopic colorectal surgery
Basic requirements for disease	Non-locally advanced tumor; Non-locally advanced tumor; No bowel obstruction and perforation; No bowel obstruction and perforation; Benign tumor, Tis and T1 tumor when local excision is not indicated Benign tumor, Tis and T1 tumor when local excision is not indicated	Non-locally advanced tumor; Non-locally advanced tumor; No bowel obstruction and perforation; No bowel obstruction and perforation; Benign tumor, Tis and T1 tumor when local excision is not indicated Benign tumor, Tis and T1 tumor when local excision is not indicated
Tumor invasion depth	T2 or T3 most appropriate	T2 or T3 most appropriate
Maximum circumferential diameter of specimen	<3 cm most appropriate	3–5 cm most appropriate
Body mass index	<30 kg/m2 most appropriate	30-35 kg/m2 most appropriate
Other requirements	Anal stenosis and anal dysfunction should be not recommended	Young women who have not completed their family should be not recommended

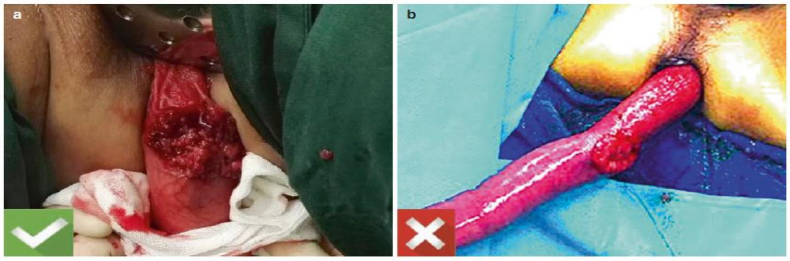


Fig. 1.8 Eversion of specimen. (a) Eversion of the lower rectal tumor; (b) Eversion of the upper rectal tumor

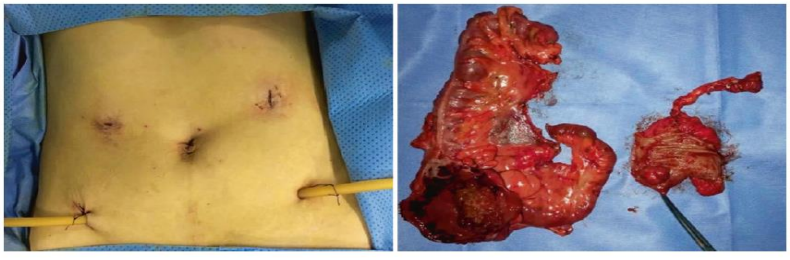


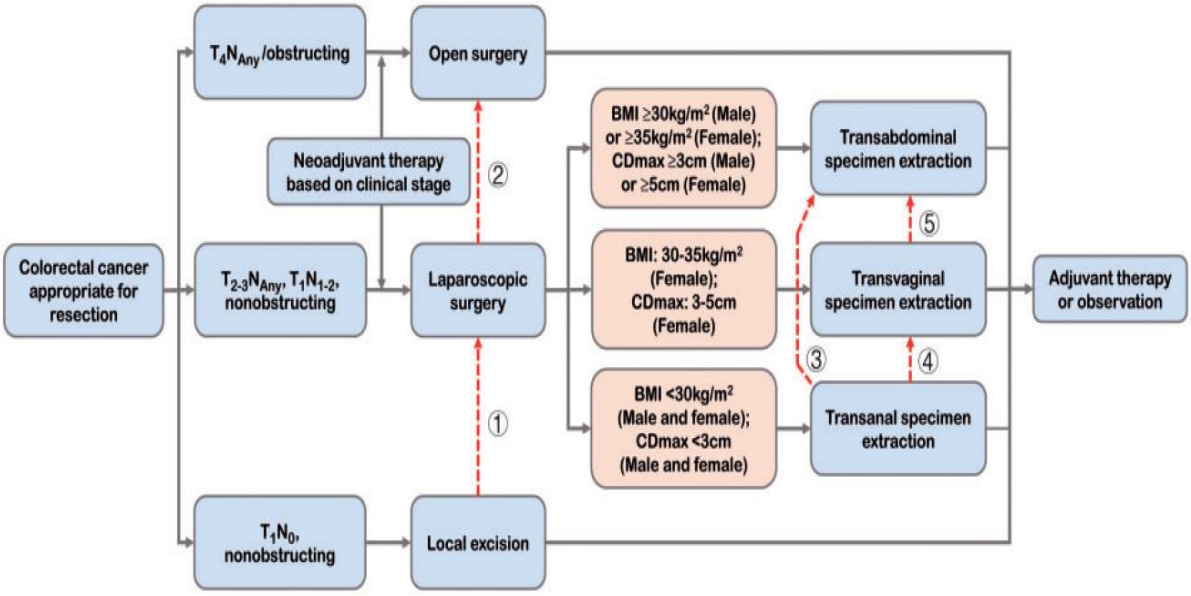
Fig. 1.9 Right hemicolectomy combined with rectal cancer resection

Technical Difficulty:

The requirements for technical skills in NOSES are demonstrably higher for both specimen extraction and digestive tract reconstruction compared to conventional laparoscopic surgery [11].

Bacteriological concerns have been raised because of the breach in peritoneal sterility in some NOSES procedures, such as enterotomy and completely intraperitoneal bowel reconstruction [6]. To address this, the consensus recommends prophylactic antibiotic administration, mechanical bowel preparation, intraoperative peritoneal irrigation, intraoperative transanal lavage with a large amount of povidone–iodine and normal saline, use of a transluminal wound retractor, and placement of pelvic or abdominal drains to reduce the bacterial load [12]. Recent studies have also shown that the risk of bacterial contamination after NOSES is not significantly higher compared with conventional laparoscopic surgery [12].

Major concerns exist regarding oncological safety in NOSES procedures for colorectal surgery. Tumor-related manipulation mainly arises from specimen extraction via a narrow natural orifice, with the potential for compromise in oncological safety [13]. In clinical practice, many techniques have been summarized to prevent iatrogenic dissemination of tumors, including the use of sterile protection devices when extracting specimens and avoiding over-pulling and compression of lesions during specimen extraction. Previous findings showed that transluminal specimen extraction provided the same degree of protection as transabdominal specimen extraction by comparison of peritoneal tumor cytology tests [13].



Fig(5): The flow chart for the selection of natural orifice specimen extraction surgery (NOSES). BMI: body mass index; CDmax: maximum circumferential diameter

1 If pathologic examination shows pT2 or pT1 with high-risk features including positive margins, lymphovascular invasion, poor differentiation or invasion into the
lower third of the submucosa (sm3 level), a more radical transabdominal resection is recommended.
2 If extensive adhesions are detected in the abdominal cavity, tumor is detected in locally advanced stage or an uncontrollable complication occurs during surgery,
the laparoscopic surgery should be converted to open surgery.
3 For male patient, if the specimen cannot be extracted transanally, transabdominal specimen extraction should be performed.
4 For female patient, if the specimen cannot be extracted transanally, transvaginal specimen extraction should be performed.
5 For female patient, if the specimen cannot be extracted transvaginally, transabdominal specimen extraction should be performed

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