

Short Commentary

Role of Natural Orifice Specimen Extraction Technique in Colorectal Cancer Surgery

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Introduction

Laparoscopic-Assisted Colectomy (LAC) aims to enhance oncological outcomes and functional preservation by leveraging magnification, precision, and an improved pelvic view. However, large-scale Randomized Controlled Trials (RCTs) have not demonstrated a clear long-term superiority of LAC over open surgery. Nevertheless, LAC has the undisputed advantage of minimizing abdominal wall trauma. To further enhance minimal invasiveness, techniques such as single-incision laparoscopic surgery and needlescopic surgery have been introduced. However, these approaches still necessitate a minilaparotomy for specimen extraction, which can compromise their minimally invasive nature due to associated complications and pain.

Natural Orifice Specimen Extraction (NOSE) represents a significant advancement in minimally invasive colorectal surgery, enabling transanal or transvaginal specimen retrieval (TASE or TVSE) without abdominal minilaparotomy. This technique has gained widespread adoption, and the number of publications on NOSE has increased in recent years. The key question remains: how does NOSE surgery (NOSES) benefit patients?

Indications

There is broad consensus that T4 tumors should be excluded from NOSES, as this procedure is technically demanding and involves longer operative times. Given the higher risk of tumor dissemination, excluding T4 tumors is deemed appropriate. A multicenter consensus suggests a maximum tumor diameter of 3 cm for TASE and 5 cm for TVSE to facilitate smooth extraction [1].

Currently, no reliable preoperative method exists to determine the feasibility of specimen extraction. Abandoning an attempted NOSE procedure and reinserting the specimen into the abdominal cavity should be avoided due to the risks of tumor cell and bacterial contamination, as well as potential damage to the extraction route. Many centers use Body Mass Index (BMI) as a criterion, with thresholds ranging from 28 to 35 kg/m². For TASE, a novel index has been proposed: patients with a rectal diameter-to-BMI ratio (measured via preoperative contrast barium enema) of less than 1.5 are at higher risk of extraction failure due to size mismatch. In TVSE, specimen removal is often challenging in patients without a history of vaginal delivery. Future research should aim to develop a reliable patient-specific assessment method.

Short-term outcomes

A recent meta-analysis of 3,432 patients demonstrated that NOSES is associated with reduced postoperative complications, less pain, and earlier oral intake initiation [2]. Although existing RCTs are limited in scale, additional reports support shorter hospital stays and improved cosmetic outcomes with NOSES. Intraoperative metrics, such as blood loss, number of harvested lymph nodes, and tumor margin distance, show no significant differences compared to LAC. However, operative time is generally longer for NOSES.

TVSE involves a posterior colpotomy, which has raised concerns regarding complications. A review by Ghezzi et al. encompassing 501 cases from 23 studies of TVSE for gynecologic tumors reported a 0.2% complication rate related to posterior colpotomy, which is lower than that associated with conven-

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tional minilaparotomy. Thus, NOSES has demonstrated superior short-term outcomes compared to LAC.

Long-term outcomes

Several RCTs have evaluated long-term outcomes, but none have shown significant differences between NOSES and LAC. However, these studies are single-center investigations with limited sample sizes and relatively short follow-up periods. Additionally, recurrence site data are insufficient, limiting their level of evidence. Large-scale, multicenter RCTs with extended follow-up are necessary.

A critical concern in NOSES is the potential for tumor cell dissemination during specimen extraction and intracorporeal anastomosis. Some studies have reported high cancer cell detection rates in abdominal lavage fluid after NOSES procedures. Additionally, histopathological analyses suggest that cancer cells may be present in the bowel lumen within 10 cm proximally and distally from the tumor. To avoid dissemination risk, experts advocate for standardized protocols, including mechanical bowel preparation, protective retractors at the rectum or vagina, specimen extraction in a retrieval bag, and thorough rectal washout or intraperitoneal lavage. While definitive evidence is lacking, these measures are considered effective in reducing contamination risk.

Impact of TASE on anorectal function

Wolthuis et al. conducted an RCT assessing postoperative anorectal function using manometry and found no significant differences in basal or maximum squeeze pressures between TASE and LAC at 6 weeks and 3 months postoperatively [3]. However, their analysis revealed a trend toward lower maximum squeeze pressures in the TASE group (preoperative: 293 vs. 300 mmHg; 6 weeks: 263 vs. 304 mmHg; 3 months: 279 vs. 335 mmHg). This suggests that a larger sample size might reveal a significant difference. Temporary anorectal dysfunction may be related to digital dilatation of the anal sphincter and specimen extraction. Many studies of Transanal Endoscopic Microsurgery (TEM), a technique that also dilates the anal sphincter, have also reported temporary loss of function. They have all concluded that, in the long term, function is restored to preoperative levels. Previous ultrasound studies have confirmed that significant anal dilatation produce muscle rupture. We should strictly refrain from excessive anal dilatation.

Sexual function and fertility after TVSE surgery

The impact of transvaginal specimen extraction on postoperative sexual function and fertility remains underexplored. While some studies report no adverse effects on sexual function, others indicate that 26% of patients experience dyspareunia. Variability in assessment methods may contribute to these discrepancies.

Regarding fertility, gynecologic studies suggest no significant differences in pregnancy rates between transvaginal and transabdominal surgery. Theoretical concerns about fertility impairment appear minimal.

Quality of life after NOSES

Limited studies have comprehensively evaluated Quality of Life (QOL) after NOSES. Most findings suggest that NOSES yields QOL outcomes comparable to or slightly superior to LAC. In a study using the Short Form-36 (SF-36) questionnaire, TASE was associated with superior scores in the domains of vitality, social functioning, role emotional, and mental health from 2 weeks to 2 months postoperatively. These findings align with RCTs comparing LAC to open surgery, suggesting a similar QOL advantage of TASE over LAC as LAC holds over open surgery. Notably, differences were more pronounced in mental health subscales than physical health, highlighting the importance of incorporating patient-reported outcomes in future comparative studies.

Future directions

In 2024, two meta-analyses from China reported favorable short-term outcomes with robotic-assisted NOSES. Robotic technology may help overcome technical challenges associated with NOSES, and the da Vinci® SP system holds promise for reducing port-site trauma in transanal and transvaginal procedures.

Additionally, Reduced-Port Surgery (RPS), including single-incision laparoscopic and needlescopic techniques, is being increasingly combined with NOSES to further minimize abdominal wall trauma. Takahashi et al. conducted a multicenter prospective study on RPS combined with TVSE, demonstrating its safety and superior analgesic outcomes [4]. Future advancements are expected to integrate RPS, NOSES, and robotic technology, tailoring minimally invasive approaches to individual patient characteristics.

Conclusion

NOSES is an innovative and promising approach to minimally invasive colorectal surgery, offering significant advantages in short-term outcomes. Standardization through international collaboration is essential for broader adoption. However, long-term oncological safety remains inadequately studied, necessitating high-quality RCTs to establish definitive conclusions. Continued advancements in robotic-assisted and reduced-port surgery will further refine NOSES, paving the way for the next evolution in minimally invasive colorectal surgery.

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