Review Article

Combined resections with colorectal surgeries and their combined natural orifice specimen extractions (NOSE): a clinical practice review

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Abstract: Compared to conventional ones, minimally invasive surgical techniques have come to the fore in many fields, especially in colorectal surgery (CRS), due to their benefits. These benefits are better postoperative outcomes, particularly due to less abdominal trauma and smaller incisions. However, postoperative pain, incisional hernia or infection, and poor cosmesis, due to abdominal incisions made for specimen extraction, reduce the positive results that can be achieved. The basic starting point of natural orifice specimen extraction (NOSE) surgery is to eliminate these incisions and their negative effects. NOSE has been performed more frequently, especially in CRS, with the increase in experience. In some of the patients, in addition to CRS, combined resections may be required for metastases, secondary primary malignancies, or benign diseases. However, in the literature, NOSE in combined resections with CRS is limited to case reports and it is controversial. We aimed to review the literature in terms of NOSE for combined resections with CRS, including preoperative details, technical feasibility, perioperative findings and postoperative results. When a total of 42 cases in the literature were examined; it was observed that organs such as liver, stomach, pancreas, gallbladder, endometrium and ovaries were removed synchronously in CRS combined with NOSE. No major complication due to NOSE was observed perioperatively. According to these available data, NOSE in combined organ resections with CRS may be a safe and effective alternative surgical technique. It is obvious that there is a need for studies on this subject in order to obtain more reliable results.

Keywords: Natural orifice specimen extraction (NOSE); colorectal surgery (CRS); multivisceral; synchronous; simultaneous

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Introduction

Recently, minimally invasive surgery (MIS) become almost the gold standard surgical approach in many centers due to its benefits compared to open surgery (1). Especially in colorectal surgery (CRS), it is stated that minimally invasive approach is associated with less postoperative pain, earlier bowel function recovery and shorter hospital stay (2). However, the approach requires an abdominal incision approximately 3–8 cm long for specimen extraction. Natural orifice specimen extraction (NOSE) is the technique in which the intra-abdominally resected specimen is extracted by opening a hollow organ that communicates with the outside of the body, including anus, vagina, mouth or ureter, and it aims to reduce postoperative pain, incisional hernia, wound infection and cosmetic concerns, due to abdominal incision (3,4). The indications of NOSE are similar to conventional minimally invasive colorectal resections (3). Although this technique reaches a high number of cases especially for CRS; recently, it has started to be used as a minimally invasive alternative for other organ resections, such as stomach, liver, and adrenal gland (4-6).

Since 1991, when it was first performed (7,8), CRS combined with NOSE has been successfully performed with increasing numbers in many centers (3). The studies have shown that while general complication rates are similar, NOSE is superior to transabdominal specimen extraction, especially in terms of postoperative pain, length of hospital stay and cosmesis, and this result have been very effective in these increasing numbers (9). In addition to the benefits of the technique, rare complications such as perioperative organ injury, anastomotic leakage, fecal incontinence, intra-abdominal contamination, dyspareunia and recurrence in the specimen extraction area can be seen (10). In order to minimize these complications, recommendations such as preoperative rectal and vaginal cleaning, selection of a natural orifice compatible with the specimen diameter, or extraction of the specimen in a protective sheath, were presented in the 'CRS combined with NOSE consensus report' in 2019 (3).

In some of the cases, in addition to CRS, combined resections may be required for metastases, secondary primary malignancies, or benign diseases, and it is controversial. PubMed and Google Scholar database were scanned in April 2022 and 812 potential articles were selected for research. After exclusions (non-English articles, Natural Orifice Transluminal Endoscopic Surgery (NOTES), and only colorectal resections with NOSE articles) and reference cross check, we collected 19 eligible studies including 42 case reports who included the study. These data were summarized in *Table 1*. In the present study, we aimed to review the literature of NOSE for combined resections with CRSs, from the perspective of choice of the natural orifice, technical feasibility, and postoperative results.

Colorectal carcinoma liver metastasis

Colorectal cancer is frequently seen in the world and it is also the leading cause of cancer-related deaths. The liver is the most common organ of colorectal cancer metastasis with a rate of 15–25%, and if possible, the only potentially curative treatment is surgical resection. Synchronous resections can be performed with comparable short and long term results as an alternative to "liver first approach" and "tumor first approach" (28). Currently, MIS is used effectively and safely for both colorectal and liver resections. MIS, which is the gold standard for CRS, has become a promising alternative for liver resections with the increasing number of cases. As a result, it has become inevitable to perform combined resections in colorectal carcinoma liver metastases that require technical challenges. Synchronous resections of colorectal cancer and liver metastases combined with NOSE are few in the literature and are limited to case reports (5,9,17,29). When all of these cases were examined, we saw that it is possible to use NOSE in relation to tumor diameter in combined resections that include minor hepatectomies (up to 2 segments of the liver) or metastasectomies. Due to the larger specimen diameters in major hepatectomies, it is unlikely to perform NOSE. In the colorectal cancer NOSE consensus, it is stated that the transanal route is the ideal orifice for extraction and the transvaginal route is the second alternative especially for more bulky specimens due to its elasticity (3). Additionally, the transvaginal route has a considerable limitation it can be performed only for females. It has been suggested that the orifice selection should be based on the maximum circumferential diameter of the specimen in the consensus report (the transanal route for tumor <3 cm and the transvaginal route for tumor 3–5 cm). In conclusion, we think that using similar specimen extraction route principles for combined resections in colorectal cancer liver metastasis, if both of the specimens' circumferential diameters are suitable, would be better in terms of technical feasibility and postoperative results.

Table 1 Clinicodemographics, perioperative findings and postoperative results of the cases

Patients	Author	Year	Country/ region	Gender	Age (years)	Operation	Specimen extraction	Colorectal pathology malignant/benign	Indication of combined resection malignant/benign	Protection sheath	Combined organ	Duration of surgery (min)	Blood loss (mL)	Complication	Length of hospital stay (d)
P1	Breitenstein *et al.* (11)	2006	Switzerland	F	59	Sigmoidectomy/hysterectomy	Transvaginal	Benign	Benign	0	Uterus	NA	NA	Colitis	15
P2	Breitenstein *et al.* (11)	2006	Switzerland	F	39	Sigmoidectomy/hysterectomy	Transvaginal	Benign	Benign	0	Uterus	NA	NA	0	9
P3	Lakshman *et al.* (12)	2006	Australia	F	42	Anterior resection/hysterectomy/bilateral salphingo-ooferectomy	Transvaginal	Benign	Benign	1	Uterus/ovary/salpings	240	200	0	3
P4	Lakshman *et al.* (12)	2006	Australia	F	46	Anterior resection/hysterectomy/bilateral salphingo-ooferectomy	Transvaginal	Malignant	Benign	1	Uterus/ovary/salpings	270	200	0	4
P5	Lakshman *et al.* (12)	2006	Australia	F	55	Anterior resection/hysterectomy/bilateral salphingo-ooferectomy	Transvaginal	Malignant	Malignant	1	Uterus/ovary/salpings	180	100	0	NA
P6	Dozois *et al.* (13)	2008	USA	F	53	Total colectomy/hysterectomy	Transvaginal	Malignant	Benign	0	Uterus	455	400	0	7
P7	Pickron *et al.* (14)	2009	USA	F	40	Ileocecal resection/hysterectomy/bilateral salphingo-ooferectomy	Transvaginal	Benign	Benign	0	Uterus/ovary/salpings	NA	NA	NA	NA
P8	García Flórez *et al.* (15)	2010	Spain	F	86	Anterior resection/right salphingo-ooferectomy	Transvaginal	Malignant	Malignant	1	Right salping/ovary	225	180	0	6
P9	Tan *et al.* (16)	2017	Singapore	F	74	Low anterior resection/hysterectomy/bilateral salphingo-ooferectomy	Transvaginal	Malignant	Benign	NA	Uterus/ovary/salpings	469	NA	0	5
P10	Karagul *et al.* (17)	2017	Turkey	NA	NA	NA	NA	NA	Benign	NA	Gallbladder	NA	NA	NA	NA
P11	Sumer *et al.* (18)	2018	Turkey	M	66	Subtotal colectomy/gastrectomy	Transanal	Malignant	Malignant	0	Stomach	520	250	0	17
P12	Wang *et al.* (19)	2020	China	M	68	Anterior resection/gastrectomy	Transanal	Malignant	Malignant	1	Stomach	355	50	0	NA
P13	Gundogan *et al.* (9)	2021	Turkey	NA	NA	Right hemicolectomy/cholesystectomy	Transanal	Malignant	Benign	NA	Gallbladder	NA	NA	NA	NA
P14	Gundogan *et al.* (9)	2021	Turkey	NA	NA	Right hemicolectomy/liver metastatectomy	Transanal	Malignant	Malignant	NA	Liver	NA	NA	NA	NA
P15	Cheng *et al.* (20)	2020	Taiwan	NA	NA	Right hemicolectomy/NA	Transanal	NA	NA	NA	NA	NA	NA	NA	NA
P16	Cheng *et al.* (20)	2020	Taiwan	NA	NA	Right hemicolectomy/NA	Transanal	NA	NA	NA	NA	NA	NA	NA	NA
P17	Efetov *et al.* (21)	2021	Russia	F	NA	Anterior resection/right salphingo-ooferectomy	Transanal	Malignant	Benign	NA	Right salping/ovary	NA	NA	NA	NA
P18	Wang *et al.* (22)	2021	China	M	65	Anterior resection/gastrectomy	Transanal	Malignant	Malignant	NA	Stomach	NA	NA	NA	NA
P19	Meng *et al.* (23)	2021	China	F	37	Right hemicolectomy/pancreaticoduodenectomy	Transvaginal	Malignant	Malignant	1	Pancreas-duodenum	470	130	0	7
P20	Lendzion and Gilmore (24)	2021	Australia	F	74	Right hemicolectomy/hysterectomy	Transvaginal	Malignant	Benign	1	Uterus	240	NA	0	5
P21	Lendzion and Gilmore (24)	2021	Australia	F	45	Right hemicolectomy/hysterectomy	Transvaginal	Malignant	NA	1	Uterus	270	NA	0	3
P22	Lendzion and Gilmore (24)	2021	Australia	F	75	Anterior resection/right hemicolectomy/bilateral salphingo-ooferectomy	Transvaginal	Malignant	Malignant	1	Peritoneum/omentum/ bilateral ovaries/salpings	510	NA	0	4
P23–34	Chen *et al.* (25)	2021	Australia	NA	NA	Colorectal resections/cholecystectomy/ appendectomy/hysterectomy/salphingo-oofrectomy	Transanal/ Transvaginal	Benign	NA	1	4 gallbladders; 2 appendix; 5 ovaries/salphings; 1 uterus	NA	NA	NA	NA
P35	Aydin *et al.* (5)	2022	Turkey	F	70	Anterior resection/liver metastasectomy	Transvaginal	Malignant	Malignant	1	Liver	540	0	0	5
P36	Aydin *et al.* (5)	2022	Turkey	F	45	Anterior resection/liver metastasectomy	Transanal	Malignant	Malignant	1	Liver	420	0	Pleural effusion	8
P37	Aydin *et al.* (5)	2022	Turkey	M	58	Anterior resection/liver metastasectomy	Transanal	Malignant	Malignant	1	Liver	390	50	Anastomosis leak	39
P38	Aydin *et al.* (5)	2022	Turkey	F	73	Anterior resection/liver metastasectomy	Transvaginal	Malignant	Malignant	1	Liver	390	60	0	8
P39	Aydin *et al.* (5)	2022	Turkey	F	44	Anterior resection/liver metastasectomy	Transanal	Malignant	Malignant	1	Liver	300	0	0	9
P40	Gonçalves *et al.* (26)	2022	Portugal	F	45	Sigmoidectomy/hysterectomy	Transanal	Benign	Benign	0	Uterus	NA	NA	0	NA
P41	Drestadt *et al.* (27)	2020	Germany	NA	NA	Anterior resection/cholecystectomy	Transvaginal	Benign	Benign	0	Gallbladder	NA	NA	NA	NA
P42	Drestadt *et al.* (27)	2020	Germany	NA	NA	Anterior resection/liver resection	Transvaginal	Benign	NA	0	Liver	NA	NA	NA	NA

F, female; NA, not available; M, male.

Secondary primary gastrointestinal malignancies or locally advanced colorectal tumors

Multiple primary carcinomas are defined as more than one cancer in the same individual, these may be either synchronous or metachronous (22). The localization of these tumors can be in organs such as colon, rectum, small intestine, stomach, and pancreas. Sometimes a synchronous tumor may also be present in different parts of the colon (24). Although secondary primary gastrointestinal cancers are extremely rare, the potentially curative treatment is surgical resection. Conventional surgery of synchronous gastrointestinal tumors requires large incisions and so, the first choice is to perform both organ resections with a minimally invasive approach. Today, the MIS comes to the fore in all kinds of gastrointestinal resections. There are also case reports showing that NOSE can be used for multivisceral resections in locally advanced colorectal tumors that have invaded other organs, although it is not recommended in the NOSE consensus for colorectal cancers (23). It is clear that combining MIS with NOSE will further improve postoperative outcomes. When the literature is reviewed, MIS combined with NOSE for synchronous gastrointestinal tumors is limited to a few case reports (18,19,22-24). The majority of cases had secondary primary gastric cancers. When these cases were examined, we saw that NOSE can be used effectively and safely in synchronous tumor resections or multivisceral resections of locally advanced tumors. It is noteworthy that large samples such as combined gastrectomy can also be obtained using the transanal route. In addition, there is a study showing the feasibility of NOSE in combined resections for additional organ diseases in the surgical treatment of benign colorectal diseases (25). In conclusion, the absence of any major complications in the early or late postoperative period is highly positive and promising that this type of multivisceral resections and NOSE can be combined in experienced hands.

Gynecological resections

The minimally invasive approach in gynecological surgery has recently come to the fore. The vagina, as an access to the abdominal cavity, has been used by gynecologists for a very long time. Especially after hysterectomy, the open vaginal cuff, which is large enough, has encouraged surgeons to perform the main specimen extraction transvaginally over time. So as a result, NOSE has almost become the standard approach in minimally invasive gynecological surgery. With the exception of patient disapproval, virginity, or pelvic anomalies, transvaginal specimen extraction has become almost routine (9). The transvaginal route is more suitable for the extraction of larger specimens, due to its elasticity, than the transanal route. Although rectovaginal fistula, pelvic abscess, and bladder dysfunction are major complications associated with transvaginal route usage, these are quite rare (30). In the literature, gynecological resections combined with CRSs are limited to case reports (11-16,21,26). The most common gynecological indications for combined CRSs are benign or malignant gynecological tumors (ovaries, endometrium and cervix) and endometriosis. Especially colorectal implants of endometriosis are one of the most important reasons for the need for combined resections. Perhaps the point that should be emphasized here is; since resection of other system organs will be required in these operations, multidisciplinary teamwork (gynecologist and gastrointestinal surgeon) may be required. In conclusion, when the cases in the literature were examined, transvaginal specimen extraction has become the standard approach for gynecologists interested in MIS, and this method has been used effectively and safely, when additional CRSs are required.

Others

There are case reports of other organ resections combined with CRSs in the literature, such as cholecystectomy, appendectomy, lymphadenectomy (9,17,20,25,27). When the perioperative findings and postoperative results were examined, it was seen that the resected specimens of these organs were mostly benign, and NOSE was quite practical and effective for such cases.

Conclusions

NOSE in CRSs is a new and effective approach in current surgery. In cases requiring additional organ resection combined with colorectal diseases, NOSE is technically feasible in selected patients by experienced surgeons. To minimize the complications, we think consensus recommendations should be followed as similar to single organ resections. It is certain that new studies on this subject are needed in order to obtain clearer results.

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Footnote

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References

1. Zengin A, Bag YM, Aydin MC, et al. Laparoscopic gastric cancer surgery for 65 age and elderly patients: A single center experience. J Exp Clin Med 2022;39:434-7.
2. COLOR Study Group. COLOR: a randomized clinical trial comparing laparoscopic and open resection for colon cancer. Dig Surg 2000;17:617-22.
3. Guan X, Liu Z, Longo A, et al. International consensus on natural orifice specimen extraction surgery (NOSES) for colorectal cancer. Gastroenterol Rep (Oxf) 2019;7:24-31.
4. Sumer F, Bag YM, Aydin MC, et al. Mini-laparoscopic adrenalectomy with transgastric specimen extraction. Updates Surg 2021;73:1487-91.
5. Aydin MC, Bag YM, Gunes O, et al. Comparison of Natural Orifice Versus Transabdominal Specimen Extraction Following Laparoscopic Minor Hepatectomy. Indian J Surg 2022;84:288-93.
6. Sumer F, Gundogan E, Kaplan K, et al. Transvaginal Specimen Extraction After Laparoscopic Gastrectomy for Tumors. Surg Laparosc Endosc Percutan Tech 2021;32:247-51.
7. Stewart EA, Liau AS, Friedman AJ. Operative laparoscopy followed by colpotomy for resecting a colonic leiomyosarcoma. A case report. J Reprod Med 1991;36:883-4.
8. Nezhat F, Nezhat C, Pennington E, et al. Laparoscopic segmental resection for infiltrating endometriosis of the rectosigmoid colon: a preliminary report. Surg Laparosc Endosc 1992;2:212-6.
9. Gundogan E, Kayaalp C, Gokler C, et al. Natural orifice specimen extraction versus transabdominal extraction in laparoscopic right hemicolectomy. Cir Cir 2021;89:326-33.
10. Zengin A, Okut G, Turgut E. Complications and management of natural orifice specimen extraction in colorectal cancer: a narrative review. Ann Laparosc Endosc Surg 2022;7:24.
11. Breitenstein S, Dedes KJ, Bramkamp M, et al. Synchronous laparoscopic sigmoid resection and hysterectomy with transvaginal specimen removal. J Laparoendosc Adv Surg Tech A 2006;16:286-9.
12. Lakshman N, Chang R, Ho Y. Laparoscopic combined rectal anterior resection and total hysterectomy with bilateral salpingo-oophorectomy. Tech Coloproctol 2006;10:350-2.
13. Dozois EJ, Larson DW, Dowdy SC, et al. Transvaginal colonic extraction following combined hysterectomy and laparoscopic total colectomy: a natural orifice approach. Tech Coloproctol 2008;12:251-4.
14. Pickron TB, Cooper J. Laparoscopic hysterectomy and ileocecal resection for treatment of endometriosis. JSLS 2009;13:224-5.
15. García Flórez LJ, Argüelles J, Quijada B, et al. Transvaginal specimen extraction in a laparoscopic anterior resection of a sigmoid colon neoplasia with en bloc right salpingo-oophorectomy. Tech Coloproctol 2010;14:161-3.
16. Tan CN, Chong CS, Fong YF, et al. Laparoscopic

Anterior Resection with Transvaginal Specimen Extraction (TVSE) for Colorectal Cancer and Concomitant Total Hysterectomy and Bilateral Salpingo-Oophrectomy (THBSO): A Technical Description. Ann Surg Oncol 2017;24:441.
17. Karagul S, Kayaalp C, Sumer F, et al. Success rate of natural orifice specimen extraction after laparoscopic colorectal resections. Tech Coloproctol 2017;21:295-300.
18. Sumer F, Karakas S, Gundogan E, et al. Totally laparoscopic resection and extraction of specimens via transanal route in synchronous colon and gastric cancer. G Chir 2018;39:82-6.
19. Wang YL, Huang R, Wu HY, et al. Totally laparoscopic resection and natural orifice specimen extraction surgery (NOSES) in synchronous rectal and gastric cancer. Gastroenterol Rep (Oxf) 2019;8:79-81.
20. Cheng CC, Hsu YR, Chern YJ, et al. Minimally invasive right colectomy with transrectal natural orifice extraction: could this be the next step forward? Tech Coloproctol 2020;24:1197-205.
21. Efetov SK, E Kitsenko Y, S Rebrova A, et al. Transanal extraction of two specimens after laparoscopic anterior resection with extended D3 lymph node dissection and unilateral salpingo-oophorectomy (NOSES) - a video vignette. Colorectal Dis 2021;23:560-1.
22. Wang D, Fan K, Yan Y, et al. Totally laparoscopic subtotal gastrectomy and radical anterior resection for synchronous gastric and rectal cancer with natural orifice specimen extraction (NOSE) - a video vignette. Colorectal Dis 2020;22:2361.
23. Meng H, Xu H, Wang X, et al. Total laparoscopic en bloc right hemicolectomy and pancreaticoduodenectomy with transvaginal specimen extraction for locally advanced right colon cancer: a case report. Gland Surg 2021;10:1780-5.
24. Lendzion RJ, Gilmore AJ. Laparoscopic right hemicolectomy with intracorporeal anastomosis and natural orifice surgery extraction/minimal extraction site surgery in the obese. ANZ J Surg 2021;91:1180-4.
25. Chen MZ, Cartmill J, Gilmore A. Natural orifice specimen extraction for colorectal surgery: Early adoption in a Western population. Colorectal Dis 2021;23:937-43.
26. Gonçalves N, Antunes A, Oliveira O, et al. Sigmoid endometriosis: laparoscopic natural orifice specimen extraction sigmoidectomy and hysterectomy - A video vignette. Colorectal Dis 2022;24:536-7.
27. Derstadt M, Thomaidis P, Seefeldt CS, et al. Transvaginal hybrid-NOTES vs. traditional laparoscopic sigmoid resection for diverticulitis: a short-term comparative study. Sci Rep 2020;10:22321.
28. Moris D, Tsilimigras DI, Machairas N, et al. Laparoscopic synchronous resection of colorectal cancer and liver metastases: A systematic review. J Surg Oncol 2019;119:30-9.
29. Gundogan E, Kayaalp C, Sansal M, et al. Transanal specimen extraction following combined laparoscopic colectomy and liver resection. Cir Cir 2020;88:120-3.
30. Ghezzi F, Cromi A, Ciravolo G, et al. A new laparoscopic-transvaginal technique for rectosigmoid resection in patients with endometriosis. Fertil Steril 2008;90:1964-8.

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