ORIGINAL ARTICLE

Natural orifice specimen extraction versus transabdominal extraction in laparoscopic right hemicolectomy

Extracción de muestras de orificio natural versus extracción transabdominal después de una hemicolectomía derecha totalmente laparoscópica

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Abstract

Introduction: *Natural orifice specimen extraction (NOSE) for colorectal resections, which further enhance the advantages of minimally invasive surgery, are being used increasingly more often. In this study, we aimed to compare NOSE and transabdominal specimen extraction methods in cases of totally laparoscopic right colon resections.* **Methods:** *Data of 52 patients who underwent laparoscopic right colon surgery between 2013 and 2019 were included in the study. Transabdominal specimen removal was done in 35 patients, while 17 patients underwent NOSE. Demographic data, operative findings, pathological results, and follow-up data were compared.* **Results:** *Female (94% vs. 28%, p = 0.0001), co-morbid (76% vs. 40%, p = 0.01), and previous abdominal surgery history (75% vs. 23%, p = 0.001) were higher in the NOSE group. All the other pre-operative features of the groups were comparable. Intraoperative blood loss, operation time, and complication rates were similar in both groups. Post-operative visual analog scale (2.8 ± 1.2 vs. 4.5 ± 2.4, p = 0.001) and cosmetic scores were better in the NOSE group (10 vs. 7, p = 0.0001). Oncologic results were similar after a mean follow-up of 27.4 ± 20.5 (1-77) months.* **Conclusion:** *The NOSE method following laparoscopic right colon resection was a more advantageous method in terms of cosmetics and post-operative pain than transabdominal specimen extraction.*

Key words: *Natural orifice specimen extraction. Colon cancer. Minimally invasive surgery. Natural orifice surgery. Laparoscopic colorectal.*

Resumen

Introducción: *La extracción de muestras de orificio natural (NOSE) para resecciones colorrectales, que mejoran aún más las ventajas de la cirugía mínimamente invasiva, se utilizan cada vez con mayor frecuencia. En este estudio, nuestro objetivo fue comparar los métodos de extracción de muestras de nariz y transabdominales en casos de resecciones de colon derecho totalmente laparoscópicas.* **Métodos:** *Se incluyeron datos de 52 pacientes que se sometieron a cirugía laparoscópica de colon derecho entre 2013 y 2019. La extracción de muestras transabdominales se realizó en 35 pacientes, mientras que 17 pacientes fueron sometidos a NOSE. Se compararon datos demográficos, hallazgos operativos, resultados patológicos y datos de seguimiento.* **Resultados:** *Las mujeres (94% frente a 28%, p = 0,0001), comórbidas (76% frente a 40%, p = 0,01) y antecedentes de cirugía abdominal previa (75% frente a 23%, p = 0,001) fueron más altas en el grupo NOSE . Todas las otras características preoperatorias de los grupos fueron comparables. La pérdida de sangre intraoperatoria, el tiempo de*

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operación y las tasas de complicaciones fueron similares en ambos grupos. La escala VAS postoperatoria (2.8 ± 1.2 vs. 4.5 ± 2.4, p = 0.001) y los puntajes cosméticos fueron mejores en el grupo NOSE (10 vs. 7, p = 0.0001). Los resultados oncológicos fueron similares después de un seguimiento medio de 27.4 ± 20.5 (1-77) meses. **Conclusión:** *El método NOSE después de la resección laparoscópica del colon derecho fue un método más ventajoso en términos de cosméticos y dolor postoperatorio que la extracción de muestras transabdominales.*

Palabras clave: *NOSE. Cáncer de colon. Cirugía mínimamente invasiva. Cirugía de orificio natural. Colorrectal laparoscópico.*

Introduction

Since 1991, laparoscopic colon resection has been increasingly used for benign and malignant diseases. Although dissection, resection, and anastomosis can be performed laparoscopically, an abdominal incision is usually needed for specimen extraction resulting in incision-related morbidity and pain, reducing post-operative patient satisfaction, and increasing the cost significantly[1]. Natural orifice transluminal endoscopic surgery (NOTES) and single incision laparoscopic surgery have been proposed to reduce this disadvantage during the development of minimally invasive surgery. Although the NOTES method has not attracted much interest because of the advanced equipment and high skill requirements, natural orifice specimen extraction (NOSE), which is used as a bridge method, has attracted much interest. This method was first used in 1993 with laparoscopic cholecystectomy, and from 2007 onward, it has been used for laparoscopic right hemicolectomy[2].

Our aim in this study was to compare NOSE and the transabdominal specimen extraction method after laparoscopic right colon resection.

Methods

This study was approved by the Inonu University Ethical committee (2017/27-5) and registered by www.clinicaltrials.gov (NCT03487289). We included 52 patients who underwent totally laparoscopic right colon resection between January 2013 and March 2019 in our clinic. Demographic data, operative findings, pathologic results, and follow-up data were collected prospectively in a databank and analyzed (prospective cross-sectional case series). Seventeen patients underwent NOSE and 35 patients underwent transabdominal specimen extraction. The choice of specimen extraction method was made based on patient preference or technical suitability. After giving detailed information about the disease and the surgical techniques, the patient's operation preferences were asked and a detailed consent form was obtained. Technical suitability for NOSE method selection was applied according to the perioperative findings (tumor size, vaginal, or transanal access suitability). For transvaginal extraction, female patients with a tumor size < 9 cm (3) and available vaginal access (no vaginal atresia, no virginity) were the indications. For transanal extraction, intraluminal lesions (no visible mass at laparoscopy) were our indication. Patient age, gender, body mass index (BMI), comorbid diseases, history of prior abdominal surgery, length of incision, duration of operation, amount of bleeding, perioperative and post-operative complications, length of stay, pathology, tumor size, number of retrieved lymph nodes, number of positive lymph nodes, tumor stage, visual analog scale (VAS) for pain score, cosmetic score, long-term complications, presence of recurrence, disease-free survival, and general survival parameters were evaluated.

Tumor size was taken as the largest size indicated in the pathological reports. In the pre-operative period, patients were informed for the post-operative pain scoring (VAS scores) as the highest pain score was 10 and the lowest pain score was 1. The VAS score was collected without analgesic support in the morning for the first 3 days postoperatively. Our analgesic protocol was, post-operative pethidine, followed by paracetamol or dexketoprofen if necessary. Cosmetic score grading was performed on a scale with the best score being 10, the worst score 1. Patients were contacted by telephone during the follow-up period and their latest information, incisional hernia presence, and cosmetic score information were obtained. Descriptive statistics were performed for all data and reported as mean values and percentages or median and range when heterogeneous distributions. Continuous variables were analyzed by unpaired t-tests or the Mann–Whitney U test. Categorical variables were analyzed by Chi-square and Fisher's exact test. Statistical significance was taken as $p < 0.05$.

Surgical technique

Patients were operated at lithotomy in the Trendelenburg and right lateral up position. Surgery was

performed with three 12 mm and one 5 mm trocars under 12 mmHg pressure. After mesocolic dissection, the ileocolic artery was divided and the hepatic flexure of the colon was mobilized. Terminal ileum and transverse colon were transected with a laparoscopic stapler (Ethicon or Covidien, 60 mm–blue). Isoperistaltic side to side anastomosis was then performed between the ileum and the transverse colon with a laparoscopic stapler (Ethicon or Covidien, 60 mm–blue). In all patients, ileotransversostomy anastomosis was performed intracorporeally. The common stapler entry was closed intracorporeally with 3/0 polypropylene running sutures as two rows. Then, vaginal cleaning with 10% povidone-iodine was performed for the transvaginal group and a posterior colpotomy was performed transvaginally under laparoscopic view. The specimen was placed into an endobag and transvaginally taken out of the abdomen with the ileum segment coming out first[3]. The vaginal opening was closed by intracorporeally or transvaginally in all cases. For the transanal group, the portion of the closed transverse colon stump was opened after the resection and the specimen was removed from this opening with the aid of a colonoscope (transcolonic access)[4]. In the transabdominal extraction group, the suprapubic incision was preferred and the specimen was removed through an approximately 5-8 cm incision (the length of the incision was adjusted according to the size of the specimen). In two patients of the transabdominal extraction group, right lower quadrant and midline incisions were used depending on the previous abdominal surgery scars.

Results

Among the patients included in the study, 26 (50%) were men with a mean age of 56.5 ± 14.5. In the NOSE group, the number of women, co-morbidity, and a history of previous operations were found to be more frequent, while no difference was found for any other demographic data (Table 1).

Among the total 52 surgical procedures, 50 (96.1%) were right hemicolectomies and two were an extended right hemicolectomy. There were combined resections in six of the patients. One patient had a synchronous proximal gastric tumor with a right colon tumor and total gastrectomy was added to the laparoscopic right hemicolectomy. Segmental small bowel resection with a right hemicolectomy was performed in two patients with a T4 tumor in the right colon that adherent to small bowel. Segmental sigmoid resection with a right hemicolectomy was performed in one patient with Crohn's disease in the right colon that adherent to sigmoid. Right hemicolectomy and cholecystectomy

Table 1. Pre-operative parameters

Parameters	Nose (n: 17)	Transabdominal (n: 35)	p
Gender (Female/Male)	16/1	10/25	0.0001
Age			
Mean SD	58.9 ± 14.4	55.3 ± 14.5	0.40
Median (Range)	62 (19-76)	56 (20-77)	
BMI			0.10
Mean SD	29.0 ± 5.7 kg/m^2	26.6 ± 4.5 kg/m^2	
Median (Range)	27.6 (19-40.5)	25.3 (20.4-36.6)	
Patients with comorbidity	13 (76%)	14 (40%)	0.01
Diabetes mellitus	4 (23%)	6 (17%)	
Hypertension	9 (53%)	6 (17%)	
Chronic obstructive pulmonary disease	1 (6%)	2 (5%)	
Cardiac disease	0 (0%)	2 (5%)	
Goiter	1 (6%)	2 (5%)	
Peripheral vascular disease	1 (6%)	2 (5%)	
Patients with prior abdominal surgery	12 (75%)	8 (23%)	0.001
Gynecologic operation	3^	2	
Open inguinal hernia repair	1	1	
Open cholecystectomy	3	0	
Open nephrectomy	0	1	
Open Meckel's diverticulitis	0	1	
Open appendectomy	5*	2	
Open pancreaticoduodenectomy	1^	0	
Laparoscopic cholecystectomy	1*	0	
Laparoscopic colectomy	1	1	
Location			
Appendix	1 (6%)	2 (5%)	1.00
Cecum	8 (47%)	11 (31%)	0.36
Ascending colon	5 (29%)	16 (45%)	0.36
Hepatic flexure	3 (18%)	6 (17%)	1.00

BMI: body mass ındex, *laparoscopic cholecystectomy and appendectomy in the same patient. ^Gynecologic operation and pancreaticoduodenectomy in the same patient.

Table 2. Intraoperative and post-operative outcomes

Parameters	Nose (n: 17)	Transabdominal (n: 35)	p
Duration of surgery			0.48
Mean SD	262 ± 93 min	241 ± 102 min	
Median (Range)	300 (120-420)	240 (110-600)	
Intraoperative bleeding			
Mean SD	79 ± 55 ml	108 ± 150 ml	0.59
Median (Range)	75 (5-200)	55 (5-800)	
Combined resections	2 (11%)	4 (11%)	1.00
Incision length			
Mean SD	0	7.0 ± 1.6 cm	0.0001
Median (Range)	0	7 (5-12)	
Intraoperative complications	1 (6%)	4 (11%)	1.00
Bladder rupture during the extraction	1	0	
Terminal ileum ischemia	0	1	
Colon ischemia	0	2	
Duodenal injury	0	1	
Post-operative complications	3 (17%)	7 (20%)	1.00
Intraabdominal complications	1	3	
Bladder fistula	1	0	
Abscess * #	0	2	
Stapler line leak*	0	2	
Anastomotic leakage#	0	1	
Extraabdominal complications	2	2	1.00
Peripheral neuropathy	1	0	
Hyponatremia	1	0	
Pleural effusion	0	2	
Abdominal wall related complications	0	4	0.29
Wound infection#	0	3	
Incisional hernia*	0	1	
Visual analog scale score (total)			
Mean SD	2.8 ± 1.2	4.5 ± 2.4	0.001
Median (Range)	3 (1-6)	5 (0-10)	
Visual analog scale score on day 1			
Mean SD	3.7 ± 1.2	6.2 ± 2.4	0.01
Median (Range)	3.5 (3-6)	6 (1-10)	
Visual analog scale score on day 2			
Mean SD	2.7 ± 0.6	4.2 ± 2.1	0.06
Median (Range)	3 (2-4)	4.5 (0-8)	
Visual analog scale score on day 3			
Mean SD	1.8 ± 1.0	3.2 ± 1.6	0.03
Median (Range)	1.5 (1-4)	3 (0-6)	
Length of hospital stay (days)			
Mean SD	4.9 ± 1.6	6.1 ± 3.3	0.16
Median (Range)	5 (3-8)	5 (3-22)	
Cosmetic score			
Mean SD	9.0 ± 1.8	6.3 ± 1.6	0.0001
Median (Range)	10 (3-10)	7 (1-9)	
Perioperative mortality	0 (0%)	2 (5%)	1.00
Recurrence^	1 (12%)	0 (0%)	0.33
Duration of follow-up			0.07
Mean SD	34.7 ± 25.3 months	23.9 ± 16.6 months	
Median (Range)	25 (4-77)	23 (1-72)	

*Abdominal abscess, incisional hernia, and stapler line leak in the same patient. #Anastomotic leakage, abdominal abscess, and wound infection in the same two patients. ^Statistics were made among tumor patients.

were performed in a case with symptomatic gall bladder stones. Right hemicolectomy and metastasectomy were performed in a case with liver metastasis (Table 2).

NOSE was intended for 23 patients but in six patients, it was failed, and the procedure was completed with transabdominal extractions. In five of these patients, the size of the specimen was not suitable for NOSE, whereas, in one patient, NOSE failed because of insufficient vaginal exploration due to the pelvic anomaly. NOSE following right hemicolectomy failed in 26% of the selected patients and the overall success rate was 32.7%. There were 26 female patients and NOSE was successful in 16 (61.5%). Contrary, only in two male patients we achieved the NOSE (3.8%) following laparoscopic right hemicolectomies ($p < 0.001$).

The mean operating time was 249 ± 100 min and mean intraoperative bleeding was 102 ± 135 ml.

Perioperative complications were seen in five patients (9.6%). One of these patients suffered a bladder perforation during transvaginal extraction and the ruptured area was repaired laparoscopically. One patient had a duodenal injury and was repaired laparoscopically. After the right hemicolectomy in one patient, a 20 cm small bowel segment resection was included because of ileal segment ischemia. In another two patients, transverse colon ischemia was detected after ileocolic anastomosis and the anastomosis was renewed laparoscopically after partial colonic resection.

Transanal extraction was limited only two highly selected cases both had no major macroscopic pathologies of the caecum (microscopic positive surgical margin following an appendectomy and Crohn's disease). Therefore, both extractions through a transcolonoscopic route could be accomplished without any difficulty. The patients who converted from the NOSE to the trans-abdominal extraction (failed NOSE cases), no vaginal cuff opening was done. Specimen extraction was done in a bag and there was no trouble or excessive strain while pulling the specimen out.

Post-operative complications were seen in ten patients (19.2%). Six of them were medically treated without requiring further intervention (Table 2). Two patients with anastomosis leaks were re-operated and end ileostomies were done. In one patient, leakage from the transverse colon stump was also required an end ileostomy. In the patient with bladder rupture, a vesicovaginal fistula developed during the follow-up period and she was re-operated 1 month after the first operation and the fistula was repaired successfully. No patients had vaginal suture line dehiscence.

When the two groups were compared, there was no difference in terms of the operation time, blood loss, or intraoperative and post-operative complications. There was no surgical site infection in the NOSE group, while there were surgical site infections in three patients (8.5%) in the transabdominal specimen extraction group. Post-operative first, 3rd day's and total VAS scores were lower in the NOSE group (p = 0.001, p = 0.01, p = 0.03). A significant difference was found between the cosmetic scores of the patients after an average of 27 months of post-operative follow-up (Table 2).

Forty-one (79%) patients had malign pathology (38 adenocarcinoma, one neuroendocrine tumor, and two mixed adenoneuroendocrine carcinoma). There were benign pathologies in eight patients (four Crohn's disease, one angiodysplasia, one ileocecal invagination, one adenoma, and one lipoma) and in one case the pathology report cannot be accessed. Two patients had been operated due to reported appendix tumors in their first surgeries, but their pathology revealed no malignancy. The mean length of the specimens and the tumor sizes were was 27.4 ± 14.2 cm and 6.2 ± 2.5 cm, respectively. The mean total lymph nodes dissected was 30.4 ± 14.8, while the mean positive lymph node was 5.0 ± 14.4 (Table 3).

Mortality was seen in two patients in the early post-operative period (3.8%). These patients were in the

Table 3. Pathology of the malignancies

Parameters	Nose (n: 12)	Transabdominal (n: 29)	p
T			
T1	0	1	1.00
T2	1	5	0.65
T3	9	15	0.29
T4 (a-b)	2 (2-0)	8 (6-2)	0.69
N			
0	3	13	0.30
1 (a-b)	4 (2-2)	7 (3-4)	0.70
2 (a-b)	5 (3-2)	9 (4-5)	0.71
Stage			
1	1	5	0.65
2 (a-b-c)	2 (1-1-0)	8 (6-0-2)	0.69
3 (a-b-c)	8 (0-5-3)	15 (1-7-7)	0.49
4	1	1	1.00
Length of specimen			
Mean SD	23.4 ± 9.4 cm	29.4 ± 15.7 cm	0.15
Median (Range)	22 (13-42.5)	27 (7.5-78)	
Tumor size			
Mean SD	5.6 ± 1.4	6.5 ± 2.8	0.29
Median (Range)	5 (4.5-9)	7 (0.8-13)	
Removed lymph node (Total)*			0.56
Mean SD	28.3 ± 20.9	31.2 ± 11.3	
Median (Range)	22 (10-96)	32 (16-56)	
Positive lymph node*			0.11
Mean SD	10.2 ± 25.0	2.9 ± 4.8	
Median (Range)	2 (0-96)	0.5 (0-17)	

*Tumor-negative appendix tumors were included.

transabdominal extraction group and were stage 3b and 3c. One of them died of unrelated to surgical technique due to cardiac problems 14 days after hospital discharge. The other patient was re-operated for anastomotic leakage and died on the 12th day after the second operation due to sepsis. In the late period, mortality was seen in three patients (5.7%). One patient with stage 2b in the NOSE group developed a recurrence with peritoneal metastases 13 months after surgery and died in the 16th month. The stages of the other two patients were 3c and both in the NOSE group but their mortality was not related to cancer. One of them was 76-year-old lady and had many comorbidities (hypertension, diabetes mellitus, and chronic heart disease), died in the 4th month. She died due to acute renal failure and hyponatremia. The other one was 58-year-old lady and had a previous Whipple operation. She died in the 35th month due to cardiac problems.

Discussion

The NOSE method started to be used in combination with laparoscopic right colon surgery in the early 2000s. Transvaginal route following laparoscopic right hemicolectomy is the generally accepted way for NOSE. Previous pelvic surgery, obesity, virginity, and congenital vaginal anomalies were emphasized as exclusion criteria for transvaginal extraction[5]. The exclusion criteria for transvaginal extraction in our work were the patient preference, virginity, or pelvic anomalies. Prior pelvic surgery or obesity was not used as exclusion criteria. Although the preferred method is the transvaginal route, the transcolonic route is also one of the available routes[4,6,7]. In our study, transvaginal access was used in the majority of NOSE patients, and the transanal way was used only in two patients. Especially extraction through a narrow sigmoid colon is the main limiting criteria for the transcolonic way. Although NOSE following right hemicolectomy is more realistic by transvaginal route in women[8], transanal way can be an alternative for small sized lesions in men.

There was no difference between the two groups in terms of operation time. Two studies comparing NOSE and transabdominal specimen extraction after right colon resection indicated that the duration of the operation was higher in the NOSE group[6,9]. Although Awad et al. stated that this difference was significant, it was not significant in the study of Park et al. Contrary to expectations, average operation time in the transabdominal extraction group was longer in our study. The reason for this difference in the transabdominal extraction group was attributed to incorporation of six patients into the transabdominal extraction group when NOSE was tried but failed and operations on large tumors with the transabdominal technique.

At least a 5-8 cm abdominal incision is required to remove a specimen after laparoscopic right hemicolectomy and that abdominal incision is more prone to wound-related complications than the trocar site incisions. The wound-related complications following laparoscopic colon resections are pain, incisional hernia, wound infection, and esthetic problems due to scar formation. With NOSE, a reduction in the rate of wound infection, an early post-operative chemotherapy initiation time, a low pain score, and a high cosmetic score are expected[10]. When we examined the pain scores of the two groups in this study, the pain scores on the 1st and 3rd days were higher in the transabdominal group. Park et al. found that the post-operative pain scores were significantly lower in the NOSE group similarly[6].

Wound infection is emphasized as another area of advantage in the NOSE technique. In our study, wound infections were not detected in the NOSE group, whereas in the transabdominal group, three patients (8.5%) developed infections at the specimen extraction area despite the routine, rigorous care with wound protector. When the literature was reviewed, this complication is as high as 20% in patients who undergo laparoscopic right hemicolectomy and transabdominal extraction[11]. In a previous study comparing the two techniques, no wound infections were seen in the NOSE group but two patients (5.8%) in the transabdominal group[6]. Considering the wound complication rates, although a strong conclusion cannot be reached due to the limitations induced by the low number of patients, we think that this difference will become meaningful in studies with larger numbers of patients. NOSE surgery is expected to have a shorter duration of hospitalization due to abdominal incisions. Although the difference was not significant in our study, it was determined that the length of stay in the NOSE group was shorter. Two comparative studies in the literature indicated two opposite results on hospitalization[6,9].

It is known that there is a correlation between the size of the incision and the risk of herniation. We predict that the use of NOSE will be able to eliminate the risk of an incisional hernia due to the absence of an extraction incision. In our study, one patient in the

transabdominal extraction group had a midline incisional hernia. In the literature, it is reported that the incidence of midline incisional hernia is as high as 8.7% in patients undergoing laparoscopic right hemicolectomy following transabdominal extraction[11]. In our study, no hernia was found in the suprapubic incision or in the NOSE group. Suprapubic incision may more advantageous than the midline incision in terms of morbidity, hospital stay, and incisional hernia, but more comparative studies are required for this conclusion.

There was no difference between the two groups in terms of the number of lymph nodes and positive lymph nodes removed when tumor pathologies were examined in our study. In a study involving right colon-located tumor patients, an average of 22.7 lymph nodes was removed. However, when the stage distributions of the patients in that study were examined, 50% of them were stage 1[7]. The mean number of lymph nodes in our study group was 30.4 in general, but it was higher than the meta-analysis data in the literature (23.3 ± 14.6)[12]. Although most of the patients in the meta-analysis were stage 3 cancer (85%), in our series, the stage 3 cancer ratio was also high (61%). Therefore, we think that our oncological surgical techniques were acceptable.

By reducing the length of the incision with the NOSE method, it is expected to decrease scar formation and thus improve esthetics. As a result of changes in minimally invasive methods and an increase in the level of experience, esthetic concerns have become a more important problem for patients. Here the cosmetic scores of the patients were found to be significantly better in the NOSE group. When the comparative studies in the literature were examined, it was seen that the cosmetic scores were higher in the NOSE group, consistent with our study[6]. The post-operative emotional state is very important in the recovery process, considering the presence of colon cancer in the majority of our patients. In these patients, although oncological outcome is a priority, we think that the least harmful technique should be preferred without sacrificing the surgical oncological principles. In addition, the preference of women along with consideration of esthetic concerns may further increase the number of patients preferring this technique. In the long-term follow-up results, we found both transvaginal and transanal specimen extraction groups had no short- or long-term complications.

This study has some limitations, particularly on the number of patients in the NOSE group. We have two clear indications as mentioned above; if the patient does not agree with the NOSE or has technical unsuitability, we abandoned the NOSE and only 17 of 52 patients (33%) were in the criteria of these indications. We openly told the patients that this was a research program and our expectations as a hypothesis were less post-operative pain, less wound-related complications, and better cosmetic outcomes. Moreover, the drawbacks were the potential complications of the transvaginal or transanal extraction-related complications. The reason of the low number of NOSE patients was due to these strict criteria. Previously we completed the study in 2018 (total number of patients was 35 instead of 52), but because of the limited number of NOSE patients, we went on to collect data and prepared this last version. Despite the limited number of patients in the NOSE group, there were significant differences between the groups in terms of two of our three expectations (pain and cosmesis but not wound-related complications). Although the difference on wound-related complications was not significant, it was suggestive (0% vs. 11.4%, p = 0.29).

Our previously published systematic review[13] and international guideline[14] showed that some patients are more suitable for NOSE following laparoscopic colorectal resections. The characteristics of these patients are as follows: patient acceptance, tumors without complication (no perforation or obstruction), T1-3 staging tumor without local invasion, en-mass lesion of < 8 cm for transvaginal extraction or < 3 cm for transanal extraction, not virgin women for the transvaginal extraction, and absence of anal stenosis or anal dysfunction for the transanal extraction.

Conclusion

NOSE combined with laparoscopic right hemicolectomy can be performed with appropriate patient selection and has better post-operative pain and cosmetic results than the transabdominal specimen extraction technique.

Conflicts of interest

The authors declare that does not exist conflicts of interest.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors have obtained the written informed consent of the patients or subjects mentioned in the article. The corresponding author is in possession of this document.

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