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Original Article

Comparison of Benign and Malignant Lesions in NOSES After Laparoscopic Colorectal Surgery: A Prospective Study

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ABSTRACT

Objective: Natural orifice specimen extraction surgery (NOSES) is defined as the removal of the specimen through natural orifices following laparoscopic colorectal surgery, and it is an important component of minimally invasive surgery. This study aims to compare the extraction of resected malignant and benign lesions through natural orifices after laparoscopic colorectal surgery.

Methods: Among 45 patients undergoing laparoscopic colorectal resection with planned NOSES between January 2019 and March 2020, 36 patients underwent NOSES. Transanal and transvaginal routes were utilized for extraction following laparoscopic resection. The transvaginal route was used in gynecologic cases and if there was a hysterectomy. Patients were divided into two groups based on the diagnosis of malignant or benign lesions. Demographic characteristics, perioperative and postoperative findings, as well as pathology and specimen sizes, were examined.

Results: Lesion localization was predominantly in the rectosigmoid region in the malignant group and in the rectum in the benign group. There was a statistically significant difference between the groups ($p<0.05$). The maximum specimen size was higher in the malignant group ($p>0.05$), whereas the maximum lesion size was larger in the benign group ($p<0.05$). Mesenteric dissection distribution was higher in the malignant group ($p<0.05$). There were significant differences between the patient groups in terms of specimen extraction site distribution and anvil localization ($p<0.05$). Transanal extraction and extracorporeal anastomosis were more common in the malignant group, whereas transvaginal extraction and intracorporeal anastomosis were more common in the benign group.

Conclusion: NOSES can be safely performed for both malignant and benign colorectal lesions. Despite larger lesion sizes in benign lesions in comparison to malignant ones, specimen sizes are smaller. Therefore, they are easier to extract through natural orifices after laparoscopic resection. Moreover, benign lesions can be dismembered into smaller sizes for extraction, in contrast with the case for malignant lesions.

INTRODUCTION

For approximately 40 years, laparoscopic colorectal surgery has been proven to be superior to conventional techniques.[1,2] The most significant disadvantage of laparoscopic surgery and the part responsible for complications is the mini-laparotomy incision for specimen extraction.[3] There has been a need for a minimally invasive approach to optimize surgical outcomes and improve recovery. However, this generally entails a long learning curve since it might necessitate intracorporeal anastomosis. The pinnacle of minimally invasive surgery is the natural orifice specimen extraction surgery (NOSES).[1,4] Thus, NOSES provides less pain, faster recovery, shorter hospitalization time, better cosmetic results, and lower risk of incisional hernia.[5,6] After laparoscopic colorectal surgery, specimen extraction can be done in two ways depending on the extraction site: transanal and transvaginal. Transanal extraction can be further classified based on the extraction site, such as transcolonic, transrectal, and transanal. Transcolonic extraction is rarely performed. Transcolonic extraction, which involves extracting the specimen from the colon by making use of colonoscopy after ileocolic resection, is controversial in terms of its feasibility.[7,8] Transanal and transrectal extraction are more commonly performed.[9] Transvaginal extraction is a route used only

in female patients.[10,11] Although there are studies in the literature examining the advantages and disadvantages of the NOSES method for malignant colorectal cancer cases, there is no clinical study comparing malignant and benign cases.[12,13] This study was conducted to compare transvaginal and transanal extractions of benign and malignant colorectal lesions. Therefore, it may be a useful study in terms of contributing to the literature.

MATERIALS AND METHODS

This study was conducted as a prospective clinical study in the general surgery clinic of a tertiary university hospital between January 2019 and March 2020. Approval was obtained from the hospital's medical ethics committee (Ethics committee approval number; 2019/514/146/2-28.01.2020). Informed consent was obtained from the patients before surgery. The study was conducted in accordance with the declaration of Helsinki. The type of pathology, specimen size, tumor stage (excluding metastasis), history of previous surgery, segment of resection, patient's gender, and body mass index were not considered. Patients under 18 years of age, those with metastases, those who did not consent, and those with virginity and anal-vaginal anomalies were excluded from the study. Laparoscopic colorectal resections were performed using established standard methods. In malignant lesions, the meso was partially dissected parallel to vascular structures with sealing devices to facilitate extraction without compromising vascular integrity before removing large-volume specimens. Patients were operated under general anesthesia in the modified Lloyd-Davies position. The transanal and transvaginal extraction sites were cleansed with povidone-iodine solution. Laparoscopic colorectal resections were performed using standard, well-established techniques. Transanal route was the first choice for specimen extraction after laparoscopic resection, and if unsuccessful, transvaginal route was attempted in female patients. If both were unsuccessful, the specimen was extracted through an abdominal wall incision. Patients were divided into two groups, malignant and benign, based on the diagnosis. In the comparison of anvil localization of both groups; in the malignant group, 12 anvils were placed extracorporeally, 10 anvils were placed intracorporeally, and the lesions of these 10 patients were located in the rectum and their anastomoses were at a lower level. In the comparison of anvil localization of both groups; in the benign group, 12 had anvil extracorporeal and in 3 had anvil intracorporeal, the lesions of these 11 patients were rectal and their anastomoses were at a lower level. The increase in intracorporeal placement of anvil in the benign group is due to the diagnosis of endometriosis. Demographic data, body mass index (BMI), American Society of Anesthesiologists Association (ASA) score, accompanying comorbidities, previous abdominal surgery, diagnosis, tumor location, type of operation, type of colectomy, number of trocars, additional organ resection, method of specimen extraction, method of anvil placement, operation time, blood loss, type of anastomosis, postoperative day 1 visual analog pain score (VAS), time to oral intake, length of hospital stay, complications, and pathology report (type, specimen size, length of lesion) of the patients were analyzed. In the pathological evaluation of the groups, the type of lesion, the maximum diameter of the specimen (including the entire resected pathological lesion and the specimen), and the maximum diameter of the lesion itself (measuring only the pathological lesion within the resected specimen) were examined. Patients diagnosed with rectal prolapse in the benign group were excluded from the statistical analysis due to the absence of a measurable lesion diameter. A total of 45 patients, for whom NOSES was planned after laparoscopic colorectal resection, were involved in this study (Fig. 1). Conversion was performed in seven patients for various reasons (ureteral invasion, proximal colon ischemia, inability to locate tumor in sigmoid colon, inability to determine distal part of tumor, and advanced local tumor in three patients). Moreover, two patients were not suitable for NOSES due to the short length of the distal rectum. Conventional laparoscopic colectomy followed by specimen extraction through a suprapubic incision was performed in these patients. The analysis was conducted on the data obtained from 36 successful NOSES cases. Of the malignant group, 11 had rectosigmoid tumors, 9 had sigmoid colon tumors, one had a rectum tumor, and one had a right colon tumor. In the benign group, 7 patients were rectal and 3 were resections due to endometriosis and rectal prolapse. Of the other patients in this group, one had a polyp located in the splenic flexure and three had diverticulosis located in the sigmoid colon.

Statistical Method

Nominal and ordinal data were analyzed using frequency analysis, while scale parameters were defined using means and standard deviations. Differences between nominal and ordinal parameters were analyzed using the Chi-square test and Chi-square similarity ratios. The Kolmogorov-Smirnov test was used for testing the normal distribution of scale parameters. Independent Samples T-test was utilized for normally distributed parameters, whereas the Mann-Whitney U test was used for non-normally distributed parameters. All analyses were conducted using SPSS 17.0 software with a significance level of 0.05 and a confidence interval of 95%. Software program used for statistical analysis was IBM Corp (2017). IBM SPSS Statistics for Windows, Version 25.0 (Armonk, NY: IBM Corp.).

RESULTS

Over a fourteen-month period, 45 patients were evaluated and 36 patients were involved in this study. Some demographic and clinical characteristics of the patient groups are shown in Table 1. The mean age was higher in the malignant group, but the BMI was higher in the benign group. The age difference was significant ($p<0.05$), whereas the difference in BMI values was not statistically significant ($p>0.05$). Gender and ASA class differences between patient groups

Table 1. Demographic and clinical characteristics of patient groups

	Malign (n=22)	Benign (n=14)	p
Age, mean±SD	60.86±9.28	53.00±13.17	0.043[a]
Gender, n (%)			
Female	9 (40.9)	13 (92.9)	0.002[b]
Male	13 (59.1)	1 (7.1)	
BMI, mean±SD	27.73±5.69	28.73±5.29	0.600[a]
ASA Score, n (%)			
1	2 (9.1)	1 (7.1)	0.032[c]
2	14 (63.6)	13 (92.9)	
3	6 (27.3)	-	
HT, n(%)	9 (40.9)	3 (21.4)	0.219[c]
DM, n(%)	8 (36.4)	2 (14.3)	0.137[c]
COPD, n(%)	1 (4.5)	-	0.317[c]
Other comorbidity, n (%)	2 (9.1)	3 (21.4)	0.303[c]
Abdominal Surgery, n (%)	6 (27.3)	8 (57.1)	0.073[b]

[a]Independent Samples T-test, [b]Chi-Square, [c]Chi-Square Likelihood Ratio. SD: Standard Deviation. BMI: Body Mass Index; ASA: American Society of Anesthesiologists; HT: Hypertension; DM: Diabetes Mellitus. COPD: Chronic Obstructive Pulmonary Disease.

Table 2. Analysis results and comparison between patient groups in terms of specimen and operative technical parameter differences

	Malign (n=22)	Benign (n=14)	p
Lesion localization, n (%)			
Sigmoid colon	9 (40.9)	3 (21.4)	0.000[a]
Rectum	1 (4.5)	10 (71.4)	
Rectosigmoid	11 (50.0)	-	
Right colon	1 (4.5)	-	
Splenic flexure case	-	1 (7.1)	
Max specimen dimension, mean±SD	14.67±14.10	12.21±5.07	0.860[b]
Max lesion dimension, mean±SD	3.05±1.51	6.67±3.78	0.005[c]
Number of trocars, mean±SD	4.14±0.35	4.28±0.47	0.470[b]
Mesentery dissection, n (%)	22 (100.0)	4 (28.6)	0.000[a]
Organ resection, n (%)			
No	20 (90.9)	10 (71.4)	0.131[a]
Yes	2 (9.1)	4 (28.6)	
Specimen extraction, n (%)			
Transanal	20 (90.9)	6 (42.9)	0.002[a]
Transvaginal	2 (9.1)	8 (57.1)	
Anastomosis type, n (%)			
Circular staplers	20 (91.0)	13 (92.9)	0.580[a]
Linear staplers	1 (4.5)	1 (7.1)	
Coloanal	1 (4.5)	-	
Anvil localization, n (%)			
Extracorporeal	12 (54.5)	3 (21.4)	0.049[d]

[a]Chi-Square Likelihood Ratio, [b]Mann Whitney U Test, [c]Independent Samples T-Test, [d]Chi-Square. SD: Standard Deviation.

were also found to be statistically significant ($p<0.05$). The difference in comorbidity distribution between patient groups was not statistically significant ($p>0.05$). Differences in specimen and operative technical parameters between patient groups and the analysis results are shown in Table 2. Lesion localization was predominantly in the rectosigmoid in the malignant group and in the rectum due to endometriosis in the benign group, and the difference

Table 3. Perioperative and postoperative characteristics of patients and difference analysis results

	Malign (n=22)	Benign (n=14)	p
Operation duration (min), mean±SD	171.59±42.85	190.00±33.97	0.184[a]
Blood loss (ml), mean±SD	49.54±26.99	39.28±19.40	0.311[b]
Oral intake (day), mean±SD	1.86±0.56	1.43±0.65	0.049[b]
Postop VAS, mean±SD	2.18±1.62	2.14±1.23	0.835[b]
Drain duration (day), mean±SD	4.73±0.88	4.57±1.02	0.629[a]
Hospitalization duration (day), mean±SD	4.86±0.94	5.21±1.19	0.511[b]
Perop complications, n (%)			
None	19 (86.4)	14 (100.0)	0.209[c]
Trocar site bleeding	1 (4.5)	-	
Colon injury	2 (9.1)	-	
Post complications, n (%)			
None	17 (77.3)	12 (85.7)	0.186[c]
Trocar site hernia	1 (4.5)	-	
Bleeding	2 (9.1)	-	
Atelectasis	1 (4.5)	-	
Rectovaginal fistula	1 (4.5)	-	
Ileus	-	1 (7.1)	
Bleeding + Trocar site hernia + Rectovaginal fistula	-	1 (7.1)	

[a]Independent Samples T-test, [b]Mann Whitney U Test, [c]Chi-Square Likelihood Ratio. SD: Standard Deviation; VAS: Visual Analogue Scale.

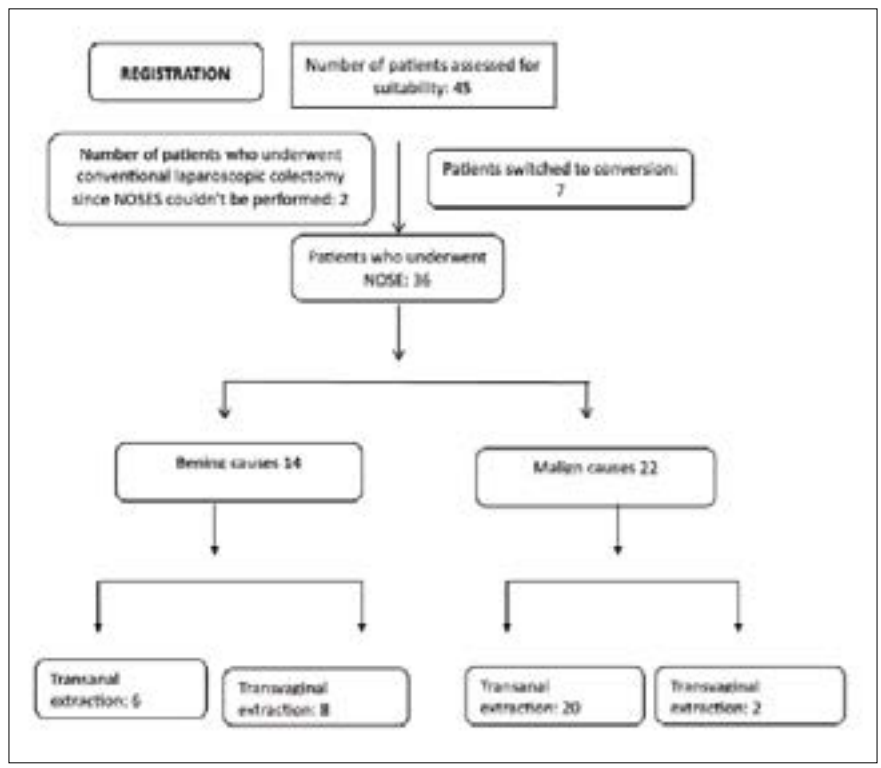

Figure 1. Flow Chart.

in lesion localization between groups was statistically significant (p<0.05). The maximum specimen size was larger in the malignant group (p>0.05), and the maximum lesion size was higher in the benign group (p<0.05). Mesenteric dissection distribution was higher in the malignant group (p<0.05). The distribution of sample extraction site and

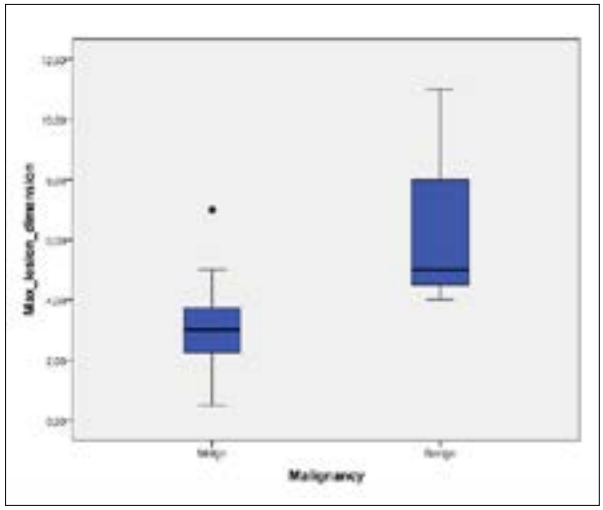

Figure 2. Evaluation of malignant and benign lesions by lesion diameter.

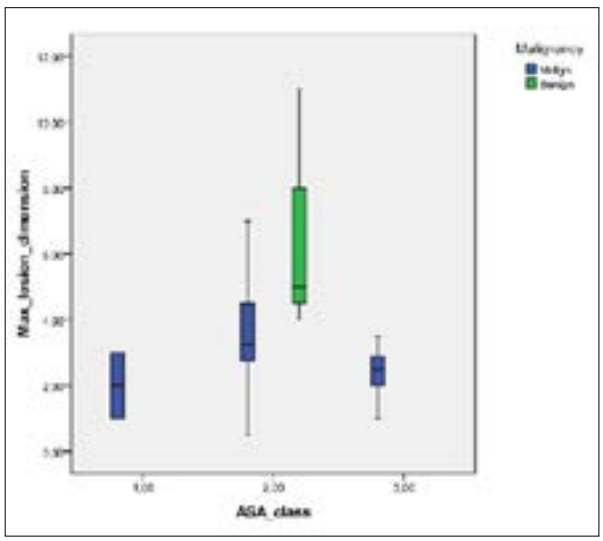

Figure 3. Comparison of maximum lesion diameter with ASA class.

anvil localization was also significantly different between patient groups ($p<0.05$). The transanal and extracorporeal regions were more common in the malignant group, while the transvaginal and intracorporeal regions were more common in the benign group. The preoperative and postoperative characteristics of patients and the results of the difference analysis are provided in Table 3. As seen in Table 3, only the oral fluid intake time was significantly higher in the malignant patient group ($p<0.05$). On the other hand, the operation time, level of blood loss, postoperative VAS, drainage removal, hospital stay, perioperative, and postoperative complications did not show statistically significant differences between groups ($p>0.05$). The average lesion was lower in the malignant group and higher in the benign group, and the range of variation was higher in the benign group (Fig. 2). The largest lesion size was observed in benign cases with the ASA score of 2, and the range of variation was also higher in ASA 2 when compared to other classes, indicating more diverse values (Figs 3, 4).

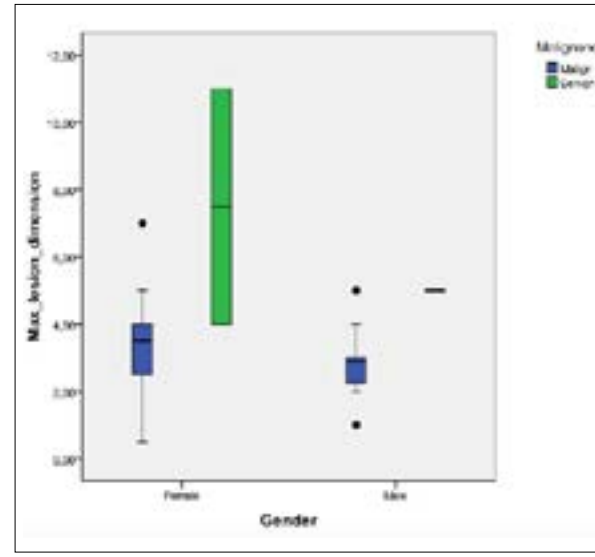

Figure 4. Comparison of maximum lesion diameter with gender.

DISCUSSION

The rate of colorectal diseases treated with laparoscopic surgery is increasing.[14] Laparoscopic colorectal surgery is undoubtedly superior to open surgery.[15] Upon determining the advantages of laparoscopic colorectal surgery, minimally invasive surgery came to the forefront to take these advantages further. Natural orifice specimen extraction surgery was developed to minimize surgical trauma and enhance recovery after laparoscopic surgery. Many studies confirmed that the anus is the most ideal orifice, particularly in left-sided colorectal surgery, in line with minimally invasive surgery.[16] In colorectal surgery, natural orifice specimen extraction can be categorized into two categories: transanal and transvaginal routes.[17,18] The vagina may be an ideal alternative to transanal extraction due to reasons such as sufficient flexibility and blood flow, healing capacity, and easy access.[19,20] Transvaginal specimen extraction was first used in gallbladder removal and later in the extraction of colon, kidney, and spleen samples.[21] After Franklin et al.[13] published the NOSES study, many studies were published in the last 20 years on this subject. However, there is no study comparing benign and malignant colorectal lesions. Differing from the other studies, the present study was carried out to evaluate the transanal and transvaginal extraction of colorectal benign and malignant lesions. Transvaginal extraction is less common today than transanal extraction due to the need for incision for specimen extraction from this healthy organ, and it is only applicable to female patients.[11] Transcolonic specimen extraction is performed through colonoscopy, mostly after right-sided or proximal segmental colon resections, and there are two studies in the literature on this subject.[22,23] Its practical applicability is debated. In-

deed, no transcolonic extraction was performed in this study. Transrectal NOSES can be applied in both sexes. It is a suitable option for the extraction of specimens in benign and left-sided malignant tumors such as diverticulitis, adenoma, and endometriosis, and for colorectal anastomosis.[1] In this study, transanal extraction was applied to 6 patients and transvaginal extraction to 8 patients for benign reasons, whereas transanal extraction was applied to 20 patients and transvaginal extraction to 2 patients for malignant reasons. Transvaginal extraction was more common for benign reasons due to gynecological lesions, while transanal extraction was more common for malignant lesions. The advantage of transvaginal NOSES is that it allows the extraction of larger lesions that cannot be extracted transanally in both right and left colon resections. However, this approach can only be applied to female patients. In the present study, the first choice for colorectal specimen extraction was transanal extraction. However, in cases where this was not possible, the second choice was transvaginal extraction. The size of benign lesions is one of the challenging situations for the NOSES method. Especially, the length of the segment resected in rectal prolapse and diverticular disease pose difficulties in creating a safe anastomosis. However, one of the advantages of benign cases is that the specimen can be divided without oncological concerns during the extraction of a large specimen. Nevertheless, in malignant cases, specimen division may pose risks of oncological consequences. Studies have shown that lesions smaller than 3 cm can be easily removed transanally, while those larger than 3 cm present challenges. Tumor size is a significant factor affecting the success of transanal NOSES procedures. Specimens up to 5 cm in size can be easily removed transvaginally,[9] but this technique is applicable only in female patients. In this study, the mean lesion size for benign tumors was 6.67 cm, while it was 3.05 cm for malignant tumors. As expected, the maximum specimen size was larger in the malignant group, but the maximum lesion size was higher in the benign group. Another concern in malignant diseases treated with the NOSES technique is whether oncological principles are compromised. Protective devices are placed in the orifices before specimen extraction in both transanal and transvaginal methods to prevent tissue and tumor contact. If the lesion size or specimen size is not suitable for extraction through the orifices, or if there is a risk of tumor perforation, then the conventional laparoscopic method is switched to, and specimen extraction is achieved through a suprapubic mini-incision. Gynecologists may have difficulty closing posterior colpotomy wounds.[24] If difficulties are encountered during the procedure, the vaginal incision may be left open. However, all posterior colpotomy incisions were closed in this study. In cases where closure was challenging, intracorporeal suturing was performed.

The average operation time was reported to be 229 minutes by Awad et al.[25] and 212 minutes by McKenzie et al.[26] Park et al.[27] reported the operation time to be 171 minutes and Franklin et al.[13] reported it to be 159 minutes. In this study, the mean duration was 171 minutes for malignant lesions and 190 minutes for benign lesions. NOSES surgery is performed after a long learning curve, and the operation time in this study was comparable to those reported by other authors. Transanal NOSES colectomy was significantly associated with shorter operation times when compared to conventional laparoscopic colectomy.[28] The major limitation of this study is that transvaginal extraction can only be performed in female patients, resulting in heterogeneous extraction sites for both benign and malignant lesions. Another limitation is the difficulty in removing large malignant tumors. Other findings may vary relative to these limitations. Additionally, we plan to publish the long-term oncological outcomes of our study with larger series in the future.

Conclusion

NOSES, which has a long learning curve, can be safely performed following a suitable malignant and benign colorectal surgery. Benign lesions are more advantageous than malignant lesions due to both ease of manipulation and specimen size. Numerous prospective studies are needed to compare the differences.

Ethics Committee Approval

The study was approved by the Kartal Dr. Lütfi Kırdar City Hospital Ethics Committee (Date: 28.01.2020, Decision No: 2019/514/146/2).

Informed Consent

Retrospective study.

Peer-review

Externally peer-reviewed.

Authorship Contributions

Concept: Y.E.A., İ.E.; Design: Y.E.A., O.A.; Supervision: Y.E.A., İ.E.; Fundings: O.A., İ.E.; Materials: Y.E.A., O.A.; Data collection &/or processing: İ.E., O.A.; Analysis and/or interpretation: O.A.; Literature search: Y.E.A.; Writing: İ.E.; Critical review: Y.E.A., İ.E.

Conflict of Interest

None declared.

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Laparoskopik Kolorektal Cerrahi Sonrası NOSES'de Benign ve Malign Lezyonların Karşılaştırılması; Bir Prospektif Çalışma

Amaç: Laparoskopik kolorektal cerrahi sonrası spesmenin doğal deliklerden çıkarılması natürel orifis spesmen ekstraksiyonu cerrahisi (NOSES) olarak adlandırılmakta olup, bu işlem minimal invaziv cerrahinin önemli bileşenidir. Çalışma, laparoskopik kolorektal cerrahi sonrası rezeke edilen malign ve benign lezyonların doğal deliklerden çıkarılmasını karşılaştırma amacı ile yapılmıştır.

Gereç ve Yöntem: Ocak 2019 ile Mart 2020 tarihleri arasında kliniğimizde laparoskopik kolorektal rezeksiyon sonrası NOSES planlanan 45 hastadan 36 hastaya NOSES yapıldı. Laparoskopik rezeksiyondan sonra ekstraksiyon için jinekolojik kaynaklı değilse öncelikle transanal yol denendi. Jinekolojik kaynaklı ve histerektomi yapılmışsa öncelikle transvajinal yol denendi. Hastalar, çıkarılan materyallerin benign ve malign lezyonlar olmasına göre iki gruba ayrıldı. Hastaların demografik bulgularına, peroperatif ve postoperatif bulgularına, patoloji ve spesmen boyutlarına bakıldı.

Bulgular: Lezyon lokalizasyonu malign grupta rektosigmoid, benign grupta rektum çoğunluktaydı ve lezyon lokalizasyonu gruplar arasında istatistiksel olarak anlamlı derecede farklıydı ($p<0.05$). Maksimum spesmen boyutu malign grupta daha yüksekti ($p>0.05$) ve maksimum lezyon boyutu benign grupta daha yüksekti ($p<0.05$). Mezenter diseksiyonu dağılımı malign grupta daha yüksekti ($p<0.05$). Spesmen ekstraksiyon yeri dağılımı ve anvil lokalizasyonuna göre de gruplar arasında anlamlı farklılık vardı ($p<0.05$). Transanal ekstraksiyon ve ekstrakorporeal anastomoz malign grupta, transvajinal ekstraksiyon ve intrakorporeal anastomoz benign grupta daha yaygındı.

Sonuç: Uygun olan malign ve benign kolorektal lezyonlarda NOSES güvenle yapılabilir. Benign lezyonlar her ne kadar lezyon boyutu bakımından malign lezyonlardan büyük olsa da spesmen boyutu olarak malign lezyonlardan daha küçüktür. Bu nedenle laparoskopik rezeksiyon sonrası doğal deliklerden çıkarılmaları daha kolaydır. Ayrıca benign lezyonlar, malign lezyonların aksine daha küçük boyutlara bölünerek çıkarılabilir.

Anahtar Sözcükler: Benign kolorektal tümörler; laparoskopik kolorektal cerrahi; malign kolorektal tümörler; minimal invaziv cerrahi; doğal orifis yoluyla örnek çıkarma cerrahisi.