

# Effect of preoperative radiotherapy and emergent surgery on conversion in laparoscopic colorectal surgery: A retrospective cohort study

## Preoperatif radyoterapi uygulanmasının ve acil cerrahinin laparoskopik kolorektal cerrahide açığa geçiş üzerine etkisi: Retrospektif kohort çalışması

Mehmet Buğra Bozan<sup>1</sup>, Barış Gültürk<sup>2</sup>, Nizamettin Kutluer<sup>2</sup>, Ayşe Azak Bozan<sup>3</sup>, Burhan Hakan Kanat<sup>2</sup>, Ali Aksu<sup>2</sup>, Abdullah Büyük<sup>2</sup>

<sup>1</sup> Department of General Surgery, Kahramanmaraş Sutcu İmam Üniversitesi, Kahramanmaraş, Turkey  
<sup>2</sup> Department of General Surgery, Medical Sciences University, Elazığ Training and Research Hospital, Elazığ, Turkey  
<sup>3</sup> Department of Anesthesiology and Reanimation, Necip Fazıl State Hospital, Kahramanmaraş, Turkey

### ORCID ID of the author(s)

MBB: 0000-0001-5573-2645  
BG: 0000-0003-4511-3693  
NK: 0000-0002-1092-2979  
AAB: 0000-0001-8737-4408  
BHK: 0000-0003-1168-0833  
AA: 0000-0002- 9226-1720  
AB: 0000-0003-0628-9303

### Corresponding author/Sorumlu yazar:

Mehmet Buğra Bozan  
Address/Adres: Kahramanmaraş Sütçü İmam Üniversitesi, Genel Cerrahi Anabilim Dalı, Kahramanmaraş, Türkiye  
e-Mail: mbozan@yahoo.com

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### Abstract

**Aim:** The effects of preoperative radiotherapy and emergent surgery on conversion in laparoscopic colorectal surgery is not clear. We therefore aimed to determine the effects of neoadjuvant radiotherapy and emergent surgery on conversion.

**Methods:** The data of 67 patients, who were operated for familial adenomatosis polyposis coli, colon, and rectum malignant neoplasms by the same surgical team between October 2016 and January 2018 were evaluated retrospectively. Among them, fifty-five laparoscopically finished or converted to open surgery cases were included in the study. The exclusion criteria included cases which began as open surgery, history of previous colorectal surgery for benign or malignant diseases, morbid obesity (body mass index >40 kg/m<sup>2</sup>) and missing data. Demographic values (age, gender), localization of tumor, whether it was an emergent or elective surgery, history of preoperative chemotherapy and radiotherapy, and causes of conversion were evaluated.

**Results:** Among 55 patients, 35 were male (63.6%) and 20 were female (36.4%), with a mean age of 58.4 (13.4) (22 – 80) years. Mean ages of conversion and laparoscopically finished cases were 62.86 (8.91) (53 – 73) and 57.71 (13.84) (22 – 80) years, respectively (P=0,216). The reason for operation was right colon cancer in three patients (5.5%), left colon cancer in six (10.9%), rectum cancer in thirty-seven (67.3%), rectosigmoid junction cancer in five (9.1%) and adenocarcinoma due to familial adenomatous polyposis coli in four patients (7.3%). In seven patients (12.7%), the need for conversion to open surgery arose. Among 55 patients, 47 patients were operated electively (85.5%) and 8 were operated under emergent conditions (14.5%). Of the 7 conversion patients, 5 were operated under emergent conditions and 2 were operated electively (P<0,001). This result showed that conversion rates were higher in emergent surgery patients. Neoadjuvant radiotherapy wasn't administered to 38 patients (69.1%) (chemotherapy was administered alone to 3 of the patients and 35 patients were not treated with any neoadjuvant therapy), and neoadjuvant chemoradiotherapy combination was administered to 17 patients (39.1%). Among 7 conversion patients, 1 had been administered neoadjuvant radiotherapy while 6 had not (P=0.308). This result showed no statistical differences between patients to whom preoperative radiotherapy were and were not administered.

**Conclusion:** Laparoscopic colorectal surgery can be performed as successfully as conventional open surgery under elective conditions. Preoperative radiotherapy is not related to conversion.

**Keywords:** Rectum cancer, Colon cancer, Laparoscopic surgery, Conversion, Radiotherapy, Emergent surgery

### Öz

**Amaç:** Laparoskopik kolorektal kanserlerde açığa geçiş üzerinde neoadjuvan radyoterapi uygulanmasının ve acil şartlarda operasyon yapılmasının etkisi açık değildir. Bu nedenle Neoadjuvan radyoterapi alınması ve acil cerrahinin preoperatif açık cerrahiye geçiş üzerine etkilerini değerlendirmek amaçlandı.

**Yöntemler:** Ekim 2016 – Ocak 2018 tarihleri arasında aynı cerrahi ekip tarafından ailesel polipozis coli, kolon malign neoplazisi ve rektum malign neoplazisi nedeniyle aynı cerrahi ekip tarafından opere edilen 67 hastanın dosyaları retrospektif olarak incelendi. Laparoskopik tamamlanan veya laparoskopik başlanıp açık cerrahiye geçilen 55 hasta çalışmaya dahil edildi. Çalışmadan çıkarılma kriterleri; direkt açık cerrahi uygulanmak, benign veya malign sebeplerle daha önce kolorektal cerrahi uygulanmış olmak, morbid obezite (vücut kitle indeksi >40 kg/m<sup>2</sup>) ve verilere ulaşılamamaktır. Hastalar demografik özellikleri (yaş, cinsiyet), tümör lokalizasyonu, cerrahinin acil ya da elektif olarak yapılması, preoperatif kemoterapi ve radyoterapi uygulanması, açığa geçiş nedenleri açısından değerlendirildi.

**Bulgular:** Çalışmaya dahil edilen 55 hastanın 35'i erkek (%63,6), 20'si kadın (%36,4) hastaydı. Hastaların yaş ortalaması 58,4 (13,4) (22 – 80) yaştı. Açığa geçilen hastaların yaş ortalaması 62,86 (8,91) (53 – 73) ve laparoskopik tamamlanan hastaların yaş ortalaması 57,71 (13,84) (22 – 80) yaştı (P=0,216). Hastaların operasyon nedenleri; 3 sağ kolon kanseri (%5,5), 6 sol kolon kanseri (%10,9), 37 rektum kanseri (%67,3), 5 rektosigmoid bölge tümörü (%9,1) ve 4 familiar polipozis coli sendromu zemininde gelişen adenokarsinomdu (%7,3). 7 hastada cerrahiye laparoskopik başlandı ancak açık cerrahiye geçilmek zorunda kaldı (%12,7). 47 hasta elektif şartlarda (%85,5) opere edilirken 8 hasta acil şartlarda (%14,5) opere edildi. Açığa geçilen 7 hastanın 5'i acil şartlarda opere olurken 2 hasta elektif şartlarda opere edildi (P<0,001). 38 hasta (%69,1) neoadjuvan radyoterapi almamışken (3'ü sadece kemoterapi, 35'i hiçbir neoadjuvan tedavi almadı), 17 hastaya (%39,1) neoadjuvan kemoterapi ve radyoterapi kombinasyonu verilmişti. Açığa geçilen 7 hastadan 1'inde neoadjuvan radyoterapi uygulanmışken, 6'sı neoadjuvan radyoterapi almamıştı (P=0,308).

**Sonuç:** Laparoskopik kolorektal cerrahi, elektif şartlarda konvansiyonel açık cerrahi kadar başarı ile uygulanabilen bir cerrahidir. Preoperatif radyoterapi alınması ile açığa geçiş arasında ilişki yoktur.

**Anahtar kelimeler:** Rektum kanseri, Kolon kanseri, Laparoskopik cerrahi, Açığa geçiş, Radyoterapi, Acil cerrahi

## Introduction

Colorectal cancers are the most common cancers of the gastrointestinal tract, the third most common malignancy after prostate and lung cancer for men and second leading cancer after breast cancer for women in cancer-related deaths [1-3]. Treatment options include endoscopic or surgical interventions (laparoscopic and conventional surgery), depending on the tumor stage, along with chemotherapy, radiotherapy, and their combinations when necessary. With these additional therapies, local recurrences and distant organ spreads can be controlled [2,4].

With advances in surgical instruments and surgical techniques, laparoscopic surgery has become as feasible as open surgery [5]. Compared to traditional open surgery, laparoscopic surgery has advantages such as decreased surgical trauma and pain, less intraoperative blood loss, decreased postoperative complication and faster recovery [6]. For this reason, it has been proven that it can be safely applied as an alternative surgical treatment in gastrointestinal cancers [5-7]. Although it had a narrower indication in the past, laparoscopic colorectal surgery indications have been expanded today to include not only early stage cancers but also advanced stage cancers, obese patients, and patients with a history of previous laparotomy [7]. However, despite these advantages, the rate of conversion in laparoscopic colectomies can reach up to 41% [8].

Around 10-28% of the patients are hospitalized with intestinal obstruction due to negligence of clinical symptoms, requiring emergency surgery. However, the morbidity and mortality rates of emergent colorectal surgeries are higher than elective surgeries [2].

In this study, we aimed to evaluate the effects of neoadjuvant chemoradiotherapy (chemoRT) administration and emergent surgery on conversion in laparoscopic colorectal surgery patients.

## Materials and methods

This retrospective cohort study was conducted to evaluate the effect of preoperative radiotherapy and emergent surgery on conversion in laparoscopic colorectal surgery patients. The data of 67 patients who were operated by the same surgical team for familial polyposis coli (FAP), colon malignant neoplasia and rectum malignant neoplasia were retrospectively analyzed between October 2016 and January 2018. Patients' data were obtained from patient hospital records, files, and computer records. Exclusion criteria consisted of cases which began as open surgery, benign colorectal pathologies, previous colorectal or abdominal surgeries, morbid obesity (body mass index >40 kg/m<sup>2</sup>) and missing data. Fifty-five patients who met the inclusion criteria of the study were included.

Patients were evaluated in terms of demographic characteristics (gender, age), localization of tumor, type of surgery, whether it was an emergent or elective surgery, administration of preoperative chemotherapy and radiotherapy, and reasons for conversion.

### Statistical analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) for Windows version 22

statistical software (IBM Corp., Armonk, NY, USA). Kolmogorov-Smirnov or Shapiro Wilk tests were used to determine the normality of the results. Based on the normality of distribution, Chi-square test or Fischer's exact test were used to compare categorical data and independent sample t-test, or Mann Whitney U test were utilized for assessment of numerical results. A multivariate analysis was performed to evaluate the relationship between conversion, neoadjuvant radiotherapy, and emergent surgery. Numerical values were given as mean (standard deviation) or median (minimum – maximum values). Categorical data were given as number (n) and percentage (%).  $P < 0.05$  value was considered statistically significant.

## Results

Among 55 patients included in the study, 35 were males (63.6%) and 20 were females (36.4%), with an overall mean age of 58.4 (13.4) years. The mean ages of male and female patients were 58.63 (13.23) and 57.9 (13.92) years, respectively. The mean age of patients who required conversion to open surgery and of those whose surgeries were finished laparoscopically were 62.86 (8.91) and 57.71 (13.84) years, respectively, with no significant difference ( $P=0.216$ ).

The tumor localization of 14 patients were colon [3 right colon cancers (5.5%), 6 left colon cancers (10.9%), 5 rectosigmoid junction cancers (9.1%)], 37 patients, rectum (67.3%) and 4 patients, adenocarcinoma developing on the basis of familial adenomatous polyposis syndrome (7.2%). Surgical interventions of patients included 31 laparoscopic low anterior resections (56.4%), 2 laparoscopic intersphincteric rectum resections (3.6%), 4 laparoscopic abdominoperineal resections (7.3%), 2 laparoscopic total colectomies (3.6%), 3 laparoscopic proctocolectomies (5.5%), 3 laparoscopic right hemicolectomies (5.5%), and 3 laparoscopic left hemicolectomies (5.5%). Forty-seven patients were operated electively (85.5%) and 8 patients were operated emergently (14.5%).

In 7 patients, surgery was started laparoscopically, but due to various reasons (intestinal dilatation in 3, iatrogenic jejunum injury in 1, distal rectal injury in 1, peritoneal carcinomatosis in 1 and brids in 1) converted to open surgery (12.7%). Five of the 7 patients were operated under emergent conditions, and 2 patients were operated electively ( $r^2=0.38$ ;  $P < 0.001$ ) (Table 1 and Figure 1). Operation under emergent conditions showed a positive correlation with conversion.

While 38 patients (69.1%) had not received neoadjuvant radiotherapy (3 patients received only chemotherapy, 35 patients received no neoadjuvant therapy), 17 patients (39.1%) had received neoadjuvant chemoRT (Figure 2). One of the 7 converted patients had received neoadjuvant chemoRT, and the remaining 6 did not ( $P=0.308$ ;  $r^2=0.028$ ) (Table 2). Administration of preoperative radiotherapy did not correlate with conversion. Median neoadjuvant RT dosage was 5000 (4500 – 5490) centigray (cGy) in the chemoRT group. Selected chemotherapeutic agent for the chemoRT group was 5-fluorouracil (5-FU).

Table 1: Demographic values

		Emergent surgery		Total	P-value
		Yes	No		
Gender (n %)	Male	5 (9.1%)	30 (54.5%)	35 (63.6%)	0.617
	Female	3 (5.5%)	17 (30.9%)	20 (36.4%)	
Total		8 (14.5%)	43 (84.5%)	55 (100%)	
Age (Years)		61.13 ± 10.64	59.35 ± 12.36		
Localization of tumor (n %)	Colon (Right or left)	3 (5.5%)	11 (20%)	14 (25.5%)	0.473
	Rectum	5 (9.1%)	32 (58.2%)	37 (67.3%)	
	FAP	0 (0%)	4 (7.3%)	5 (7.3%)	
	Total	8 (14.5%)	47 (85.5%)	55 (100%)	
Conversion (n %)	Yes	5 (9.1%)	2 (3.6%)	7 (13.7%)	<0.001
	No	3 (5.5%)	45 (81.5%)	44 (86.3%)	
Total		8 (12.7%)	47 (87.3%)	55 (100%)	

FAP: Familial Adenomatous Polyposis

Table 2: Demographic parameters of preoperative chemotherapy and radiotherapy

		Preop ChT and RT			Total	P-value
		ChT	ChT + RT	None		
Gender (n %)	Male	3 (5.5%)	9 (16.4%)	23 (41.8%)	35 (63.6%)	0.166
	Female	0 (0%)	8 (14.5%)	12 (21.8%)	20 (36.4%)	
Total		3 (5.5%)	17 (30.9%)	35 (63.6%)	55 (100%)	
Age (years)		61 (51 - 78)	61 (33 - 74)	56 (22 - 80)		
Localization of tumor (n %)	Colon (Right or Left)	0 (0%)	1 (2%)	13 (25.5%)	14 (27.5%)	0.081
	Rectum	3 (5.9%)	16 (31.4%)	18 (35.3%)	37 (72.5%)	
	FAP	0 (0%)	0 (0%)	4 (7.3%)	4 (7.3%)	
	Total	3 (5.9%)	17 (33.3%)	31 (60.8%)	51 (100%)	
Conversion (n %)	Yes	0 (0%)	1 (1.8%)	6 (10.9%)	7 (12.7%)	0.308
	No	3 (5.5%)	16 (29.1%)	29 (52.7%)	48 (87.3%)	
Total		3 (5.5%)	17 (30.9%)	35 (63.6%)	55 (100%)	

ChT: Chemotherapy, RT: Radiotherapy, FAP: Familial Adenomatosis Coli Syndrome

Additionally, postoperative adjuvant therapies can be started early [13]. Moreover, no difference was noted between the two methods in terms of overall survival, oncological results, recurrence rates, complication rates, or reoperation rates [13,14].

The term “Conversion” means the termination of the laparoscopic procedure and continuing with a midline incision and should not be considered as a complication of minimally invasive surgeries. Therefore, its etiology and number should be independent from open surgeries [13]. The conversion rates are 7 - 25% in large series and 2 - 41% in smaller series [15-17]. Like the previous results, our conversion rate was 12.7%. Reasons of conversion can be classified as patient-related causes (male gender, obesity, history of abdominal surgery, tumor size and neoadjuvant therapies), surgeon-related factors (surgical experience, technical skills, patient volume), resected surgical area (narrow pelvis, especially in male patients), intraoperative complications (organ injuries, uncontrolled bleeding, anastomotic difficulties) [13, 18-20]. The conversion etiology of our study included intestinal dilatation, iatrogenic injuries (jejunum, distal rectum), abdominal adhesions thought to be related with peritonitis carcinomatosa and chemoRT.

Up to 15% of colon cancer patients present with obstructive symptoms. Acute abdomen can be observed due to abdominal distention or perforation (because of fecal contamination due to colonic perforation). This is related with increased mortality and morbidity rates and decreased oncological success [21]. The relative contraindications of laparoscopic colonic resections include intestinal obstructions, large tumors, tumor invasions to adjacent organs and pregnancy [22]. Due to obstruction, dilated bowel loops cause restriction in the field of view. In addition, tissues are more easily injured due to excessive edema [22]. In our study, conversion rates were significantly higher in emergent cases compared to elective ones. This was due to the lack of vision as a result of dilated loops and resulted with intestinal injuries.

In colorectal cancers, local recurrences have required additional treatment options. RT and CT have been included in the treatment plan in order to provide cure with additional treatment, especially in patients with local recurrence in rectum cancers, to prevent disease recurrence, provide organ-preserving treatment and improve disease-free survival period. RT, initially added as adjuvant therapy, is included in neoadjuvant applications in local advanced stage tumors in current approaches [4]. Although there is no definitive neoadjuvant protocol for colon cancers, preoperative RT alone or with CT (chemoRT) in rectum cancers as a combined treatment (such as according to clinical staging anterior and fairly low T2, T3 tumors according to clinical staging, or T4 tumors according to pelvic magnetic resonance imaging) has become gold standard [23-25]. RT is administered to decrease tumor size or stage for an effective oncological resection. After the use of surgery and chemoRT combinations, survival rates in patients with regional rectal cancer have increased from 45% to 70% since the 1970s [26]. If complete pathological response is obtained in some selected patients, surgery may not even be required after neoadjuvant chemotherapy [24]. However, as a result of these applications, various complications related to chemoRT may occur (such as excessive tissue edema causing loss of surgical

Figure 1: Number of conversion and laparoscopically finished cases due to emergent and selective surgery

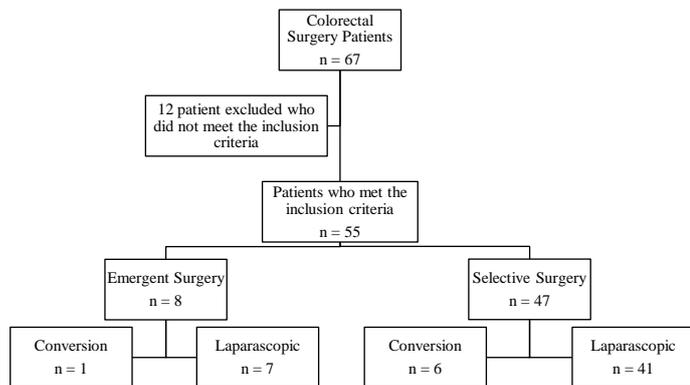
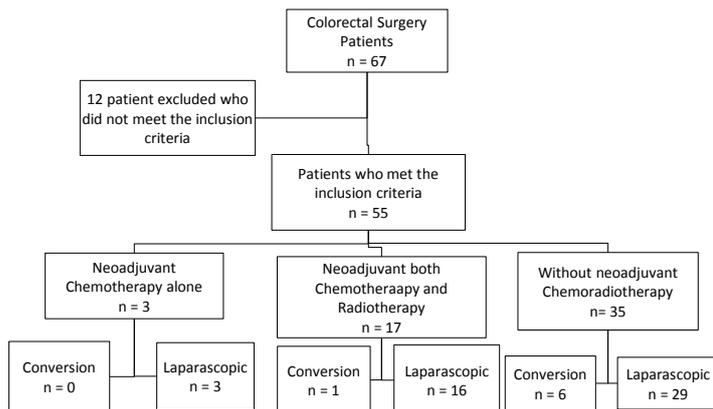


Figure 2: Number of conversion and laparoscopically finished cases due to preoperative radiotherapy application



Discussion

Since it was first described in 1991, the laparoscopic approach in the treatment of benign and malignant colorectal diseases became widely accepted [9]. Compared with open surgery, laparoscopic colorectal surgery is associated with better short-term results such as faster recovery, shorter postoperative ileus times, lower wound infection rates, shorter hospital stay, decreased postoperative pain, and faster enteral feeding [9-13].

plans, wound separation, surgical site infections, anastomotic leaks, fistulas, proctitis, diarrhea, surgical interventions related with obstructions, anorectal or genitourinary dysfunctions) [24]. Apart from these postoperative effects, it is necessary to evaluate the effects of chemoRT on conversion and intraabdominal adhesions in colorectal surgery. A study conducted by Rezvani et al. on 60 patients with rectum surgery reported that neoadjuvant chemotherapy increased the rate of conversion [27]. In contrast to their findings, in our study, conversion and neoadjuvant chemoRT administration were not related. This led us to believe that administration of neoadjuvant chemoRT has no effect on conversion rates. However, our limited number of patients prevent us from reaching a certain result.

### Limitations

The most important limitations of our study are the small number of cases, its retrospective and single center nature, and lack of randomization. Elimination of patients with other risk factors that may be effective on conversion (such as morbid obesity, previous abdominal surgery, surgery for benign colorectal diseases) resulted in both a limited number of patients and high rates of rectum surgery.

### Conclusion

Laparoscopic colorectal surgery can be performed as successfully as conventional open surgery under elective conditions. Neoadjuvant chemoRT administration does not affect conversion in laparoscopic colorectal surgery.

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