The Predictive Impact of Frailty Index on Outcomes Following Emergency Colectomy for Obstructing and Perforated Colon Cancer

Kırılganlık İndeksinin Tıkayıcı ve Perfore Kolon Kanseri İçin Yapılan Acil Kolektomi Sonuçları Üzerine Etkisi

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Öz

Bu çalışma ile tıkayıcı ve perfore kolon kanseri nedeniyle acil cerrahi geçiren hastalarda kırılganlık indeksinin ameliyat sonuçları üzerine prediktif etkisini araştırmayı amaçladık. Şubat 2017 ile Ekim 2020 tarihleri arasında, tümörün tıkanması veya perforasyonu nedeniyle acil sağ ve sol hemikolektomi yapılan doksan-dokuz hasta retrospektif olarak değerlendirildi. 5-mFI skoru (modified frailty index), kırılganlık özelliklerinin her bir sayısının değerlendirmesiyle ölçüldü (her biri 1 puan; 0-5 puan) ve üç gruba ayrıldı (mFI=0, mFI=1 ve mFI≥2). Hasta popülasyonunun ortalama yaşı 65.21±13.84 idi. Erkek hastalar 60 (%60) idi. Daha yüksek mFI olan hastalarda albümin düzeyi daha düşük saptandı (3.86±0.63 vs. 3.51±0.76 vs. 3.51±0.65, p=0.045). Artan mFI ile doğru orantıda, Clavien Dindo sınıflamması (CDC) [OR: 1.49,%95 CI: 0.82-2.75, p=0.2], morbidite [OR: 2.43,%95 CI: 0.50-13.98, p=0.3] ve anastomoz kaçağı [OR: 2,02,%95 CI: 0,63-6,65, p=0,2] artmış olduğu tespit edildi. Morbidite (16,%24.6 vs. 16,%47.1), p=0.041) ve mortalite (10,%15.4 vs. 9,%26.5, p=0.289) sağ kolon kanseri için daha fazla oranda görüldü. Stoma oluşumu genellikle sol taraf kolon kanserli hastalarda izlendi (29,%60 vs. 8,%23.5, p=0.001). 5-mFI skoru; morbidite, mortalite, uzun süre hastanede kalış ve reoperasyonlar dikkate alınarak acil kolon cerrahisi bulguları için muhtemel bir preoperatif prognostik belirteç olarak düşünülebilinir. Sağ taraflı tümörlerde morbidite ve mortalite ve sol taraflı tümörlerde stoma oluşumu daha artmış görülmeşine rağmen, 5-mFI skoru hastalarda kolon kanser yerleşim yerine bağımlı olmadan değerlendirilebilir.

Anahtar Kelimeler: Acil, Kırılganlık, Kolektomi

Abstract

This study aimed to analyze the predictive impact of frailty index and patterns of outcomes in patients with obstructing and perforated colon cancer who had emergency surgery. The nighty-nine patients who underwent right and left hemicolectomy were retrospectively evaluated within emergency conditions such as obstruction or perforation of tumor between February 2017 and October 2020. The 5-mFI (modified frailty index) score was measured by multiplying each number of frailty features (1 point per each existence; 0 - 5 points) and categorized into three groups (mFI=0, mFI=1, and mFI ≥ 2). The average age of the patient population was 65.21±13.84 years old. The male patients were 60 (60%). Albumin level was seen lower in patients who had higher mFI (3.86±0.63vs. 3.51±0.76 vs. 3.51±0.65, p=0.045). The predictive outcomes regarding the mFI potentially showed increased Clavien Dindo classification (CDC) [OR: 1.49, 95%CI: 0.82-2.75, p=0.2], morbidity [OR: 2.43, 95%CI: 0.50-13.98, p=0.3], and leakage [OR: 2.02, 95%CI: 0.63-6.65, p=0.2]. The morbidity (16, 24.6% vs. 16, 47.1%), p=0.041) and mortality (10, 15.4% vs. 9, 26.5%, p=0.289) were more likely seen for right sided tumors. Stoma formation was seen more likely for left sided tumors (29, 60% vs. 8, 23.5%, p=0.001). The 5-mFI score might be assumed as a preoperative prognostic tool for emergency colon surgery considering morbidity, mortality, prolonged hospitalization, and reoperation. Although morbidity and mortality in right-sided tumors and stoma formation are higher in left-sided tumors, 5-mFI score can be evaluated in patients regardless of colon cancer location.

Keywords: Emergency, Frailty, Colectomy

Introduction

Approximately 15–40% of patients with colorectal cancer could be primarily presented as emergency complications following perforation and obstruction (1). The first presentation of colon cancer with perforation involves 3–10%, and obstruction contains 8–40%, which is implied as a subsequent complication following poor prognostic factors (1–6). Previously in the literature, numerous instruments calculated 'frailty' as a replacement of physiological age and a predictive factor for postoperative complications with increased length of hospital stay (LOS), morbidity, mortality, and increased cost of hospital care (5-7).

The modified frailty index (mFI) was derivative of the Canadian Study of Health and Aging frailty index (CSHA-FI) to 11 parameters gathered by the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) (8-9). Similarly, CSHA-FI, the 11-item mFI (11-mFI), was improved to a simple five-item modified frailty index (5-mFI) to be an effective predictor of postoperative consequences (7-9).

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The preoperative application of evaluating frailty shows a beneficial tool to detect modifiable risk factors that might be adjusted. The 5-mFI has been validated and shown to have significant predictability for the outcomes of gastrointestinal resections (7,10-11).

However, no previously determined study has analyzed 5-mFI predictability for emergency surgery of obstructed left and right-sided colon cancer. The purpose of the current study was to assess the impact of the 5-mFI in predicting postoperative outcomes regarding characteristics of patients who had emergency surgery for right and left-sided primary colonic cancer.

Material and Method

Patients who underwent right and left hemicolectomy within emergency conditions with tumor obstruction between February 2017 and October 2020 were included in this retrospective study. A local institutional review board of Bagcilar Training and Research Hospital, University of Health Science, approved this retrospective study. The Clinical Research Ethics Committee of Bagcilar Training and Research Hospital of Health Science University approved the study protocol (decree number: 2020.09.2.11.138, date of approval:25.09.2020). We excluded patients with coexisting inflammatory bowel diseases (ulcerative colitis and Crohn's disease) or benign diseases (plastron appendicitis, diverticulitis, vs.), and rectal cancer. Demographical and clinical characteristics were reported from patients' files. Patients' characteristics included Frailty index (0-5), gender, age, American Society of Anesthesiology (ASA) classification, comorbidities (hypertension (HT), congestive heart failure (CHF), diabetes mellitus (DM), Carlson comorbidity index (CCI;<4 and ≥4), vs. chronic obstructive pulmonary disease (COPD), albumin (mg/dL), platelet (PLT, 103/mm^3), white blood cells count(109/L), c-reactive protein (CRP), neutrophil (cells/mm^3), lymphocyte (cells/mm^3) and hemoglobin (g/dL) level. Metastatic disease was measured by using computed tomography. All patients were operated on with an open technique. An operative report was used to define right-sided lesions (tumor proximal to the splenic flexure) and left-sided lesions (tumor distal to the splenic flexure). Other per-operative data included the presence of serosal lesions, tumor obstruction or perforation, and the presence of intraabdominal metastases. Mainoperative procedure time, complications (leakage, surgical site infection, vs.) stoma formation, and closure were reported. Postoperative data included 30-day morbidity, mortality, and length of hospital stay. Morbidity was reported following the Clavien Dindo classification (CDC) (12). Pathological reports included TNM staging following the 7th edition of the UICC classification. Modified frailty index included five features as the 5-mFI: congestive heart failure, chronic obstructive pulmonary disease, hypertension requiring medication, diabetes, and non-independent functional status. The 5-mFI score was measured by multiplying each number of frailty features (1 point per existence; 0 - 5 points). Patients were categorized into three groups (mFI=0, mFI=1 and mFI ≥ 2).

Quantitative variables were presented using descriptive statistics. The categorical measurements are expressed as numbers and percentages, as well as mean and standard deviation. Chi-square ($\chi 2$ test) test was used to compare categorical variables. Parametric methods were used for the measurement suitable for normal distribution. According to the parametric methods, the "Independent Sample-t" test (t-table value) was used in the comparison of the measurement values of two independent groups, and the "ANOVA" test method was used in comparison with the measurement values of three or more independent groups. Non-parametric methods were used for non-normal distribution measurements. Following non-parametric methods, the "Mann-Whitney U" test was used to compare the measurement values of two independent groups. The "Kruskal-Wallis" test was used to compare the measurement values of three or more independent groups. A logistic regression model was used to show significant independent predictors of outcomes about the frailty index based on the clinical importance and literature review considering the patient population. R version 4.0.5 (1.0.143 - © 2009-2016 RStudio, Inc.) package program was used for statistical analysis. $P < 0.05$ was considered statistically significant.

Results

The average age of the patient population was 65.21±13.84 years old. The male patients were 60 (60%). Ninety-nine patients presented with obstruction, respectively, as an initial symptom. Demographics and laboratory findings of the patients who had emergency surgery for the left and right colon were reported in Table 1. The emergency colectomy for tumor malignancy was performed for the left side in 65 (65%) patients and the right side in 34 (35%) patients. The hemoglobin (12.42±2.31 vs. 11.09±2.30) and albumin (3.76±0.63 vs. 3.45±0.74) level was lower for right side colectomies. Higher CCI (≥4) was reported more likely for right-sided colectomies (24 (36.9%) vs. 18 (52.9%), p=0.188).

Per-operative outcomes of the emergency surgery for the left and right colon were reported in Table 2. Subtotal colectomy approach was more likely performed for left-sided tumors (2, 3.1%). Stoma formation was seen more likely for left-sided tumors (29, 60% vs. 8, 23.5%, p=0.001). The morbidity (16, 24.6% vs. 16, 47.1%), p=0.041) and

mortality (10, 15.4% vs. 9, 26.5%, p=0.289) were more likely seen for right-sided tumors.

Demographics and laboratory findings of emergency colectomies regarding the mFI were reported in Table 3. The older patients were more likely higher mFI (56.12, 13.28% vs. 68.35, 11.04% vs.73.3, 9.75%, p<0.001). Albumin level was seen lower in patients with higher mFI (3.86±0.63vs. 3.51±0.76 vs. 3.51±0.65, p=0.045). The higher CCI (>4) was reported for patients who had higher mFI (13, 32.5% vs. 9, 39.1% vs. 20, 55.6%, p=0.119).

Table 1. Demographic and laboratory findings of the emergency surgery for the left and right colon

	Left Colon (n=65)	Right Colon (n=34)	p
Age	64.35±13.99	66.85±13.60	0.396
Male (%)	44 (67.7)	16 (47.1)	0.075
ASA (%)			0.159
1	7 (10.8)	3 (9.1)	
2	19 (29.2)	10 (30.3)	
3	36 (55.4)	14 (42.4)	
4	3 (4.6)	6 (18.2)	
Hemoglobulin	12.42±2.31	11.09±2.30	0.007
Neutrophil	8.28±4.43	7.27±2.93	0.230
Lymphocyte	1.65±1.14	1.70±0.93	0.830
PLT	333.34±96.34	340.32±113.52	0.748
CRP	56.92±76.81	70.96±82.28	0.401
Albumin	3.76±0.63	3.45±0.74	0.030
HT (%)	22 (33.8)	11 (32.4)	0.996
CHF (%)	16 (24.6)	13 (38.2)	0.237
Hepatic insufficiency (%)	1 (1.5)	0 (0.0)	0.979
DM (%)	14 (21.5)	8 (23.5)	0.984
COPD (%)	11 (16.9)	2 (5.9)	0.218
Renal insufficiency (%)	3 (4.6)	3 (8.8)	0.697
CCI (≥4) (%)	24 (36.9)	18 (52.9)	0.188
Frailty Index (%)			0.856
mFI =0	27 (41.5)	13 (38.2)	
mFI =1	14 (21.5)	9 (26.5)	
mFI ≥ 2	24 (36.9)	12 (35.3)	

CCI: Carlson comorbidity index, CDC; Clavien Dindo classification, HT: hypertension, CHF: congestive heart failure, SSI, surgical site infection. PLT: platelet, CRP; c-reactive protein

Table 2. Per-operative outcomes of the emergency surgery for the left and right colon

	Left Colon (n=65)	Right Colon (n=34)	p
Surgery (%)			<0.001
Left hemicolectomy	25 (38.5)	0 (0.0)	
Right hemicolectomy	0 (0.0)	34 (100.0)	
Subtotal colectomy	2 (3.1)	0 (0.0)	
Anterior resection	38 (58.5)	0 (0.0)	
Stoma (%)	39 (60.0)	8 (23.5)	0.001
Tumor size	14.28±5.30	15.56±5.02	0.248
T Stage (%)			0.318
2	2 (3.1)	1 (2.9)	
3	25 (38.5)	8 (23.5)	
4	38 (58.5)	25 (73.5)	
Total LN	21.68±10.93	27.71±15.91	0.029
Positive LN	3.75±5.69	4.76±8.56	0.484
Metastasis (%)	28 (43.1)	17 (50.0)	0.657
SSI (%)	5 (7.7)	5 (14.7)	0.454
Perforation (%)	9 (13.8)	5 (14.7)	0.897
Leakage (%)	39 (60.0)	16 (47.1)	0.309
Stoma SSI (%)	19 (29.2)	11 (32.4)	0.928
Re-laparotomy (%)	4 (6.2)	3 (8.8)	0.937
Operation duration	133.69±49.73	143.15±44.32	0.354
Hospitalization	12.02±16.49	8.68±5.09	0.253
Morbidity (%)	16 (24.6)	16 (47.1)	0.041
Mortality (%)	10 (15.4)	9 (26.5)	0.289
CDC (%)			0.546
1	7 (10.8)	6 (17.6)	
2	26 (40.0)	14 (41.2)	
3	18 (27.7)	6 (17.6)	
4	2 (3.1)	0 (0.0)	
5	12 (18.5)	8 (23.5)	

CDC; Clavien Dindo classification, SSI, surgical site infection. LN; Lymph node.

Per-operative outcomes of emergency colectomies regarding the mFI were reported in Table 4.

Mortality was more likely seen for patients with higher mFI (3, 7.5% vs. 4, 17.4% vs. 12, 33.3%, p=0.016). Higher CDC (score 5) was more likely seen for patients who had higher mFI (3, 7.5% vs. 4, 17.4% vs. 13, 36.1%, p=0.073). Longer hospitalization was reported for patients who had higher mFI (8.28±4.34 vs. 11.13±8.54 vs. 13.58±21.13, p=0.244). Increased re-laparotomy was reported for patients who had higher mFI (2, 5% vs. 1, 4.3% vs. 4, 11.1%, p=0.493). The patients with mFI≥2 have higher mortality (p=0.016). The patients with mFI=1 has higher leakage ratio (17, 73.9% vs. 15, 37.5%, p=0.009). The anterior resection was mostly performed for patients who had mFI=0 (47.5%, p<0.001), and the subtotal colectomy was mostly performed for the patients with mFI≥2 (5.6%, p<0.001).

Multivariate analysis of outcomes regarding mFI was performed (Figure 1). The predictive outcomes regarding the mFI potentially showed increased CDC [OR: 1.49, 95%CI: 0.82-2.75, p=0.251], morbidity [OR: 2.43, 95%CI: 0.50-13.98, p=0.374], and leakage [OR: 2.02, 95%CI: 0.63-6.65, p=0.269].

Discussion

Emergency colorectal cancer surgeries following bowel obstruction were associated with poor postoperative outcomes (6). Subsequently, the presence of right and left-sided colon cancer with obstruction showed higher morbidity and mortality in the literature following emergency surgeries (13). Especially, regardless of any difference between the male and female population, frail and old patients generally presented with obstruction, which was the majority of our population in our study, too. (14-15). Then, we understand the unmet needs to consider preoperatively to evaluate frailty as a beneficial tool to detect risk factors for postoperative outcomes. Recently, we adjust the 5-mFI to optimize preoperative risk assessment for frail patients who had emergency surgery for right and left-sided colon cancer related to obstruction. A frailty score was created by measuring the potential deficiencies during patients' preoperative management (7-9). However, our analyses' incremental increase in mFI score had no meaningful impact on colon cancer's obstruction side (32.5% vs. 39.1% vs. 33.3%, p=0.856). The right-sided colon cancer of our study population developed more likely higher morbidity than left-sided tumors in small sample size and a restricted region. At the same time, it was controversial in the literature, respectively (16-18).

Previous studies reported that 5-mFI and 11-mph could be independent predictors for overall morbidity. Also, they analyzed both elective and emergency cases where we evaluated only emergency colon surgeries. As another exclusion criterion in our study, we investigated only obstructive right and left colon cancer surgeries. Various studies investigated inflammatory bowel diseases and rectum cancer cases. Although mFI was associated with poor outcomes regarding widely variable subjective results (19-20). Consistent with the literature, a higher frailty score showed more likely higher morbidity [OR: 2.43, 95%CI: 0.50-13.98, p=0.3].

Table 3. Demographic and laboratory findings of the Frailty Index (FI)

	FI=0 (n=40)	FI=1(n=23)	FI≥2 (n=36)	p
Age	56.12±13.28	68.35±11.04	73.31±9.75	<0.001
Male (%)	26 (65.0)	13 (56.5)	21 (58.3)	0.755
Obstruction location (right colon) (%)	13 (32.5)	9 (39.1)	12 (33.3)	0.856
ASA (%)				<0.001
1	10 (25.6)	0 (0.0)	0 (0.0)	
2	18 (46.2)	5 (21.7)	6 (16.7)	
3	10 (25.6)	14 (60.9)	26 (72.2)	
4	1 (2.6)	4 (17.4)	4 (11.1)	
Hbg	12.44±2.17	12.14±2.78	11.32±2.27	0.115
Neutrophil	7.76±3.89	8.59±4.57	7.71±3.78	0.668
Lymphocyte	1.72±1.19	1.46±0.66	1.75±1.14	0.571
PLT	341.79±101.01	320.30±79.42	338.88±116.67	0.708
CRP	50.93±76.10	102.08±97.87	47.99±58.53	0.018
Albumin	3.86±0.63	3.51±0.76	3.51±0.65	0.045
HT (%)	1 (2.5)	7 (30.4)	25 (69.4)	<0.001
CHF (%)	1 (2.5)	8 (34.8)	20 (55.6)	<0.001
Hepatic insufficiency (%)	1 (1.5)	0 (0.0)	0 (0.0)	0.475
DM (%)	1 (2.5)	3 (13.0)	18 (50.0)	<0.001
COPD (%)	1 (2.5)	3 (13.0)	9 (25.0)	0.015
Renal insufficiency (%)	2 (5.0)	1 (4.3)	3 (8.3)	0.769
CCI (>4) (%)	13 (32.5)	9 (39.1)	20 (55.6)	0.119

Hbg: Hemoglobulin, CCI: Carlson comorbidity index, CDC; Clavien Dindo classification, HT: hypertension, CHF: congestive heart failure, SSI, surgical site infection. PLT: platelet, CRP; c-reactive protein

Table 4. Per-operative outcomes regarding the Frailty Index (FI)

	FI=0 (n=40)	FI=1 (n=23)	FI≥2 (n=36)	p
Surgery (%)				**<0.001**
Left hemicolectomy	8 (20.0)	7 (30.4)	10 (27.8)	
Right hemicolectomy	13 (32.5)	9 (39.1)	12 (33.3)	
Subtotal colectomy	0 (0.0)	0 (0.0)	2 (5.6)*	
Anterior resection	19 (47.5)*	7 (30.4)	12 (33.3)	
Stoma (%)	17 (42.5)	13 (56.5)	17 (47.2)	0.562
Tumor size	14.32 (5.50)	15.57 (4.89)	14.61 (5.18)	0.659
T Stage (%)				0.568
2	0 (0.0)	1 (4.3)	2 (5.6)	
3	12 (30.0)	9 (39.1)	12 (33.3)	
4	28 (70.0)	13 (56.5)	22 (61.1)	
Total LN	27.20±15.54	20.35±10.21	22.08±11.02	0.085
Positive LN	4.60±8.40	3.70±5.92	3.81±5.27	0.835
Metastasis (%)	20 (50.0)	10 (43.5)	15 (41.7)	0.749
SSI (%)	5 (12.5)	4 (17.4)	1 (2.8)	0.155
Perforation (%)	4 (10.0)	6 (26.1)	4 (11.1)	0.170
Leakage (%)	15 (37.5)	17 (73.9)*	23 (63.9)	**0.009**
Stoma SSI (%)	15 (37.5)	5 (21.7)	10 (27.8)	0.389
Re-laparotomy (%)	2 (5.0)	1 (4.3)	4 (11.1)	0.493
Operation duration	131.80±49.99	156.96±47.33	129.86±43.51	0.071
Hospitalization	8.28±4.34	11.13±8.54	13.58±21.13	0.244
Morbidity (%)	10 (25.0)	9 (39.1)	13 (36.1)	0.427
Mortality (%)	3 (7.5)	4 (17.4)	12 (33.3)*	**0.016**
CDC (%)				0.073
1	8 (20.0)	3 (13.0)	2 (5.6)	
2	20 (50.0)	8 (34.8)	12 (33.3)	
3	9 (22.5)	7 (30.4)	8 (22.2)	
4	0 (0.0)	1 (4.3)	1 (2.8)	
5	3 (7.5)	4 (17.4)	13 (36.1)	

*: FI≥2 has higher mortality (p=0.016). FI=1 has higher leakage (p=0.009). mFI=0 has higher anterior resection and mFI≥2 has higher subtotal colectomy (p<0.001).

Similarly, one of the recent studies in the literature showed the adverse effect of the higher frailty index regardless of age among the morbidity and mortality (21). Also, some study findings reported increased CDC to emphasize the severity of the postoperative complications (22.1%), while we reported higher CDC for more frail patients. Higher CDC (score 4-5), more extended hospitalization (21.13%), and increased re-laparotomy (11.1%) were reported for patients who had higher mFI as it was consistent with the literature (7).

The leakage as a significant complication of emergency surgeries for colon cancers, even in the literature, shows different outcomes, especially for left-sided colon surgeries that had bowel anastomosis without a stoma formation. Interestingly, SSI was seen in fewer patients with mFI<2, corroborating the previously published studies (13-16). At the same time, stoma site-related SSI (37.5%, p=0.389) mainly was observed as one of the morbidities more likely for the less frail patients (mFI<1), consistently with the previously published reports.

Perforation due to obstruction of cancer was seen mostly in right-sided tumor (13.8% vs. 14.7%) and mFI=1 (10% vs. 26.1% vs. 11.1%, p=0.17) patients in our patients. Some studies mentioned that the perforation is a separate presentation or iatrogenic finding, per-operatively in emergency surgeries (7-9, 18-20).

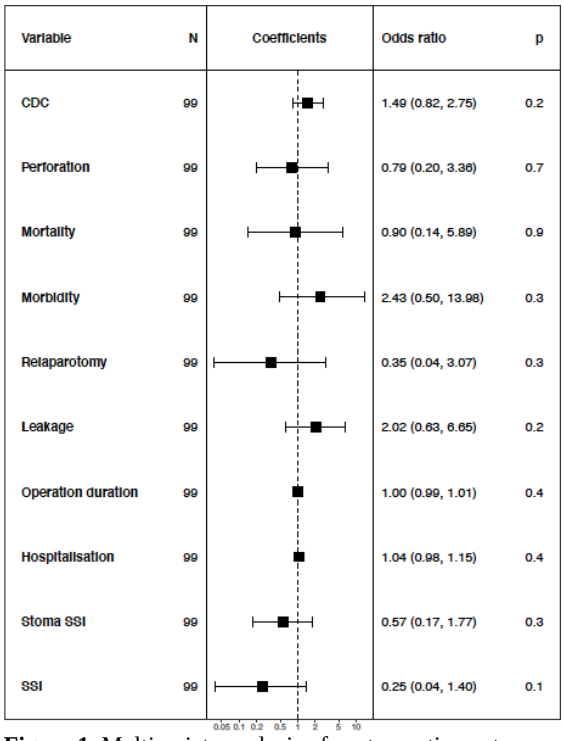

Figure 1. Multivariate analysis of postoperative outcomes regarding Frailty Index (FI).

Additionally, emergency colectomies have different approaches to perform with or without stoma and anastomosis. That could be one of the

main prognostics for challenging postoperative morbidity and mortality to optimize postoperative care (13-16). However, our results are inconsistent with previously reported studies, such as mortality of our population had no meaningful difference regarding frailty index [OR: 0.90, 95%CI: 0.14-5.89, p=0.9]. An example of our findings, such as right-sided colon cancer surgery, showed a more likely higher ratio of mortality (15.4%vs. 26.5%), which was another challenging finding in the literature (19-24).

It was seen that even less frail patients considering a younger population had a higher amount of advanced disease stage (70%), metastasis (50%), and positive lymph node (8.4%) resection. Possible reasons for considering those findings might be significant deficits in early diagnosis or interventions for younger patients in our population follow-up. Numerous reports determined the importance of early medical health care and diagnostic tools for younger patients to prevent increased morbidity and mortality. Independent of age regarding the patients' frailty for emergency surgeries of obstructive colon cancer, we should counsel early to recognize the less frail patients by preoperative assessment (20-26).

Regarding the limitations of our study, this was a retrospective review with a small sample size in a single center in a restricted region. Due to the study's retrospective design, we could not analyze potential cofounders of clinical data because of missing information. Besides, other studies did not analyze various clinical scoring systems to calculate correlations. Therefore, the patient- and surgeon-related factors might prompt selection bias. The analyses might not have sufficient power to express statistical significance in group comparisons. Hence, our study is the first approach of frailty score analysis among the emergency surgery for the right and left-sided obstructing and perforated colon cancers.

In conclusion, the 5-mFI score might be assumed as a preoperative prognostic tool of emergency colon surgery for morbidity, mortality, prolonged hospitalization, and reoperation. This could be relevant regardless of right or left-sided colon cancer location or surgical techniques. The impact of frailty as a preoperative predictive tool for evaluating patients with emergency colon surgery might allow surgeons to acknowledge frail patients to minimize postoperative complications. Future analyses should emphasize the potential possibility of 5-mFI to distinguish patients' postoperative outcomes in colorectal surgery. The preoperative risk stratification as a predictive tool is warranted.

Ethics Committee Approval: The Clinical Research Ethics Committee of Bagcilar Training and Research Hospital of Health Science University approved the study protocol (decree number: 2020.09.2.11.138, date of approval:25.09.2020).

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