

Comparison of preoperative and postoperative frailty in elderly following gastrointestinal cancer surgery

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ABSTRACT

Objectives: This study aimed to compare preoperative and postoperative frailty status in patients undergoing elective gastrointestinal cancer surgery using the FRAIL (Fatigue, Resistance, Ambulation, Illness, and Loss of weight) and Clinical Frailty Scale (CFS) indices and to determine the relationship between frailty and early postoperative complications as well as surgical outcomes.

Methods: This prospective study included patients aged 65 years and older who underwent elective gastrointestinal cancer surgery. Preoperative and early postoperative frailty assessments were conducted using the FRAIL and CFS scores. Statistical analyses were conducted to investigate the association between frailty scores and surgical/clinical outcomes.

Results: Of the 91 patients included in the study the mean age was 70.9 ± 6.1 years (range: 65-75). The mean FRAIL score increased postoperatively (1.9 ± 1.2 preoperatively to 2.3 ± 1.5 postoperatively, $\Delta_{\text{post-pre}}: 0.4 \pm 0.9$, $P < 0.001$). A similar trend was observed in the CFS scale, the mean CFS score increased postoperatively (4.8 ± 1.2 preoperatively to 5.1 ± 1.6 , postoperatively, $\Delta_{\text{post-pre}}: 0.3 \pm 0.8$, $P < 0.001$). Patients with higher baseline frailty levels exhibited longer hospital stays ($P = 0.015$), higher mortality rates ($P = 0.030$), and increased rates of discharge with an ostomy or drain ($P = 0.003$).

Conclusions: Our findings suggest that while frailty scores may increase postoperatively, higher baseline frailty score is associated with several adverse outcomes, including prolonged hospital stays, increased mortality, and a higher likelihood of requiring ostomies or drains upon discharge.

Keywords: Elderly patient, frailty, gastrointestinal cancer surgery, mortality, FRAIL, CFS scale

Cancer is an important health problem that increases in frequency with age. The number of cancer cases, which was determined to be 1.6 million in 2010, is expected to increase to 2.3 million in 2030. The most important reason for the increase in cancer cases is the aging population. It is expected that 67% of total cancer cases will be elderly individuals [1]. Gastrointestinal (GI) system cancers are very

common cancers, accounting for 1 in 4 cancer cases and 1 in 3 cancer deaths worldwide [2]. Surgical treatment is the gold standard for GI system cancers; however, the physiological limitations of older individuals, including their physical condition and comorbidities, can significantly impact their ability to tolerate surgical interventions. Another factor affecting the success of GI system cancer surgeries is frailty [3].

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Frailty, a physiological decline associated with a marked sensitivity to stress factors, is a complex syndrome with diverse clinical consequences [4]. It is common in older patients. Frailty in the elderly is a complex condition that often results from diminished physiological reserves and a weakened ability to maintain homeostatic balance. These factors, combined with age-related physiological changes, increase an individual's susceptibility to environmental stressors. The risk of morbidity and mortality increases in frail elderly individuals, especially after major medical interventions such as surgery. Therefore, when performing clinical evaluations of elderly patients, not only tumor characteristics and existing comorbidities but also the level of frailty should be taken into account [5]. However, if frailty assessment is inadequate, elderly patients may either be inadequately treated or, conversely, may be at risk of serious weakening after treatment. In this context, better understanding and managing frailty is critical to improving health outcomes of the older population. Therefore, this study aimed to compare preoperative and postoperative frailty status in patients undergoing elective gastrointestinal (GI) cancer surgery using the FRAIL (Fatigue, Resistance, Ambulation, Illness, and Loss of weight) and Clinical Frailty Scale (CFS) indices and to determine the relationship between frailty and early postoperative complications as well as surgical outcomes.

METHODS

Study Design and Setting

This is a prospective cohort study conducted on patients aged 65 years and older who underwent elective GI cancer surgery at the Department of Gastroenterological Surgery, Adana City Training and Research Hospital, Adana, Turkey, between February and December 2024. The study protocol was approved by the Institutional Ethics Committee (decision number 3178, dated 15.02.2024). Written informed consent was obtained from all participating patients.

Patients scheduled to undergo elective GI cancer surgery were prospectively enrolled in the study. Exclusion criteria included: age younger than 65 years, emergency surgery, and refusal to participate in the study.

Patients presented with the following diagnoses: rectal cancer (n=25), colon cancer (n=33), gastric can-

cer (n=19), pancreatic tumor (n=11), and hepatic tumor (n=3). All patients with gastric cancer (n=19) received neoadjuvant chemotherapy. Patients with rectal cancer received either total neoadjuvant chemoradiotherapy (n=22) or neoadjuvant chemoradiotherapy (n=3).

Preoperatively and postoperatively, all patients underwent systematic assessment using the FRAIL index and CFS. Early postoperative local and systemic complications were recorded. Data collected included; surgery type (open/laparoscopic/open after laparoscopy), length of hospital stay, need for intensive care unit (ICU), time to oral feeding resumption, mortality status, and FRAIL index and CFS scores. The patients' biochemical laboratory data were also recorded. Mortality was defined as death occurring within 30 days of discharge or during the postoperative hospital stay. Demographic characteristics including; gender, marital and educational status, smoking habits, alcohol consumption, body mass index (BMI) were also noted. Statistical analyses were performed to compare preoperative and postoperative frailty scores and to investigate the association between frailty and surgical outcomes.

Frailty Assessment

Two distinct frailty assessment tools were employed: the Clinical Frailty Scale (CFS) and the FRAIL Scale. Both scales were administered to each patient twice: preoperatively and 48 hours postoperatively. Patients were evaluated preoperatively either during their outpatient clinic visit for preoperative preparation prior to elective surgery or upon hospital admission.

The CFS, a clinician-rated scale, assesses frailty based on overall clinical judgment. It utilizes a 9-point scale (1-9), where 1 represents "very healthy" and 9 represents "end-stage patient." Individuals were categorized as "non-frail" (CFS score 1-3), "pre-frail" (CFS score 4), and "frail" (CFS score ≥ 5) [6].

The FRAIL Scale is a self-reported instrument comprising five questions: 1) Fatigue; 2) Stair climbing ability; 3) Walking distance; 4) Multimorbidity (≥ 5 diseases); and 5) Unintentional weight loss ($\geq 5\%$ in 6 months). Caregivers were interviewed when patients lacked adequate cognitive function. Scores range from 0 to 5, with each component contributing one point. Individuals were classified as "non-frail" (score 0), "pre-frail" (score 1-2), and "frail" (score 3-5) [7].

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics version 26 (IBM Corp., Armonk, NY). Continuous variables were summarized as mean±standard deviation or median with interquartile range (IQR). Categorical variables were presented as frequencies and percentages. Chi-square test or Fisher's exact test (where appropriate) was used to compare categorical variables. For paired ordinal data (FRAIL Scale Categories), McNemar-Bowker test was employed. The normality of the numerical variables was assessed using the Shapiro-Wilk test. Continuous data with a normal distribution were compared using Student's t test, while Mann-Whitney U test was employed when the data were not normally distributed. For comparison of 3 or more independent discrete variables Kruskal Wallis test was used. For paired samples of the continuous variables, paired samples t test or Wilcoxon signed rank test was used according to the distribution of the data. Comparison of Multiple Groups: Kruskal-Wallis test was used for comparing three or more independent groups. A P-value of less than 0.05 was considered statistically significant.

RESULTS

Study Population

Of the 91 patients included in the study, 60 (65.9%) were male and 31 (34.1%) were female. The mean age of these patients was 70.9±6.1 (65-75) years. Demographic characteristics of the patients, including educational status, marital status, clinical findings, drug usage, operation type, postoperative conditions, use of formula, colostomy status, and other relevant factors, are presented in Table 1. The median BMI value was 25.0 (Q1:22-Q3:28).

Clinical Assessments and Outcomes

Biochemical parameters, along with pre-operative and post-operative CFS and FRAIL scale values, were obtained and the results are presented in Table 2. The median hospitalization duration was 6 days (Q1:5-Q3:8), and the median ICU stay was 1 day (range 0-23). The median time to feeding initiation was 2 days (range 0-10). An evaluation of the FRAIL index revealed a significant increase in frailty post-operatively. The mean FRAIL scale score was 1.9±1.2 pre-opera-

Table 1. Demographic characteristics and clinical findings

		n (%)
Gender	Male	60 (65.9)
	Female	31 (34.1)
Marital status	Married	55 (60.4)
	Single	18 (19.8)
	Divorced	18 (19.8)
Education status	Illiterate	6 (6.6)
	Literate	10 (11.0)
	Primary School	29 (31.9)
	Middle School	26 (28.6)
	High School	7 (7.7)
Smoking	University	13 (14.3)
	Smoker	33 (36.3)
	Nonsmoker	46 (50.5)
Alcohol consumption	Ex-smoker	12 (13.2)
	Yes	7 (7.7)
	No	84 (92.3)
Polypharmacy	Yes	30 (33.0)
	No	61 (67.0)
Operation type	Open	69 (75.8)
	Laparoscopy	19 (20.9)
	Open after laparoscopy	3 (3.3)
Local complication	Yes	27 (29.7)
	No	64 (70.3)
Systemic complications	Yes	13 (14.3)
	No	78 (85.7)
Ostomy status	Yes	23 (25.3)
	No	68 (74.7)
Use of formula	Yes	59 (64.8)
	No	32 (35.2)
Discharge with drain	Yes	9 (9.9)
	No	82 (90.1)
Mortality	Yes	9 (9.9)
	No	82 (90.1)

tively and 2.3±1.5 post-operatively. The mean change (Δ post-pre) was calculated as 0.4±0.9 ($P<0.001$).

Table 2. Biochemical findings and Frailty scores (CFS and FRAIL scale)

	Mean±SD	Median (Q1-Q3)
TSH (mIU/L)	1.6±1.4	1.2 (0.7-1.8)
Vitamin D (ng/mL)	18.4±10.6	15.8 (9.9-24)
Vitamin B12 (pg/mL)	313.9±202.4	253.5 (172-398)
Hemoglobin (g/dL)	11.6±2.2	11.7(9.8-13.4)
Albumin (g/dL)	36.6±6	38 (32-41)
FRAIL scale – preoperative	1.9±1.2	2 (1-3)
FRAIL scale – postoperative	2.3±1.5	2 (1-3)
CFS –preoperative	4.8±1.2	5 (4-6)
CFS -postoperative	5.1±1.6	5 (4-6)

CFS=Clinical Frailty Scale, TSH=Thyroid Stimulating Hormone, FRAIL=Fatigue, Resistance, Ambulation, Illness, and Loss of weigh, SD=standard deviation, Q1=25th percentile, Q3=75th percentile

A similar trend was observed in the CFS scale, with a higher mean score post-operatively ($P=0.001$). The mean change (Δ post-pre) was calculated as 0.3 ± 0.8 , with pre-operative measurements indicating a mean score of 4.8 ± 1.2 and post-operative measurements showing a mean score of 5.1 ± 1.6 .

Frailty Status Transition

Preoperatively, 11 patients were categorized as robust, 49 as pre-frail, and 31 as frail based on the FRAIL scale (Fig. 1). Postoperatively, the distribution

shifted: 9 patients were robust, 45 were pre-frail, and 37 were frail. A detailed analysis revealed that 9 of the 11 initially robust patients transitioned to the pre-frail category postoperatively. Moreover, 8 of the 49 pre-frail patients progressed to the frail category, indicating an increase in frailty. Conversely, 11 patients demonstrated a decrease in their frailty level. Although a higher number of patients experienced an increase in frailty compared to those with a decrease, this difference did not reach statistical significance according to the McNemar-Bowker test ($P=0.146$).

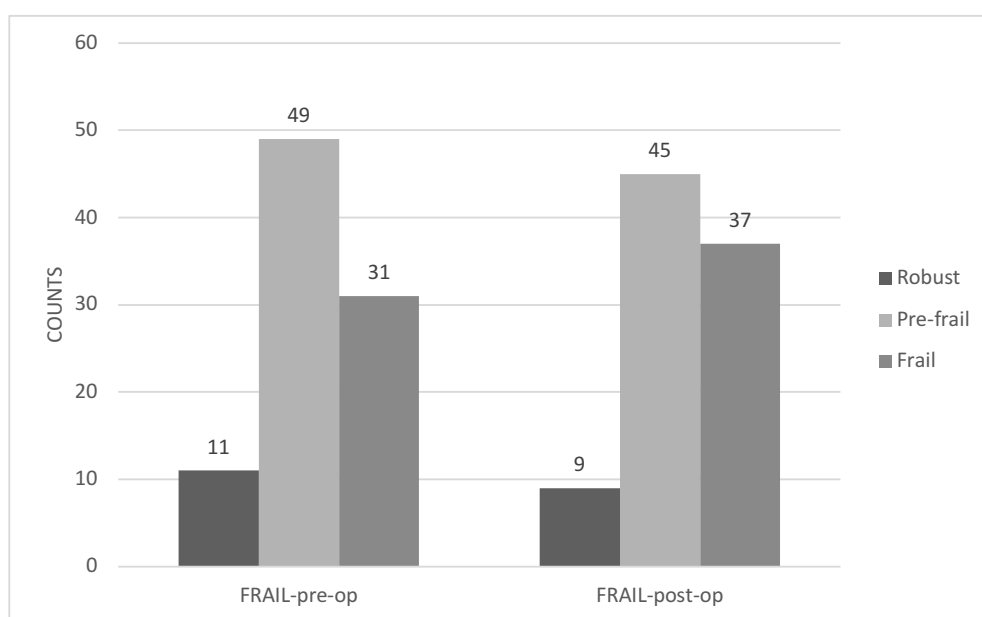
**Fig. 1. Frailty categories according to FRAIL scale at pre-operatively and post-operatively**

Table 3. Investigation of factors in patients with and without increased frailty according to the FRAIL scale

		Change in frailty		P value
		Did not change/decreased	Increased	
TSH (mIU/L)		1.21 (0.75-1.65)	1.26 (0.685-1.845)	0.847
Vitamin D (ng/mL)		15.9 (9.1-23.7)	15.1 (11.8-24.4)	0.934
Vitamin B12 (pg/mL)		273 (184-398)	224 (162-399)	0.330
Hemoglobin (g/dL)		12.2 (10.1-13.5)	11.1 (9.7-12.9)	0.151
Albumin (g/dL)		38 (37-43)	35 (30-39)	0.001
Operation duration (minutes)		197 (140-244)	230 (165-263)	0.189
Duration of hospitalization (days)		6 (5-7)	7 (5-12)	0.015
Time to feeding (hours)		2 (1-3)	3 (1.5-3)	0.132
Intensive care duration (days)		1 (1-1)	1 (1-2)	0.143
Age (years)		71.3±6.5	70.6±5.8	0.599
Mortality	Yes	1 (2.2)	8 (17.4)	0.030
	No	44 (97.8)	38 (82.6)	
Operation type	Open	33 (73.3)	36 (78.3)	0.640
	Laparoscopy	11 (24.4)	8 (17.4)	
	Open after Laparoscopy	1 (2.2)	2 (4.3)	
Local complication	Yes	10(22.2)	17 (37)	0.169
	No	35 (77.8)	29 (63)	
Systemic complications	Yes	1 (2.2)	12 (26.1)	0.002
	No	44 (97.8)	34 (73.9)	
	No	43 (97.7)	42 (91.3)	
Ostomy status	Yes	5 (11.1)	18 (39.1)	0.003
	No	40 (88.9)	28 (60.9)	
Use of formula	Yes	26 (57.8)	33 (71.7)	0.192
	No	19 (42.2)	13 (28.3)	
Discharge with drain	Yes	0 (0)	9 (19.6)	0.003
	No	45 (100)	37 (80.4)	
Gender	Male	30 (66.7)	30 (65.2)	0.999
	Female	15 (33.3)	16 (34.8)	
Marital status	Married	31 (68.9)	24 (52.2)	0.301
	Single	7 (15.6)	11 (23.9)	
	Divorced	7 (15.6)	11 (23.9)	
Education status	Illiterate	4 (8.9)	2 (4.3)	0.923
	Literate	5 (11.1)	5(10.9)	
	Primary School	14 (31.1)	15 (32.6)	
	Middle School	13 (28.9)	13 (28.3)	
	High School	4 (8.9)	3 (6.5)	
Smoking	University	5 (11.1)	8 (17.4)	0.878
	Smoker	15 (33.3)	18 (39.1)	
	Non smoker	24 (53.3)	22 (47.8)	
	Ex-smoker	6 (13.3)	6 (13)	
Alcohol consumption	Yes	4 (8.9)	3 (6.5)	0.714
	No	41 (91.1)	43 (93.5)	
Polypharmacy	Yes	13 (28.9)	17 (37)	0.505
	No	32 (71.1)	29 (63)	

Data are shown as mean±standard deviation or median (Q1-Q3) or n (%). FRAIL=Fatigue, Resistance, Ambulation, Illness, and Loss of weigh

Table 4. CFS scores according to patient characteristics

		Median (Q1-Q3)	P value
Mortality	Yes	8 (8-9)	0.001
	No	5 (4-5)	
Operation type	Open	5 (4-6)	0.334
	Laparoscopy	5 (4-7)	
	Open after Laparoscopy	4 (4-4)	
Local complication	Yes	5 (4-6)	0.117
	No	5 (4-7)	
Systemic complications	Yes	5 (4-5)	<0.001
	No	8 (7-8)	
Ostomy status	Yes	7 (5-7)	<0.001
	No	5 (4-5)	
Use of formula	Yes	4 (4-5,5)	0.008
	No	5 (4-7)	
Discharge with drain	Yes	5 (4-6)	0.875
	No	5 (4-6)	
Gender	Male	5 (4-6)	0.699
	Female	5 (4-6)	
Marital Status	Married	5 (4-6)	0.333
	Single	4 (3-7)	
	Divorced	5 (4-7)	
Education Status	Illiterate	5 (4-5)	0.755
	Literate	5 (4-5)	
	Primary School	5 (4-6)	
	Middle School	4 (4-6)	
	High School	5 (4-7)	
	University	6 (4-7)	
Smoking	Smoker	6 (4-7)	0.029
	Non smoker	5 (4-5)	
	Ex-smoker	4 (4-5)	
Alcohol consumption	Yes	7 (4-8)	0.084
	No	5 (4-6)	
Polypharmacy	Yes	5 (4-6)	0.215
	No	5 (4-7)	

CFS=Clinical Frailty Scale

Clinical Outcomes and Associations

Patients with increased frailty exhibited significantly lower serum albumin levels ($P=0.001$). These patients also demonstrated: prolonged hospitalization ($P=0.015$), higher mortality rates ($P=0.030$), increased rates of systemic complications ($P=0.002$), higher rates of ostomy and discharge with drain ($P=0.003$). These findings are summarized in Table 3.

CFS Scale Associations

Analysis of the CF) revealed weak but statistically significant positive correlations with: duration of ICU stay ($r=0.317$, $P=0.002$), duration of hospitalization ($r=0.314$, $P=0.002$). A significant difference in CFS scores was observed between survivors and non-survivors. The mortality group exhibited a significantly higher median CFS score (8 [8-9]) compared to the survival group (5 [4-5]) ($P=0.001$). Furthermore, a higher CFS score was associated with: development of systemic complications, presence of ostomy, use of formula feeding. These associations are detailed in Table 4.

DISCUSSION

This study analyzed preoperative and postoperative frailty status in elderly patients who underwent elective GI system cancer surgery. Both CFS and FRAIL scale results showed a statistically significant increase postoperatively. Also, the prevalence of frailty increased from 34.1% preoperatively to 40.7% postoperatively. Furthermore, significant associations were observed between high frailty scores and: low serum albumin levels, prolonged hospital stay, increased mortality. These findings underscore the negative impact of surgical procedures on frailty levels in elderly patients. Frailty, a condition of decreased physiological reserve and increased vulnerability, is crucial for risk assessment in aging and oncology, especially in cancer patients where it's more prevalent. Identifying frail older cancer patients is vital due to the stress of aggressive treatments [8, 9]. In the general population, frailty prevalence increases significantly with age. While approximately 10% of individuals aged 65 and over exhibit frailty, this rate rises substantially to 25-50% in those aged 85 and over. Among cancer patients, Handforth *et al.* [8] reported a median frailty

prevalence of approximately 43% in individuals aged 72 or older.

Frailty in elderly colorectal cancer surgery patients ranges from 25-46% [10]. Meta-analysis shows 31% prevalence [11], with a study reporting 34% [12]. Frailty prevalence in gastric surgery patients increased from 34.1% preoperatively to 40.7% postoperatively, as shown in our study. This aligns with reported frailty rates in similar populations (29% [3]). Both FRAIL and CFS scores significantly increased postoperatively.

GI surgery in elderly patients increases frailty risk, likely due to cancer-related stress and post-operative complications like delayed feeding, drains, and ostomies. Our study confirms this, showing increased frailty scores with ostomy or drain placement.

Serum albumin levels, reflecting nutrition and inflammation, are key health indicators, especially in surgical and elderly patients. Lower serum albumin levels correlate with higher frailty scores, indicating hypoalbuminemia as a frailty marker. Combining albumin measurements with frailty assessments improves prediction of surgical outcomes, including complications, mortality, and hospital stay [13, 14]. Prior research has underscored the significant association between frailty and hypoalbuminemia. A study involving patients undergoing free tissue flap reconstruction demonstrated that a combined assessment of frailty and hypoalbuminemia served as a strong predictor of postoperative outcomes, emphasizing their interdependent relationship [15]. Further supporting this, a study examining the relationship between frailty and outcomes following laparoscopic gastrectomy in elderly patients (≥ 80 years) with gastric cancer revealed significantly lower preoperative albumin levels in frail individuals [16]. Consistent with these findings, our study observed lower albumin levels in patients with increased frailty. Moreover, these patients exhibited prolonged hospital stays. These findings collectively emphasize the strong association between serum albumin levels and frailty.

Elderly GI surgery patients with frailty have higher mortality rates. A meta-analysis study further emphasized this association, revealing that frail patients exhibited significantly higher rates of overall mortality and rehospitalization within one year following gastrectomy [17]. Garland *et al.* [18] demonstrated a strong association between higher FRAIL Index scores and increased morbidity in elderly patients with

GI cancer. Chao *et al.* [19] reported that incorporating frailty scales as continuous variables significantly improved mortality prediction performance in individuals over 50 years of age. Furthermore, a study conducted on individuals over the age of 75 revealed a positive relationship between frailty score and mortality, independent of the underlying hospital admission diagnosis [20]. In the present study, a statistically significant increase in mortality rates was observed among patients with increased postoperative frailty compared to the preoperative period. When analyzing the relationship between frailty and survival status, the median CFS score was significantly higher in non-survivors (median: 8, range: 8-9) compared to survivors (median: 5, range: 4-5). Therefore preoperative frailty assessments are crucial for elderly surgical candidates.

Limitations

Limitations include a small sample size, the inclusion of all patients 65+ potentially obscuring age-related differences, and potential selection bias due to voluntary participation.

CONCLUSION

In conclusion, accurate preoperative frailty assessment holds significant clinical implications for optimizing surgical outcomes in elderly patients. By identifying frail individuals, clinicians can implement targeted interventions to decrease surgical risks and improve postoperative recovery. Conversely, a frailty index can help avoid overtreatment of frail patients who may not benefit from aggressive surgical approaches.

Ethical Statement

This observational prospective, cohort study was approved by the Adana City Training and Research Hospital Clinical Research Ethics Committee (Decision no. 3178, Date: 15.02.2024). Written informed consent was obtained from all participating patients.

Authors' Contribution

Study Conception: GO; Study Design: GO; Supervision: GO, AS; Funding: N/A; Materials: N/A; Data Collection and/or Processing: GO, AS; Statistical Analysis and/or Data Interpretation: GO, AS; Literature

Review: GO; Manuscript Preparation: GO, AS and Critical Review: GO, AS.

Conflict of interest

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