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Quality of life in elderly patients undergoing coronary artery bypass graft surgery: The role of inflammation, nutrition and functional status

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ABSTRACT

Objective: This prospective descriptive correlational study aimed to examine inflammation, changes in functional status, nutritional status, and quality of life in older adults undergoing coronary artery bypass graft (CABG) surgery.

Material and Methods: The study sample consisted of 120 conscious and voluntary patients aged 65 years and older who underwent on-pump CABG surgery between February 2017 and January 2018 at the Department of Cardiovascular Surgery of a Ege University Medical Faculty Hospital. Data were collected at hospital admission and at the eighth postoperative week through face-to-face interviews. Data collection included sociodemographic and clinical characteristics, inflammatory markers, functional status, nutritional status, and quality of life. Data were analyzed using SPSS for Windows, version 23.0.

Results: At the eighth postoperative week, significant declines were observed in functional status, nutritional status, and physical quality of life compared with the preoperative period ($p<0.05$). Significant differences were also found in mental status scores, inflammatory markers, five times sit-to-stand test results, timed up and go test scores, handgrip strength, Katz index of activities of daily living scores, Lawton-Brody instrumental activities of daily living scores, anthropometric measurements, and mini nutritional assessment scores ($p<0.05$). Age was not significantly associated with functional status, nutritional status, or quality of life. Exploratory, unadjusted correlation analyses identified several low associations among inflammatory markers, functional status, nutritional status, and the physical and mental components of quality of life; none met the relevant Bonferroni-adjusted thresholds.

Conclusion: During the first eight weeks after CABG, older individuals in this cohort showed multidimensional postoperative changes, particularly in functional capacity, nutritional status, inflammatory profile, and quality of life. Because the study did not include a comparator group, these temporal changes should not be interpreted as effects attributable specifically to CABG. The findings indicate a need for multidisciplinary assessment and support for functional recovery, nutritional status, and overall well-being.

Keywords: Cardiac surgery, older adults, inflammation, functional status, nutrition, quality of life

INTRODUCTION

Advances in medicine and technology have increased life expectancy, but aging is also associated with a higher risk of cardiovascular disease because of physiological and metabolic changes (1,2). Coronary artery disease remains one of the leading causes of morbidity and mortality worldwide, and coronary artery bypass grafting (CABG) is frequently used in its surgical treatment (3-7). However, cardiopulmonary bypass and the surgical process may trigger systemic inflammatory responses and postoperative complications, particularly in older adults (2,3,6).

Older patients are more vulnerable to postoperative decline because of reduced physiological reserve, comorbidities, and increased risk of functional impairment, malnutrition, and poorer quality of life after surgery (7-13). Functional status, nutritional status, and quality of life are therefore important components of recovery in this population (14-17). Multidisciplinary care, including nursing, nutritional, and psychosocial support, may improve postoperative prognosis and quality of life in older CABG patients (18,19).

However, the existing literature has mostly focused on isolated outcomes, and studies simultaneously evaluating inflammation, functional status, nutritional status, and quality of life in older CABG patients remain limited (20-22). Longitudinal evidence addressing both the preoperative and postoperative periods in this population is also insufficient (21,22). Despite the greater likelihood of postoperative deterioration

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in older patients, multidimensional studies examining these outcomes together are scarce (15,17,20-22). In addition, the European Society of Cardiology has emphasized the importance of integrating exercise and nutritional interventions in the management of cardiovascular vulnerability and sarcopenia (3,17). Accordingly, this study prospectively evaluated inflammation, functional status, nutritional status, and quality of life in older adults undergoing CABG before surgery and at the eighth postoperative week.

MATERIAL and METHODS

Aim of the Study: The aim of this study was to evaluate inflammation, functional status, nutritional status, and quality of life in older adults undergoing CABG surgery, and to examine the associations among postoperative inflammatory markers, functional status, nutritional status, and quality of life.

Design: This study employed a prospective descriptive correlational design.

Participants: The study population consisted of 186 patients aged 65 years and older who underwent CABG surgery at the Cardiovascular Surgery Department of a Ege University Hospital between February 2017 and January 2018. No sampling method was applied, as the aim was to include the entire population during the specified period. Of the 186 patients screened, 38 declined participation and 4 were excluded because their standardized mini-mental test (SMMT) score was below 24, leaving 144 participants enrolled. During follow-up, 3 participants died, 8 withdrew, and 13 did not attend the eighth-week outpatient assessment. Thus, 24 of the 144 enrolled participants (16.7%) did not complete follow-up, and the final analytic sample comprised 120 participants. Overall, 120 of the 186 screened patients (64.5%) were included in the final analysis.

Inclusion and Exclusion Criteria: Patients aged ≥65 years who underwent on-pump CABG surgery and were fully conscious were included in the study. Cognitive status was evaluated using the SMMT, and patients scoring below 24 points were excluded.

Dependent Variables: Dependent variables included serum albumin, C-reactive protein (CRP), procalcitonin, leukocyte count, neutrophil and lymphocyte percentages, durations of physical performance tests, Katz index of activities of daily living (ADL), Lawton-Brody instrumental activities of daily living (IADL) scale, mini nutritional assessment (MNA) score, muscle strength (kg), short form-12 (SF-12) scores, and SMMT scores.

Independent Variables: Independent variables included patient age, sex, marital status, household composition, employment status, medication use, presence of atrial fibrillation, sleep quality, body mass index, chronic diseases, exercise habits, weight loss, appetite changes, and smoking status.

Data Collection: Data were collected by the researchers before surgery and at the eighth postoperative week using a structured data collection form. Preoperative interviews were conducted in the cardiovascular surgery clinic, and postoperative interviews were performed during the patients' scheduled outpatient appointments. Data collection was carried out without interrupting patient examinations or laboratory procedures and was conducted at a time convenient for each participant.

Data Collection Tools: The data for this study were obtained using a structured data collection form developed by the researchers. The form consisted of sections addressing sociodemographic and medical information, the SMMT, inflammation-related markers, functional status assessments, nutritional evaluations, and quality-of-life measures. Detailed descriptions of the instruments are provided below.

-Socio-demographic and Medical Information Form: This form was developed by the researchers and included questions regarding the patient's age, sex, marital status, education level, economic status, household composition, place of residence, employment status, New York Heart Association classification (from patient records), and other medical information (23).

SMMT: SMMT developed by Molloy and Standish (24), was used to assess cognitive status. It consists of 11 items grouped under five domains: Orientation, registration, attention and calculation, recall, and language, and is scored out of a total of 30 points. Scores between 24 and 30 are considered normal. In the original version, specific administration instructions are provided, and Molloy and Standish (24) reported that the use of a standardized administration guide improves interrater reliability. The SMMT and its administration guide were translated into Turkish by Güngen et al. (25).

Inflammation-related Data: Patients' inflammatory status was evaluated using CRP, procalcitonin, erythrocyte sedimentation rate, leukocyte count, neutrophil percentage, and lymphocyte percentage, all obtained from patient records.

Functional Status Assessments: Functional status was evaluated by the researchers using the Katz index of independence in ADL, the Lawton-Brody IADL scale, the five times sit-to-stand test, and the timed up and go test.

The Katz Index of ADL: Katz index of ADL, developed by Katz et al. (26), was used to assess basic daily living activities required for independent functioning. The index consists of six items related to bathing, dressing, toileting, mobility, continence, and feeding. Each activity is scored as 3 if performed independently, 2 if performed with assistance, and 1 if the individual is unable to perform it. Total scores of 0-6 indicate dependency, 7-12 semi-dependency, and 13-18 independence. The Turkish validity and reliability study of the scale was conducted by Özkan Pehlivanoğlu et al. (27) and a Cronbach's alpha coefficient of 0.84

has been reported in the Turkish literature. In the present study, Cronbach's alpha was 0.165 in the preoperative assessment and 0.631 at postoperative week 8. The very low preoperative coefficient likely reflects the restricted variability and pronounced ceiling effect observed in the item scores. Because the Katz ADL is an index-based functional assessment tool, its internal consistency coefficients were interpreted cautiously (26,27).

Lawton-Brody IADL: The Lawton-Brody IADL index, developed by Lawton and Brody (28), was used to assess IADL. The index consists of eight items related to using the telephone, preparing meals, shopping, housekeeping, doing laundry, using transportation, managing medications, and handling finances. Each activity is scored as 3 if performed independently, 2 if performed with assistance, and 1 if the individual is unable to perform it. Total scores of 0-8 indicate dependency, 9-16 semi-dependency, and 17-24 independence. This scale is widely used both internationally and in Türkiye to evaluate IADL. The Turkish validity and reliability study of the scale was conducted by Güzel et al. (29). In that study, the Turkish version of the scale was found to be valid and reliable. In the present study, Cronbach's alpha was 0.777 in the preoperative assessment and 0.828 at postoperative week 8 (28).

Five Times Sit-to-stand Test: Used to assess lower extremity strength and balance.

Timed Up and Go Test: Used to evaluate a patient's ability to perform daily living activities independently. The timed up and go test is a practical assessment used to evaluate an individual's functional mobility and balance performance. In this test, the individual is asked to stand up from a chair, walk 3 meters, turn around, walk back, and sit down again; a longer completion time suggests impaired mobility and balance.

Nutritional Status and Weight Loss Assessments: Patients' nutritional status was evaluated using the MNA, anthropometric measurements performed by the researchers, and serum albumin levels obtained from patient records.

The MNA: The MNA was originally developed in France and published in 1994. The revised MNA provides a practical and rapid assessment of nutritional status and retains its validity and reliability in identifying individuals who are malnourished or at risk of malnutrition (30). The maximum total score is 30, with scores of 24-30 indicating normal nutritional status, 17-23.5 indicating risk of malnutrition, and scores below 17 indicating malnutrition. The Turkish validity study of the MNA and its SF was conducted by Sarikaya et al. (31), who reported that both forms are valid screening tools in Turkish older adults. In the present study, Cronbach's alpha for the MNA-SF was 0.349 in the preoperative assessment and 0.543 at postoperative week 8. Because the primary analyses used the full 30-point MNA, internal consistency was also calculated for the full instrument and was 0.397 preoperatively and 0.493 at postoperative week 8. Because the MNA comprises multidimensional items addressing nutritional and clinical risk, these internal consistency coefficients were interpreted cautiously (30,31).

Anthropometric Measurements: Weight was measured using a calibrated scale, height using a wall-mounted stadiometer, and mid-upper arm (non-dominant) and left calf circumferences were measured using a tape measure. Anthropometric measurements were used to assess patients' physical and nutritional status objectively. In this study, measurements such as body weight and related body composition indicators were considered important because they may reflect postoperative nutritional decline and recovery status in older adults undergoing CABG.

Muscle Strength Assessment: Handgrip strength was measured with a Takei hand dynamometer to provide an objective assessment of muscle strength and functional capacity. In older adults undergoing CABG, handgrip strength is a useful indicator of physical performance, recovery status, and potential decline in overall functional ability.

Quality of Life Assessment: Quality of life was assessed by the researchers using the SF-12 health survey.

The SF-12 Health Survey*:* The SF-12 health survey, originally developed by Ware et al. (32), is a brief instrument used to assess health-related quality of life. Derived from the SF-36, it includes 12 items representing eight health domains and yields two summary measures: The physical component summary (PCS) and the mental component summary (MCS). The Turkish validity and reliability study of the SF-12 was conducted by Soylu and Kütük (33), who reported that the Turkish version is a valid and reliable instrument. Because the SF-12 is interpreted through component summary scores rather than a single total score, Cronbach's alpha was not emphasized as the primary indicator of reliability in the present study (32,33).

Statistical Analysis

Data were analyzed using SPSS for Windows, version 23.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were expressed as number (percentage) for categorical variables and mean ± standard deviation for continuous variables. The normality of continuous variables was assessed using the Shapiro-Wilk test and visual inspection of histograms and Q-Q plots. According to the distributional properties of the data, parametric or non-parametric tests were used as appropriate. Correlations between numerical variables were examined using Spearman's rank correlation coefficient, because some variables were ordinal and/or did not meet the assumptions of normal distribution. The correlation analyses were exploratory; therefore, the reported p values were not adjusted for multiple

comparisons. A two-sided p-value <0.05 was used as a nominal significance threshold. To show the effect of multiplicity, table-specific Bonferroni-adjusted thresholds are provided in the table footnotes, and the correlation findings are interpreted cautiously. Missing data were checked prior to analysis, and no imputation was performed because missingness was not at a level that could affect the statistical findings (34).

Research Ethics: Written approval was obtained from the Department of Cardiovascular Surgery and the Ege University Research Ethics Committee (decision no: 17-1.1./7, date: 13.02.2017). Written informed consent was obtained from all participants prior to data collection.

RESULTS

The mean age of the patients included in the study was 70.24±3.80 years (range, 65-83). Of the participants, 66.7% were male, 73.3% were married, 15.0% lived alone, 75.8% were unemployed, 87.5% had chronic diseases, 89.2% were taking regular medications, and 35.8% had atrial fibrillation. Sleep disturbances were reported by 50.8% of patients before surgery and by 92.5% after surgery. Participation in exercise activities was reported by 16.7% of patients. Smoking habits were observed in 33.3% of patients preoperatively and in 20.8% postoperatively. Unintentional weight loss during the past three months was reported by 15.8% of patients before surgery and by 65.0% after surgery. Appetite loss was reported by 20.8% of patients preoperatively and by 59.2% postoperatively (Table 1).

The descriptive characteristics of the patients are shown in Table 1.

When comparing preoperative and postoperative eighth-week assessments, SMMT scores decreased significantly (t=3.319, p=0.001). Among the inflammatory markers, CRP (t=-5.953, p<0.001) and leukocyte levels (t=-2.615, p=0.010) increased, whereas lymphocyte percentages decreased (t=2.348, p=0.021). No significant changes were found in procalcitonin or neutrophil levels (p>0.05). Functional status indicators showed significant changes in the five times sit-to-stand test (t=-7.442, p<0.001), timed up-and-go test (t=-5.684, p<0.001), right-hand grip strength (t=3.941, p<0.001), left-hand grip strength (t=11.044, p<0.001), Katz ADL scores (t=10.169, p<0.001), and Lawton-Brody IADL scores (t=33.416, p<0.001). Significant changes were also observed in weight (t=13.360, p<0.001), body mass index (t=13.166, p<0.001), mid-arm circumference (t=12.160, p<0.001), calf circumference (t=9.873, p<0.001), triceps skinfold thickness (t=8.779, p<0.001), biceps skinfold thickness (t=9.278, p<0.001), and MNA scores (t=11.964, p<0.001).

Significant differences were found in both SF-12 component scores (PCS: t=6.462, p<0.001; MCS: t=-6.832, p<0.001). No significant changes were observed in subscapular skinfold thickness (t=1.267, p=0.208) or serum albumin levels (t=1.916, p=0.058) (Table 2).

Mean changes between preoperative and postoperative assessments are summarized in Table 2.

Table 1. Distribution of patients by descriptive characteristics (n=120)

Variables	n	%
Gender		
Female	40	33.3
Male	80	66.7
Marital status		
Married	88	73.3
Single	32	26.7
People living together		
Alone	18	15
With spouse	81	67.5
With spouse and children	4	3.4
With children(s)	17	14.2
Employment status		
Employed	29	24.2
Unemployed/retired	91	75.8
Chronic disease presence		
Yes (DM, HT, thyroid, etc.)	105	87.5
No	15	12.5
Regular medication use		
Yes	107	89.2
No	13	10.8
Atrial fibrillation		
Yes	43	35.8
No	77	64.2
Sleep problems		
Yes before surgery	61	50.8
No before surgery	59	49.2
Yes, at 8th week after surgery	111	92.5
No, at 8th week after surgery	9	7.5
Regular exercise before surgery		
Yes	20	16.7
No	100	83.3
Smoking habit		
Yes, before surgery	40	33.3
No, before surgery	80	66.7
Yes, at 8th week after surgery	25	20.8
No, at 8th week after surgery	95	79.2
Unintentional weight loss (last 3 months)		
Yes, before surgery		
No, before surgery	19	15.8
Unintentional weight loss in the at 8th week	101	84.2
Yes, after surgery	78	65
No, after surgery	42	35
Appetite loss		
Yes, before surgery	25	20.8
No, before surgery	95	79.2
Yes, at 8th week after surgery	71	59.2
No, at 8th week after surgery	49	40.8
Total	120	100

n: Number, %: Percent, DM: Diabetes melitus, HT: Hypertansion.

No association was found between patients' age and their functional status. In unadjusted exploratory analyses, low positive correlations were observed between CRP, procalcitonin, and neutrophil levels and functional status measured using the Katz index of ADL (CRP, r_s=0.191, p=0.037; procalcitonin, r_s=0.248, p=0.006; neutrophil, r_s=0.209, p=0.022). Low positive correlations were also observed between leukocyte and neutrophil levels and functional status assessed using the Lawton-Brody IADL scale (leukocyte, r_s=0.235, p=0.010; neutrophil, r_s=0.189, p=0.039) (Table 3). None of the 12 correlations in Table 3 met the Bonferroni-adjusted significance threshold of p<0.0042. No association was observed between lymphocyte levels and functional status.

The correlations between patients' age, inflammatory markers, and functional status are presented in Table 3.

Table 2. Evaluation of mean changes in study variables between preoperative and 8th-week postoperative assessments (n=120)

Variable	Preoperative Mean ± SD	8th-week postoperative Mean ± SD	Test value t	p-value*
Standardized mini-mental test	26.12±2.95	25.80±2.75	3.319	**0.001**
CRP (mg/L)	4.34±5.82	9.92±10.12	-5.953	**<0.001**
Procalcitonin (pg/dL)	1.58±4.87	1.52±4.13	0.331	0.741
Leukocyte ($10^3/\mu L$)	9.61±3.38	12.18±10.63	-2.615	**0.010**
Neutrophil (%)	69.39±14.60	70.41±16.68	-0.507	0.613
Lymphocyte (%)	17.99±10.97	15.62±9.11	2.348	**0.021**
5 sit-to-stand test (seconds)	15.95±1.38	16.26±1.21	-7.442	**<0.001**
Timed up and go test (seconds)	16.60±1.47	16.85±1.22	-5.684	**<0.001**
Hand grip strength				
Right hand (kg)	33.45±4.66	32.83±5.11	3.941	**<0.001**
Left hand (kg)	29.30±4.30	28.80±4.31	11.044	**<0.001**
Katz activities of daily living scale	17.90±0.44	16.48±1.47	10.169	**<0.001**
Lawton-Brody instrumental activities of daily living scale	20.49±2.73	15.95±2.94	33.416	**<0.001**
Anthropometric measurements				
Weight (kg)	73.18±7.96	71.28±7.84	13.360	**<0.001**
Body mass index (kg/m^2)	25.27±2.51	24.61±2.41	13.166	**<0.001**
Arm circumference (cm)	26.79±1.80	26.56±1.79	12.160	**<0.001**
Calf circumference (cm)	32.19±1.26	31.91±1.36	9.873	**<0.001**
Skinfold thickness (mm) (triceps)	12.11±4.35	11.83±4.30	8.779	**<0.001**
Skinfold thickness (mm) (biceps)	7.33±2.31	7.15±2.27	9.278	**<0.001**
Skinfold thickness (mm) (subscapular)	15.88±3.35	15.73±3.01	1.267	0.208
Mini nutritional assessment test	24.00±2.09	21.53±2.69	11.964	**<0.001**
Serum albumin (g/dL)	3.72±0.64	3.53±0.88	1.916	0.058
SF-12 health survey				
Physical component summary	43.65±5.30	40.17±4.85	6.462	**<0.001**
Mental component summary	41.88±5.55	46.43±6.11	-6.832	**<0.001**

SD: Standard deviation, *: p<0.05 (statistically significant), t: Paired t-test, SF: Short form, CRP: C-reactive protein.

Table 3. Associations between patients' age, inflammatory and nutritional markers, and functional status (n=120)

	Katz ADL score difference		Lawton-Brody IADL score difference	
	r_s	p*	r_s	p*
Age	0.058	0.529	0.119	0.197
CRP (mg/L) levels**	0.191	**0.037**	0.131	0.153
Procalcitonin (pg/dL) levels**	0.248	**0.006**	0.133	0.147
Leukocyte ($10^3/\mu L$) levels**	0.113	0.220	0.235	**0.010**
Neutrophil (%) levels**	0.209	**0.022**	0.189	0.039
Lymphocyte (%) levels**	-0.138	0.133	-0.178	0.051

*: Unadjusted two-sided p-values; p<0.05 indicates nominal significance. Bonferroni threshold: p<0.0042 (12 tests); none met it. r_s: Spearman's rank correlation coefficient, **: Preoperative-to-eighth-week postoperative change, ADL: Activities of daily living, CRP: C-reactive protein, IADL: Instrumental activities of daily living.

No correlation was found between age and change in nutritional status (r_s=-0.174, p=0.057). In unadjusted exploratory analyses, low positive correlations were observed between change in nutritional status and changes in functional status measured using the Katz ADL (r_s=0.227, p=0.013) and Lawton-Brody IADL (r_s=0.244, p=0.007). No associations were identified between changes in inflammatory markers or serum albumin levels and change in nutritional status (Table 4). None of the nine correlations in Table 4 met the Bonferroni-adjusted significance threshold of p<0.0056.

The relationships between age, functional and inflammatory parameters, and nutritional status are shown in Table 4.

No association was found between patients' age and quality of life. Similarly, no correlation was observed between Katz index of ADL scores and quality of life. In unadjusted exploratory analyses, a low positive correlation was observed between Lawton-Brody IADL scores and the physical component of quality of life (r_s=0.196, p=0.032). No association was found between CRP levels and quality of life. A low positive correlation was observed between procalcitonin levels and the mental component of quality of life (r_s=0.245, p=0.007). Low positive correlations were also observed between leukocyte, neutrophil, and lymphocyte levels and the physical component of quality of life (leukocyte, r_s=0.194, p=0.034; neutrophil, r_s=0.229, p=0.012; lymphocyte, r_s=0.223, p=0.014). No association was observed between nutritional status and quality of life (Table 5). None of the 20 correlations in Table 5 met the Bonferroni-adjusted significance threshold of p<0.0025.

The associations between functional, inflammatory, and nutritional parameters and quality-of-life outcomes are illustrated in Table 5.

DISCUSSION

In this cohort, the first eight weeks after CABG coincided with clinically important changes in several health domains. Compared with the preoperative period, reduced functional capacity was observed at postoperative week 8, reflected by deterioration in ADL, mobility, lower-extremity function, and handgrip strength. Nutritional status also worsened, as evidenced by changes in nutritional markers, anthropometric measurements, and MNA scores. These temporal changes are

Table 4. Comparison of differences in patients' age, preoperative and 8th-week postoperative ADL, IADL, inflammatory markers (CRP, procalcitonin, leukocyte, neutrophil, lymphocyte), and nutritional marker (serum albumin) with mini nutritional assessment results (n=120)

	Difference in mini nutritional assessment scores**	
	r_s	p*
Age	-0.174	0.057
Katz ADL scores**	0.227	**0.013**
Lawton-Brody IADL scores**	0.244	**0.007**
CRP (mg/L) levels**	-0.072	0.435
Procalcitonin (pg/dL) levels**	0.095	0.301
Leukocyte ($10^3/\mu L$) levels**	0.129	0.160
Neutrophil (%) levels**	-0.076	0.409
Lymphocyte (%) levels**	-0.050	0.589
Serum albumin (g/dL) levels**	-0.112	0.225

*: Unadjusted two-sided p values; p<0.05 indicates nominal significance. Bonferroni threshold: p<0.0056 (nine tests); none met it. r_s: Spearman's rank correlation coefficient; ** preoperative-to-eighth-week postoperative change, ADL: Activities of daily living, CRP: C-reactive protein, IADL: Instrumental activities of daily living.

Table 5. Associations between age, functional status (ADL, IADL), inflammatory and nutritional markers, mini nutritional assessment scores, and quality of life differences (preoperative vs. 8th-week postoperative) (n=120)

	SF-12 PCS		SF-12 MCS	
	rs	p*	rs	p*
Age	0.002	0.982	0.024	0.792
Katz ADL scores**	0.013	0.892	-0.078	0.396
Lawton & Brody IADL scores**	0.196	**0.032**	0.102	0.269
CRP (mg/L) levels**	0.059	0.519	-0.111	0.228
Procalcitonin (pg/dL) levels**	-0.172	0.060	0.245	**0.007**
Leukocyte ($10^3/\mu L$) levels**	0.194	**0.034**	0.160	0.080
Neutrophil (%) levels**	0.229	**0.012**	-0.038	0.680
Lymphocyte (%) levels**	0.223	**0.014**	-0.023	0.807
Serum albumin (g/dL) levels**	0.082	0.372	0.073	0.430
Mini nutritional assessment scores**	-0.067	0.468	0.052	0.572

*: Unadjusted two-sided p values; p<0.05 indicates nominal significance. Bonferroni threshold: p<0.0025 (20 tests); none met it. r_s: Spearman's rank correlation coefficient; PCS: Physical component summary, MCS: Mental component summary, **: Preoperative-to-eighth-week postoperative change, CRP: C-reactive protein, ADL: Activities of daily living, IADL: Lawton and Brody instrumental activities of daily living, SF: Short form.

consistent with a multidimensional decline during postoperative recovery; however, without a comparator group, they cannot be attributed specifically to CABG. Previous studies have similarly reported that older adults may experience deterioration in mobility, independence, and recovery performance after cardiac surgery (3,17,22).

Socio-demographic findings suggest that surgical outcomes in older CABG patients depend not only on the success of the operation itself, but also on the effective management of coexisting chronic diseases, psychosocial conditions, and health behaviors. In particular, living alone, continued smoking, weight loss, and reduced appetite should be considered clinical risk factors that may negatively affect postoperative recovery (35-40). Therefore, a multidisciplinary approach, smoking cessation support, and regular nutritional monitoring appear to be important components of postoperative care after CABG.

In our study, significant changes in mental status and inflammatory markers were observed between the preoperative assessment and postoperative week 8. Thus, these biological and mental-status changes coincided with the postoperative period, but the study design does not establish that CABG caused them. The findings are broadly consistent with literature examining the relationship between "inflammaging," defined as chronic low-grade inflammation associated with aging, and functional decline. Recent reviews and observational studies have shown that increased systemic inflammation in older patients is associated with reductions in muscle mass, muscle strength, and gait speed, as well as with physical frailty (6,41-43). In addition to inflammation, comorbidities, physical activity level, and physiological reserve may be related to postoperative functional recovery (44,45).

From a nutritional perspective, nutritional status worsened during the postoperative period, whereas age showed a low, non-significant inverse correlation with nutritional change. The observed deterioration coincided with postoperative recovery and may reflect several factors, including surgical stress, hospitalization, increased metabolic demands, reduced appetite, pain, fatigue, decreased physical activity, natural aging, or intercurrent illness. Because there was no comparator group, the relative contribution of CABG cannot be determined. The correlations between functional-status change and nutritional-status change were low (r_s=0.227-0.244) and did not meet the Bonferroni-adjusted threshold. They should therefore be interpreted only as weak, exploratory evidence that these changes co-occurred; their clinical importance is uncertain, and they do not establish that one change caused the other. Previous evidence has linked advanced age and functional dependence with nutritional vulnerability in older adults (46,47). No significant association was found between inflammatory markers and nutritional status at the eighth-week assessment.

With regard to inflammatory markers and quality of life, the nominally significant correlations observed in the unadjusted exploratory analyses were low (r_s=0.194-0.245). As a rough descriptive approximation, squaring coefficients of this magnitude corresponds to only about 4-6% shared variation in ranks. Moreover, none of these correlations met the Bonferroni-adjusted significance threshold for Table 5. Although previous studies have reported associations between inflammatory processes, cognitive or psychological well-being, and physical recovery after cardiac surgery (42,48-50), the present findings may reflect chance and should be considered hypothesis-generating. They do not provide robust evidence that postoperative immune-system activity is a clinically meaningful indicator of physical well-being or psychological recovery.

In terms of quality of life, no significant association was found between age and overall quality of life, supporting the view that quality of life in older adults is related to multiple factors rather than chronological age alone (51,52). The correlation between Lawton-Brody IADL scores and physical quality of life was also low (r_s=0.196, unadjusted p=0.032) and did not remain significant after Bonferroni correction. It should therefore be interpreted as a weak exploratory association of uncertain clinical relevance, rather than evidence that independence in complex activities predicts or determines physical well-being (53,54). No significant association was found between nutritional status and quality of life. Given the short follow-up period, the possibility of an association emerging later cannot be excluded (55-57).

Finally, reduced handgrip strength, poorer mobility performance, lower nutritional scores, and unintentional weight loss were observed during the postoperative period and are consistent with a frailty-related risk pattern. However, because frailty was not measured directly using a validated assessment tool, these findings should not be interpreted as a diagnosis of frailty or as evidence that CABG caused frailty (15,18,48). They instead identify frailty-related characteristics that warrant close follow-up, early rehabilitation, and nutritional support (42,48). Although this study was not designed as an ERAS-based intervention study, the observed recovery needs are consistent with ERAS-related principles, including early mobilization, nutritional support, multidisciplinary care, and close monitoring (58).

Study Limitations

The decline in ADL observed at postoperative week 8 is compatible with reduced mobility; however, muscle mass was not measured, and the mechanism underlying this change cannot be determined. No body-composition analyses were conducted to determine whether postoperative weight loss reflected loss of fat tissue, muscle tissue, or both. Identifying the specific type of tissue loss could have important implications for dietary management. Additionally, the potential contribution of

medication use to postoperative inflammation, nutritional status, and functional outcomes was not evaluated. The study focused on the early recovery period, specifically postoperative week 8; therefore, changes during later recovery were not assessed. The absence of long-term follow-up limits interpretation of the duration and trajectory of the observed changes.

The findings should be considered in light of several methodological considerations. Internal consistency coefficients for the MNA-SF, full MNA, and Katz ADL were below the conventional 0.70 benchmark.

However, these values may partly reflect the multidimensional or index-based structure of the instruments and the restricted variability observed in this relatively homogeneous older CABG cohort. Therefore, findings involving these measures were interpreted cautiously and should be confirmed in future studies conducted in comparable populations.

Of the 144 enrolled participants, 120 completed both assessments, corresponding to a follow-up retention rate of 83.3%. Individual-level baseline data were not available for the 24 participants who did not complete follow-up, including three who died; therefore, a formal comparison between completers and non-completers could not be performed, and some degree of attrition or survivorship bias cannot be excluded. Nevertheless, the relatively high retention rate and standardized prospective assessments provide useful evidence regarding early postoperative changes in this population.

Finally, the single-cohort preoperative-postoperative design did not include a non-surgical, younger, or matched comparison group. Accordingly, the observed changes describe the eight-week postoperative trajectory of the cohort but cannot be attributed exclusively to CABG. Hospitalization, postoperative recovery, changes in physical activity or nutritional intake, and intercurrent illness may also have contributed. Future controlled studies could help clarify the relative contribution of these factors.

CONCLUSION

In this single-cohort study, decreases in functional capacity, nutritional status, and physical quality of life were observed during the first eight weeks after CABG. In the absence of a comparator group, these changes cannot be attributed specifically to the surgical procedure and should be interpreted as temporal associations. The nominally significant correlations involving inflammatory profile, functional status, independence in daily living, nutritional status, and quality of life were low, and none remained significant after the relevant Bonferroni corrections. These correlations should therefore be regarded as hypothesis-generating rather than as established clinical signals. The observed postoperative needs nevertheless support multidisciplinary care that includes management of chronic diseases, smoking cessation support, early rehabilitation, nutritional monitoring, and attention to psychosocial needs.

Ethics

Ethics Committee Approval: Written approval was obtained from the Department of Cardiovascular Surgery and the Ege University Research Ethics Committee (decision no: 17-1.1./7, date: 13.02.2017).

Informed Consent: Institutional permission was also granted by the clinic where the research was conducted. Written informed consent was obtained from all patients who voluntarily agreed to participate.

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Footnotes

This study was derived from the author's master's thesis. Presented as an oral abstract at the 2nd International and 10th National Turkish Surgical and Operating Room Nursing Congress, November 2-5, 2017, Antalya, Türkiye.

Author Contributions

Concept - H.E.Y., F.D.K., Ç.E.; Design - H.E.Y., F.D.K., Ç.E.; Data Collection or Processing - H.E.Y., F.D.K., Ç.E.; Analysis or Interpretation - H.E.Y., F.D.K., Ç.E.; Literature Search - H.E.Y., F.D.K., Ç.E.; Writing - H.E.Y., F.D.K., Ç.E.

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