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ORIGINAL ARTICLE

DETERMINATION OF THE RELATIONSHIP BETWEEN FRAIL SCORE, ASA SCORE, NEUTROPHIL-LYMPHOCYTE RATIO AND ERYTHROCYTE DISTRIBUTION WIDTH AND MORTALITY AND MORBIDITY IN GERIATRIC PATIENTS

Abstract

Introduction: The global increase in the geriatric population has led to a parallel rise in the number of surgical procedures performed in elderly patients. The aim of this study was to evaluate the predictive value of the FRAIL score, ASA score, and hemogram parameters obtained in the preoperative period for postoperative mortality and morbidity.

Materials and Method: This prospective study was conducted between May 1, 2020 and December 31, 2021 with geriatric patients who were scheduled for elective surgery. FRAIL score and ASA scores were assessed during the preoperative evaluation. Preoperative and postoperative hemogram parameters were recorded for all patients.

Results: A total of 167 patients were included in the study, of whom 56 (33.5%) were female and 111 (66.5%) were male. The mean age of the patients was 74.6±8.01 (age range 65-102). According to the FRAIL score, 66 patients (39.5%) were categorized as robust, 63 patients (37.7%) as prefrail, and 38 patients (22.8%) as frail. FRAIL score, ASA score, preoperative NLR, postoperative NLR, preoperative RDW-SD, and postoperative RDW-SD were identified as the most significant parameters associated with postoperative mortality and morbidity ($p<0.0001$, $p<0.0001$, $p<0.0001$, $p=0.002$, $p<0.0001$, respectively).

Conclusion: Our findings suggest that combined preoperative evaluation of ASA score, FRAIL score, NLR, and RDW of the geriatric patients may improve the prediction of postoperative mortality and morbidity during the three-month follow-up period. These parameters, when used together, may provide a practical and effective approach for perioperative risk stratification in geriatric patients.

Keywords: Geriatric Anesthesia; Frailty; Preoperative Period; Erytrocyte Indices; Neutrophils; Lymphocytes.

INTRODUCTION

With the improvement of health policies around the world, the treatment and follow-up of many infectious and non-infectious diseases, and the increase in early diagnosis rates thanks to health screenings, human life expectancy is increasing. In particular, an absolute relative increase in the proportion of elderly and very old people is predicted in the next 30 years. This demographic phenomenon is largely responsible for the increasing prevalence of frailty in society. Frailty is a clinical condition characterized by the extreme vulnerability of the individual to internal and external stressors. This situation creates a high risk in terms of the possibility of developing adverse health-related events. Recognizing the frailty structure to biologically define the action environment of geriatric medicine will lead to the modernization of medical practice methods (1).

As the number of elderly individuals increases, many studies are being conducted on estimating prognosis and predicting mortality and morbidity by developing some scoring systems (FRAIL score, American Society of Anesthesiologists physical status classification-ASA PS), using laboratory markers (hemogram) and changes in these markers. One of these is the FRAIL score, which measures health differences among elderly individuals (2).

ASA score, which is widely used to evaluate the preoperative condition of patients, is an important parameter widely used to predict perioperative morbidity and mortality (3). In recent years, many studies have been conducted on the predictive power of mortality and morbidity using hemogram parameters such as erythrocyte distribution width (RDW) and neutrophil-lymphocyte ratio (NLR) (4,5).

Our aim in this study was to evaluate the contribution of the FRAIL score applied to the patient in the preoperative period, the NLR and RDW levels obtained from hemogram findings, and the ASA score together in predicting mortality and morbidity in the postoperative three-month period.

MATERIALS AND METHOD

This study was conducted prospectively between 01.05.2020 and 31.12.2021 with geriatric patients scheduled for elective surgery at the Operating Room of Research and Training Hospital, a tertiary center.

Patients aged 65 and over, patients who had preoperative and postoperative hemograms, and patients scheduled for elective surgery at Research and Training Hospital were included in the study.

Patients under the age of 65, those who did not accept the study, those whose hemograms were not checked during the postoperative period, those whose contact information could not be reached during the postoperative period, patients undergoing emergency surgeries, and those not scheduled for surgery at Research and Training Hospital were not included in the study.

In this study, after obtaining informed consent from all geriatric patients scheduled for elective surgery, frailty was assessed preoperatively in the outpatient clinic using the FRAIL scale (Fatigue, Resistance, Ambulation, Illnesses, and Loss of weight). The FRAIL score consists of five items, each scored as 0 or 1, yielding a total score ranging from 0 to 5. Patients were classified as robust (0 points), prefrail (1–2 points), or frail (3–5 points), and frailty status was recorded accordingly in the data collection system.

The ASA score, a rating system used to determine the health status of a person before a surgical procedure requiring anesthesia, was determined through routine preoperative examination. Patients without additional diseases were rated as ASA-I, patients with mild but well-controlled or treated conditions as ASA-II, patients with a serious condition affecting general health as ASA-III, and patients with a life-threatening condition as ASA-IV.

Intraoperative vital signs were monitored. In addition, neutrophil, lymphocyte, and RDW values were recorded in the complete blood counts of

patients examined before surgery and within the first 24 hours after surgery. To determine the possibility of mortality or morbidity within 90 days after surgery, information was obtained from the patient using the contact information and/or informed consent form registered in the hospital information system.

The study protocol was approved by the Clinical Research Ethics Committee (Decision No: 2017-KAEK-189_2020.05.28_15 File registration no: 2020-04-68) and adhered to the principles of the Declaration of Helsinki.

Statistical analysis

All statistical analyses were performed using IBM SPSS Statistics version 20.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were presented as frequencies and percentages for categorical variables, and as mean ± standard deviation or median (interquartile range) for continuous variables, as appropriate. Continuous variables with non-normal distribution, such as NLR and RDW parameters, were additionally presented as median (interquartile range), particularly in post-hoc analyses.

The distribution of continuous variables was assessed using the Kolmogorov–Smirnov test. For comparisons between two groups, independent samples t-test or Mann–Whitney U test was used according to data distribution. For comparisons among more than two groups, one-way ANOVA or Kruskal–Wallis test was applied, as appropriate. Post-hoc pairwise comparisons were performed for variables with statistically significant overall group differences, using Bonferroni correction based on Mann–Whitney U tests for non-normally distributed variables.

Regression analysis was performed to evaluate the effects of anesthesia method, ephedrine and inotrope use, blood transfusion requirement, and hemogram parameters on length of hospital stay, intensive care unit admission, and three-month mortality. Significance levels were accepted as $p<0.05$ and $p<0.01$.

RESULTS

Demographic data of the study groups

Of the 187 patients who underwent surgery in our operating room between May 1, 2020 and December 31, 2021, who agreed to participate in the study and filled out the consent forms, 167 patients who met the study criteria were evaluated. Of the patients who participated in the study, 56 (33.5%) were female and 111 (66.5%) were male. The mean age of the patients was 74.6±8.01 (age range 65-102). Morbidity developed in 29 (17.6%) patients within three months after surgery. The morbidities that occurred in these patients were prolonged intensive care unit stay, newly diagnosed COPD, limited mobilization, lower extremity weakness, wound infection, acute renal failure, COVID-19 pneumonia, progression of existing Parkinson's disease, pulmonary embolism, uncontrolled hypertension, urosepsis, widespread rash all over the body, urge incontinence, hematuria, newly diagnosed dementia, and prosthesis infection. Mortality developed in 27 (16.2%) of the patients within three months after surgery. The morbidity and mortality data of the patients included in the study are shown in Table 1.

Evaluation of all parameters with ASA score

When the data were compared in terms of ASA groups, statistically significant differences were observed between patients with high ASA scores and patient age, preoperative neutrophil level, preoperative NLR, preoperative RDW-CV, preoperative RDW-SD, postoperative neutrophil level, postoperative lymphocyte count, postoperative NLR, postoperative RDW-CV, postoperative RDW-SD, and length of stay in the intensive care unit ($p<0.05$), while no significant differences were observed in the other parameters ($p>0.05$) (Table 2-a).

Table 1. Distribution of study groups, number of patients and percentage

Patient Data		Number of Patients (n)	Percentage (%)
Gender	Female	56	33.5
	Male	111	66.5
Distribution of Patients According to Surgical Departments	General Surgery	7	4.2
	Ophthalmology	3	1.8
	Otorhinolaryngology	3	1.8
	Cardiovascular Surgery	20	12
	Neurosurgery	23	13.8
	Orthopedics	52	31.1
	Urology	59	35.3
Anesthesia Method	General Anesthesia	79	47.3
	Regional Anesthesia	88	52.7
ASA Score	II	50	29.9
	III	84	50.3
	IV	33	19.8
FRAIL Score	Robust	66	39.5
	Prefrail	63	37.7
	Frail	38	22.8
Postoperative Third Month Status	Mortality	27	16.2
	Living	111	66.5
	Morbidity	29	17.4
History of Intensive Care Unit Admission	No	107	64.1
	Yes	60	35.9

In ASA groups, postoperative NLR values differed significantly between all groups, while preoperative NLR values were significantly higher in ASA IV compared to ASA II and ASA III groups. Similarly, RDW-SD values were higher in patients with higher ASA scores, with significant differences mainly observed between ASA II and the other groups (Table 2-b).

Evaluation of all parameters with FRAIL score

When the data were compared across FRAIL groups, statistically significant differences were observed between higher FRAIL scores and age, preoperative neutrophil levels, preoperative NLR, preoperative RDW-CV, preoperative RDW-SD, postoperative neutrophil levels, postoperative NLR, postoperative RDW-CV, postoperative RDW-SD, and length of stay in the intensive care unit ($p<0.05$). No significant differences were observed in the other parameters ($p>0.05$) (Table 2-a).

In FRAIL groups, preoperative NLR and RDW-SD values were significantly higher in frail patients compared to robust individuals. Postoperative RDW-SD values differed significantly across all FRAIL groups, while postoperative NLR values were higher in prefrail and frail patients compared to robust individuals (Table 2-c).

Evaluation of all parameters with the status of the patients in the third postoperative month

When the status of the patients in the third postoperative month was compared in terms of the parameters examined; statistically significant differences were observed in terms of patient's

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Table 2-a. Comparison of ASA score and FRAIL score with demographic and other data

	ASA score													FRAIL score											
	ASAII (n=50)				ASA III (n=84)				ASA IV (n=33)					Robust (n=66)				Prefrail (n=63)				Frail (n=38)				
	Min.	Max	Ave	S.D.	Min.	Max	Ave	S.D.	Min.	Max	Ave	S.D.	p	Min.	Max	Ave.	S.D.	Min.	Max	Ave.	S.D.	Min.	Max	Ave.	S.D.	p
Age (Years)	65	88	72.11	6.29	65	102	76.84	8.73	65	102	78.76	10.15	.001**	65	88	71.36	6.34	65	91	75.65	7.72	65	102	78.5	9.02	.001**
Weight (kg)	50	110	76.08	13.2	40	110	77.29	12.82	50	103	73.1	15.96	0.173	59	100	79.24	9.39	40	100	75.31	13.3	50	110	73.09	18.68	0.104
Height (m)	1.52	1.8	1.67	0.07	0	1.9	1.65	0.22	1.48	1.8	1.66	0.1	0.664	1.46	1.9	1.68	0.08	1.45	1.85	1.67	0.08	1.45	1.8	1.55	0.35	.005**
BMI(kg/m^2)	17.3	40.4	27.41	4.4	0	43.28	27.25	5.33	17.3	37.88	26.39	5.35	0.196	19.69	36.73	28.05	3.26	17.3	43.28	26.92	4.56	17.3	40.4	26.31	8.12	0.272
Preop. NC(10^3/uL)	1.35	30.74	5.86	4.68	2.82	15.33	6.82	2.9	2.75	29.43	8.64	5.36	.001**	2.48	13.84	5.52	2.51	1.35	30.74	6.1	4.05	3.28	29.43	8.28	4.81	.001**
Preop. LC(10^3/uL)	0.54	7.8	1.84	1.04	0.29	9.38	1.68	1.16	0.29	9.38	1.48	1.56	0.237	0.44	4.79	1.87	0.74	0.54	7.8	1.81	1.14	0.29	9.38	1.47	1.49	0.183
Preop. NLR	0.99	33.44	4.31	5.05	1.11	46.17	6.38	7.05	1.23	46.17	10	10.1	.001**	1.38	31.45	3.88	4.34	0.99	16.77	4.33	3.36	1.11	46.17	9.82	9.87	.001**
Preop. RDW-CV (%)	11.9	21.5	14.07	1.6	11.9	22.6	14.65	2.03	12.4	19.9	14.85	1.69	.005**	11.9	15.7	13.63	1.01	12.1	22.6	14.7	2.16	12.7	20.9	15.13	2.02	.001**
Preop. RDW-SD (fl)	37.7	63.5	44.12	4.37	35.2	73.9	46.1	5.42	40	54.4	46.62	3.94	.004**	37.3	53.1	43.49	3.65	37.7	73.9	45.51	5.33	35.2	63.5	47.51	5.64	.001**
Postop. NC (10^3/uL)	2.37	25.31	8.9	4.18	3.48	23.13	8.27	3.76	2.37	25.31	11.73	5.84	.001**	2.95	16.13	7.69	3.07	3.48	23.57	8.67	4.38	2.37	25.31	9.93	4.29	.020*
Postop. LC (10^3/uL)	0.21	3.99	1.32	0.84	0.18	9.73	1.42	1.11	0.18	9.73	1.04	1.63	.004**	0.33	3.99	1.54	0.73	0.18	3.88	1.22	0.77	0.35	9.73	1.35	1.55	0.177
Postop. NLR	1.22	63.7	10.92	10.53	1.33	128.5	9.49	14.43	1.33	128.5	21.61	23.21	.001**	1.22	27.52	6.64	5.3	1.71	128.5	12.78	18.25	1.33	32.91	11.96	9	.014*
Postop. RDW-CV (%)	11.8	20.5	14.37	1.55	12	22	14.71	1.96	12.4	20	15.28	1.55	.001**	11.8	16.8	13.77	1.13	12.2	22	14.85	1.95	13.3	20	15.39	1.91	.001**
Postop. RDW-SD (fl)	35.4	65.9	44.77	4.86	4.5	65.6	45.77	6.91	41.1	61.1	47.85	4.58	.001**	4.5	53.6	42.99	6.26	37.5	65.6	45.78	4.94	36.1	65.9	48.52	5.74	.001**
ICU (day)	0	1	0.02	0.126	0	43	2.02	6.41	0	90	7.36	18.17	.001**	0	35	1.6	4.45	0	60	2.27	7.71	0	90	4.66	15.86	.001**

ASA: The American Society of Anesthesiologists, BMI: Body Mass Index, Preop: Preoperative, Postop: Postoperative, NC: Neutrophil Count, LC:Lymphocyte Count, NLR: Neutrophil Lymphocyte Ratio, RDW: Erythrocyte Distribution Width, ICU: Intensive Care Unit, Min: minimum, Max:maximum, Ave: Average, S.D: Standard Deviation, Statistical significance was accepted as *p<0.05 and **p<0.01.

Table 2-b. Post-hoc pairwise comparisons of NLR and RDW-SD across ASA groups (median [IQR])

Variable	ASA II (n=50)	ASA III (n=84)	ASA IV (n=33)	Comparison	p-value
Preop NLR	2.23 (1.78–4.02)	3.31 (2.11–5.05)	6.99 (3.16–13.10)	II vs III	0.069
				II vs IV	<0.001*
				III vs IV	0.008*
Postop NLR	3.47 (2.24–6.86)	6.64 (4.68–11.46)	17.88 (7.80–25.62)	II vs III	<0.001*
				II vs IV	<0.001*
				III vs IV	<0.001*
Preop RDW-SD (fl)	43.15 (40.45–44.92)	45.05 (42.18–47.75)	46.00 (43.60–49.90)	II vs III	0.033*
				II vs IV	<0.001*
				III vs IV	0.445
Postop RDW-SD (fl)	42.80 (39.95–45.10)	45.65 (42.60–49.05)	47.40 (44.40–51.10)	II vs III	<0.001*
				II vs IV	<0.001*
				III vs IV	0.187

Values are presented as median (interquartile range). Post-hoc pairwise comparisons were performed using Bonferroni correction. *p<0.05 indicates statistical significance

Table 2-c. Post-hoc pairwise comparisons of NLR and RDW-SD across FRAIL groups (median [IQR])

Variable	Robust (n=66)	Prefrail (n=63)	Frail (n=38)	Comparison	p-value
Preop NLR	2.26 (1.78–4.16)	3.33 (2.14–5.08)	6.47 (3.12–11.92)	Robust vs Prefrail	0.227
				Robust vs Frail	<0.001*
				Prefrail vs Frail	0.005*
Postop NLR	5.09 (3.11–8.13)	6.98 (4.28–14.92)	9.19 (5.23–14.44)	Robust vs Prefrail	0.029*
				Robust vs Frail	0.002*
				Prefrail vs Frail	0.855
Preop RDW-SD (fl)	43.35 (40.45–45.80)	44.70 (42.50–47.80)	47.05 (43.88–50.48)	Robust vs Prefrail	0.060
				Robust vs Frail	<0.001*
				Prefrail vs Frail	0.130
Postop RDW-SD (fl)	43.45 (40.22–45.78)	44.60 (42.15–48.55)	47.25 (44.60–52.38)	Robust vs Prefrail	0.020*
				Robust vs Frail	<0.001*
				Prefrail vs Frail	0.025*

Values are presented as median (interquartile range). Post-hoc pairwise comparisons were performed using Bonferroni correction. *p<0.05 indicates statistical significance.

age, preoperative neutrophil count, preoperative NLR, preoperative RDW-SD, postoperative neutrophil count, postoperative lymphocyte count, postoperative NLR, postoperative RDW-CV, postoperative RDW-SD and intensive care unit stay values (p<0.05), while no significant differences were observed in the other parameters (p>0.05) (Table 3).

Table 3. Comparison of the patients' conditions in the third postoperative month with demographic and other data

Evaluation of the patients' condition and parameters in the third postoperative month	Mortality (n=27)				Living (n=111)				Morbidity (n=29)				
	Min.	Max	Ave	S.D.	Min.	Max	Ave	S.D.	Min.	Max	Ave	S.D.	p
Age (Years)	65	102	78.48	9.38	65	95	73.17	7.48	66	91	76.48	7.23	.003**
Weight (kg)	50	110	74.76	14.5	40	110	77.13	12.75	58	100	76.5	13.19	0.787
Height (m)	1.48	1.78	1.67	0.07	0	1.9	1.65	0.19	1.52	1.85	1.68	0.1	0.775
BMI(kg/m^2)	20.76	38.06	26.86	4.56	0	40.4	27.39	4.78	19.14	43.28	27.45	6.04	0.914
Preop. NC (10^3/uL)	2.75	30.74	8.94	6.8	1.35	15.33	5.58	2.55	2.96	14.71	6.97	3.29	.001**
Preop. LC (10^3/uL)	0.29	7.8	1.68	1.6	0.54	9.38	1.84	0.98	0.4	4.61	1.5	0.98	0.307
Preop. NLR	1.11	46.17	10.14	11.52	0.99	23.95	3.94	3.49	1.44	23.16	6.57	5.44	.001**
Preop. RDW-CV (%)	13.1	20.9	14.96	1.95	11.9	22.6	14.13	1.76	12.2	19.9	14.77	2	0.051
Preop. RDW-SD (fl)	39.4	58.3	47.48	4.8	35.2	73.9	44.45	5	38.2	63.5	45.73	4.8	.015*
Postop. NC (10^3/uL)	4.17	25.31	9.77	4.38	2.95	17.89	8.02	3.27	2.37	23.57	9.56	5.45	.039*
Postop. LC (10^3/uL)	0.21	3.99	1.23	0.97	0.33	9.73	1.51	1.04	0.18	3.28	0.98	0.68	.025*
Postop. NLR	1.57	39.62	14.01	11.21	1.22	27.52	7.41	5.88	1.71	128.5	17.14	24.72	.001**
Postop. RDW-CV (%)	13.2	19.8	15.12	1.72	11.8	22	14.24	1.7	12.7	20	15.19	1.92	.007**
Postop. RDW-SD (fl)	39.4	57.5	47.91	5.18	4.5	65.6	44.19	6.04	38.9	65.9	47.12	5.68	.003**
ICU (day)	0	60	7.07	14.71	0	12	0.62	2.06	0	90	4.8	16.37	.001**

BMI: Body Mass Index, Preop: Preoperative, Postop: Postoperative, NC: Neutrophil Count, LC:Lymphocyte Count, NLR: Neutrophil Lymphocyte Ratio, RDW: Erythrocyte Distribution Width, Min: minimum, Max:maximum, Ave: Average, S.D: Standard Deviation, Statistical significance was accepted as *p<0.05 and **p<0.01.

Comparison of patients' conditions within three months postoperatively with ASA score

When patients were evaluated in terms of possible morbidity and mortality that may develop within three months postoperatively according to ASA score; it was determined that patients in the ASA II group had only 2% mortality, while this rate was 19% in ASA III and 30.3% in ASA IV and was observed to be statistically significant (p<0.001). However, while those in ASA II had only 6% morbidity, this rate was 17.9% in ASA III and 33.3% in ASA IV and were observed to be statistically significant (p<0.001) (Table 4)

Comparison of patients' FRAIL score groups and their postoperative three-month status

When patients were compared according to FRAIL score categories, mortality was 4.5% in the robust group, 15.8% in the prefrail group, and 36.8% in the frail group, and this difference was statistically significant (p<0.001). Similarly, morbidity was 4.5% in the robust group, 28.6% in the prefrail group, and 21.1% in the frail group, which was also statistically significant (p<0.001) (Table 4).

Regression analysis

FRAIL score, ASA score, ephedrine use, and blood transfusion requirement were evaluated as the most effective parameters in predicting mortality and morbidity. However, the explanatory power of the model was determined as 27.5%. Preoperative NLR, postoperative NLR, preoperative RDW-SD, and postoperative RDW-SD were observed to be the most effective parameters in predicting mortality and morbidity.



Table 4-a. Relationship between postoperative third month status and FRAIL score, ASA score and hemogram parameters

		Postoperative Third Month Status	FRAIL score	ASA score	Preop. NLR	Postop. NLR	Preop. RDW-SD	Postop. RDW-SD
Pearson Correlation	Postop. Third Month Status	1	-0.42	-0.391	-0.367	-0.255	-0.223	-0.255
	FRAIL score	-0.42	1	0.458	0.334	0.184	0.309	0.355
	ASA score	-0.391	0.458	1	0.35	0.421	0.242	0.349
	Preop. NLR	-0.367	0.334	0.35	1	0.389	0.255	0.258
	Postop. NLR	-0.255	0.184	0.421	0.389	1	0.166	0.176
	Preop. RDW-SD	-0.223	0.309	0.242	0.255	0.166	1	0.778
	Postop. RDW-SD	-0.255	0.355	0.349	0.258	0.176	0.778	1
Sig. (1-tailed)	Postop. Third Month Status	.	0	0	0	0	0.002	0
	FRAIL score	0	.	0	0	0.009	0	0
	ASA score	0	0	.	0	0	0.001	0
	Preop. NLR	0	0	0	.	0	0	0
	Postop. NLR	0	0.009	0	0	.	0.016	0.011
	Preop. RDW-SD	0.002	0	0.001	0	0.016	.	0
	Postop. RDW-SD	0	0	0	0	0.011	0	.
N	Postop. Third Month Status	167	167	167	167	167	167	167
	FRAIL score	167	167	167	167	167	167	167
	ASA score	167	167	167	167	167	167	167
	Preop. NLR	167	167	167	167	167	167	167
	Postop. NLR	167	167	167	167	167	167	167
	Preop. RDW-SD	167	167	167	167	167	167	167
	Postop. RDW-SD	167	167	167	167	167	167	167

Preop: Preoperative, Postop: Postoperative, NLR: Neutrophil Lymphocyte Ratio, RDW: Erythrocyte Distribution Width,, Statistical significance was accepted as $p<0.05$.

Table 4-b. Relationship between postoperative third month status and FRAIL score, ASA score and hemogram parameters

	Unstandardized Coefficients		Standardized Coefficients	95,0% Confidence Interval for B	
	B	Std. Error	Beta	Lower Bound	Upper Bound
(Constant)	3.982	0.496		3.003	4.961
FRAIL score	-0.246	0.079	-0.250	-0.401	-0.091
ASA score	-0.185	0.092	-0.171	-0.367	-0.003
Preoperative NLR	-0.023	0.009	-0.189	-0.042	-0.004
Postoperative NLR	-0.003	0.005	-0.055	-0.012	0.006
Preoperative RDW-SD	-0.004	0.016	-0.025	-0.036	0.029
Postoperative RDW-SD	-0.004	0.014	-0.029	-0.032	0.024

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.518[a]	0.268	0.240	0.662

The power to predict the probability of developing mortality and morbidity after three months was 25% for FRAIL score, 17.1% for ASA score, 18.9% for preoperative NLR, 5.5% for postoperative NLR, 2.5% for preoperative RDW-SD and 2.9% for postoperative RDW-SD. The preoperative evaluation of the ASA and FRAIL score together had a 42.1% predictive power of mortality and morbidity that would develop within three months. When the preoperative NLR was added to these parameters, the predictive power increased to 61%, and when postoperative NLR, preoperative RDW-SD, and postoperative RDW-SD were also evaluated, we observed that all parameters had a 71.9% predictive power of three-month mortality and morbidity.

DISCUSSION

With the rapidly aging world population, physicians from all specialties must develop strategies to provide optimal medical and perioperative care to patients. Older adults represent the largest population of healthcare users and have very different needs compared to other age groups.

Many geriatric patients have multiple comorbidities other than the cause of the surgery. These diseases can cause an increase in mortality and morbidity depending on the procedures performed. In addition, the increase in the geriatric patient population and the parallel increase in the number of geriatric surgeries to improve the quality of life increase the importance of the need for safe anesthesia.

The same stress factor may have different results on a frail individual compared to a healthy individual. ASA score is a guiding assessment system for the risk classification of patients and planning of an anesthetic approach. In this classification, it is assumed that age is unrelated to the physiological condition required by the age of the individual. This assumption is debatable but incorrect. Because newborns and very old people are much more vulnerable to anesthetic agents and anesthesia applications than young adults, even if they do not have any diseases (6).

Although ASA score is widely used in routine clinical practice, the extent to which it correlates with more objective risk prediction models remains uncertain. Although it was not developed to predict postoperative mortality and risk, numerous studies have been conducted to determine the relationship between ASA score and postoperative outcomes. A multi-institutional cohort study of more than two million cases from the American College of Surgeons National Surgical Quality Improvement Program database demonstrated an association between ASA score and postoperative medical complications, including deaths (7). Boorjian et al. reported that ASA score was superior in predicting 90-day mortality following radical cystectomy when compared with the Elixhauser van Walraven and Charlson comorbidity indices (CCI) (8).

Studies have shown that ASA score is a useful system for predicting mortality. In our study, the power of ASA score alone to predict three-month mortality and morbidity was observed to be 17.1%.

Frailty is a clinical condition in which an individual is exposed to various stressors and is more vulnerable to disease (9). The prevalence of frailty has been shown to increase nonlinearly with age, with approximately 10% of individuals over 65 years and up to 25% of those over 85 years being frail (10). The FRAIL scale is a simple and validated screening tool that can be easily applied in clinical practice, making it particularly useful for preoperative risk stratification in geriatric patients.

Frailty, defined as a biological syndrome of diminished reserve and resistance to stressors, has been associated with adverse postoperative outcomes and is a significant risk factor for postoperative mortality. Even following low-risk or outpatient procedures, frailty remains an important predictor of morbidity and mortality (11).

Previous studies have shown that the incidence of postoperative complications is higher in



patients with higher frailty scores (12). Therefore, preoperative recognition of frailty may be useful for risk assessment. In our study, the FRAIL score demonstrated a 25% predictive ability for three-month postoperative mortality and morbidity.

Previous studies have shown that RDW may be a nonspecific disease marker that has the potential to provide general quantitative risk stratification that may be particularly useful for a new and unknown disease. In addition, it has been reported in the literature that RDW is a marker that can be used to predict mortality in various clinical conditions, and it has been concluded that each 1% increase in RDW increases the risk of mortality by 14% (13). In our study, the preoperative RDW-SD, postoperative RDW-CV, and postoperative RDW-SD values of the patients may serve as a predictor of postoperative mortality or morbidity within three months postoperatively.

NLR is a cost-effective biomarker that can be easily calculated clinically. The change in NLR indicates the balance between neutrophils and lymphocytes. Therefore, NLR is an indicator of systemic inflammation (14). Although various conditions, including medications and comorbidities affecting neutrophil and lymphocyte counts, can affect NLR values, NLR has been confirmed to be a useful indicator for the prognosis of various diseases (15,16). Especially during inflammation, hematological increase in the number of neutrophils in the granulocyte series and increased NLR due to a decrease in the number of lymphocytes are considered an indicator of systemic inflammation (17,18).

Preoperative NLR values are independent predictors of perioperative and postoperative mortality as well as postoperative complications, regardless of the type of surgery (19-21). Silberman et al. reported that high preoperative NLR is an independent predictor of operative mortality and late mortality after cardiac surgery, pleural effusion, low cardiac output syndrome caused by a temporary decrease in systemic perfusion due to myocardial dysfunction, and prolonged ventilation (19).

It has been reported that increased NLR in the postoperative period in patients undergoing cardiac surgery is significantly associated with increased short- and long-term mortality, in-hospital death, development of postoperative acute kidney injury, postoperative atrial fibrillation, prolonged ventilation, and longer ICU and hospital stays (22-24). Our study also supports the above publications and suggests that both preoperative NLR and postoperative NLR levels can be one of the parameters that can be used to predict morbidity and mortality that may occur within three months postoperatively.

In many studies, ASA score, FRAIL score, RDW, and NLR have been evaluated separately as parameters that can be used to predict mortality and morbidity in various patient groups. However, in our study, we observed that when these four parameters were used together, the power to predict mortality and morbidity that may develop in the postoperative three-month period was 71.9%.

In order to improve the quality of life of elderly patients, there is a need for research on both their physical and mental health. Therefore, screening elderly patients for frailty before surgery, determining protective strategies, and forming multidisciplinary teams will guide clinicians in terms of predicting morbidity and mortality that may occur in the perioperative and postoperative period. Although the ASA score is widely used in routine clinical practice, it remains unclear how well it correlates with more objective risk prediction models. Our study shows that the combined evaluation of ASA score, FRAIL score, NLR, and RDW in the preoperative period in elderly patients will have a higher predictive value for mortality and morbidity that may develop in the postoperative period.

This study has several strengths. First, it was designed prospectively, which reduces potential bias. Second, multiple parameters including FRAIL

score, ASA score, NLR, and RDW were evaluated together in predicting postoperative mortality and morbidity in elderly patients. Third, routinely available laboratory parameters were analyzed, which may enhance clinical applicability.

However, this study also has some limitations. It was conducted in a single center and included a relatively small sample size. In addition, the study population was heterogeneous in terms of surgical specialty and type of procedure. In addition, the heterogeneity of surgical procedures may have influenced the outcomes. Finally, although multiple parameters were analyzed, potential confounding factors may not have been fully controlled.

Future prospective multicenter studies with larger patient populations are needed to better clarify the relationship between frailty indices, inflammatory markers, and postoperative outcomes in elderly patients. Additionally, integrating these parameters into predictive clinical models may improve perioperative risk assessment and decision-making in geriatric surgical patients.

FUTURE DIRECTIONS

Prospective multicenter studies with larger and more homogeneous patient populations are needed to validate our findings. Future research should also focus on developing and externally validating integrated predictive models combining FRAIL score, ASA score, and inflammatory markers. These models may enhance perioperative risk stratification and support clinical decision-making in geriatric patients.

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