The Role of Edmonton Frailty Scale in Determining the Postoperative Complications in Elderly: A Prospective Observational Study

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ABSTRACT

Objective: To explore the effect of Edmonton Frailty Index on the determination of postoperative complication and mortality rates in patients over 65 years of age.

Study Design: An observational study.

Place and Duration of the Study: Department of Anaesthesiology and Reanimation, University of Health Sciences, Izmir Bozyaka Training and Research Hospital, Izmir, Turkiye, from January to July 2021.

Methodology: Patients aged >65 years undergoing surgery were inducted. Frailty was defined as a multisystemic condition in which physical, physiological, and cognitive abilities are reduced. Demographic data, ASA, and Edmonton Frailty Test Score (EFS) were noted preoperatively. Subsequently, these patients were followed perioperatively and evaluated by Clavien-Dindo test (CDT) during the first month postoperatively.

Results: There was no statistically significant difference between genders, except EFS, which was higher in females than in males. EFS increased as age increased with a statistically significant positive correlation. The patients with the highest EFS underwent neurosurgical operations. There was a statistically significant and positive correlation between the length of hospital stay and EFS. EFS values increased as the ASA score increased and the positive correlation was statistically significant. The mild frality group had the highest CDT scores and were statistically significant.

Conclusion: Frailty assessed by EFS has a statistically significant correlation with ASA and the CDT scores of the patients. EFS value was associated with length of hospital stay, unlike the ASA score. Both EFS and ASA were correlated with the CDT. Preoperative evaluation, especially in geriatric patients, is very important in determining postoperative complications, mortality, and length of hospital stay.

Key Words: *Edmonton frailty index, Clavien-Dindo scoring, American society of anaesthesiologists.*

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INTRODUCTION

With the increase in average life expectancy, the geriatric population in society is increasing. This, in turn, increases the treatment needs and/or operation requirements of geriatric patients.[1] Adding surgical stress to the changes in organ systems during this process may cause an increase negative effects on patients during the surgical process, starting from the preoperative period. Preoperative anaesthesia examination can be a valuable predictor of functional status and postoperative outcome.

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Since the American Society of Anaesthesiologists' physical status classification (ASA), the most frequently used in clinical practice, may be insufficient, especially in geriatric patients, various guidelines have been developed over time.[2]

The concept of frailty describes as a multisystemic condition in which physical, physiological, and cognitive abilities are reduced.[3] According to studies, it is an independent risk factor for major morbidity, mortality, prolonged hospital stay, and delayed discharge.[4,5] Although various models and frailty scores have been developed to measure frailty, the Edmonton Frailty Scale (Figure 1) developed by Rolfson *et al*. in 2006, is the most commonly used index.[6] This index addresses cognitive status, general health, functional independence, social support, medication use, nutrition, mood, continence, and functional status.[2]Various studies have also been conducted to classify postoperative surgical complications and to establish consensus.The Clavien-Dindo Classification Grade (CDCG, Figure 2), developed by Dindo *et al*. is a tool that provides the opportunity to evaluate the treatment and the process experienced during the postoperative hospitalisation of the patient, post-discharge period, and in cases of readmission.[7,8]

The Edmonton Frail Scale:				Score: ___/17
Frailty domain	Item	0 point	1 point	2 points
Cognition	Please imagine that this pre-drawn circle is a clock. I would like you to place the numbers in the correct positions then place the hands to indicate a time of 'ten after eleven'	No errors	Minor spacing errors	Other errors
General health status	In the past year, how many times have you been admitted to a hospital?	0	1–2	≥2
	In general, how would you describe your health?	'Excellent', 'Very good', 'Good'	'Fair'	'Poor'
Functional independence	With how many of the following activities do you require help? (meal preparation, shopping, transportation, telephone, housekeeping, laundry, managing money, taking medications)	0–1	2–4	5–8
Social support	When you need help, can you count on someone who is willing and able to meet your needs?	Always	Sometimes	Never
Medication use	Do you use five or more different prescription medications on a regular basis?	No	Yes	
	At times, do you forget to take your prescription medications?	No	Yes	
Nutrition	Have you recently lost weight such that your clothing has become looser?	No	Yes	
Mood	Do you often feel sad or depressed?	No	Yes	
Continence	Do you have a problem with losing control of urine when you don't want to?	No	Yes	
Functional performance	I would like you to sit in this chair with your back and arms resting. Then, when I say 'GO', please stand up and walk at a safe and comfortable pace to the mark on the floor (approximately 3 m away), return to the chair and sit down'	0–10 s	11–20 s	One of >20 s patient unwilling, or requires assistance
Totals	Final score is the sum of column totals			

Figure 1: With the licence of the University of Alberta and Dr. Darryl Rolfson - The Edmonton Frailty Test Score.[6]

Grade	Definition
Grade I	Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic, and radiological interventions Allowed therapeutic regimens are: Medicines as antiemetics, antipyretics, analgaetics, diuretics, electrolytes, and physiotherapy. This grade also includes wound infections opened at the bedside
Grade II	Requiring pharmacological treatment with medicines other than such allowed for grade I complications Blood transfusions and total parenteral nutrition are also included
Grade III	Requiring surgical, endoscopic or radiological intervention
IIIa	Intervention not under general anaesthesia
IIIb	Intervention under general anaesthesia
Grade IV	Life-threatening complication (including CNS complications)* requiring IC/ICU management
IVa	Single organ dysfunction (including dialysis)
IVb	Multiorgan dysfunction
Grade V	Death of a patient

*Brain haemorrhage, ischaemic stroke, subarachnoid bleeding, but excluding transient ischaemic attacks.
CNS, central nervous system; IC, intermediate care; ICU, intensive care unit.

Figure 2: The Clavien-Dindo classification of surgical complications.[7]

In this study, the aim was to compare the effect of the Edmonton Frailty Index on the determination of postoperative complication and mortality rates in patients over 65 years of age and compare the effect with the ASA score.

METHODOLOGY

This prospective study was conducted after approval from the Institutional Ethical and Scientific Committee of the Medical School of Tinaztepe University and with written informed consent from patients. Patients aged >65 years undergoing surgery in the authors' institution between January to June 2021 were included in the study.

All patients aged ≥65 years, who were scheduled for elective surgery in the authors' hospital and applied to the anaesthesia outpatient clinic for preoperative evaluation, and who agreed to participate in EFS, were included in the study. Patients <65

years of age and who refused to participate in EFS were excluded.

The study was started after a license agreement was signed with Dr. Darryl Rolfson, who prepared the test for the Edmonton frailty test, and the University of Alberta, the institution where he was working. Edmonton frailty test was explained to the patients who applied to the anaesthesia polyclinic of the hospital before the operation and underwent preoperative anaesthesia examination.

Nine different situations were evaluated with the Edmonton frailty test, consisting of 11 questions. According to the test results, the patients were categorised as non-frail (0-5 points), apparently vulnerable (6-7 points), mildly frail (8-9 points), moderately frail (10-11 points), and severely frail (12-17 points).[6]

The patient's age, gender, ASA score, EFS, indication for the operation, and preferred anaesthesia methods were recorded. Then these patients were followed perioperatively and the first month postoperatively. Adverse events occurring in the postoperative period and within 1 month after discharge from the hospital were evaluated with Clavien-Dindo test. In these 6 months, anaesthesia method that was applied, duration of operation, length of hospital stay, Clavien-Dindo classification Grade (CDCG), and also readmission to the hospital with which symptom(s) after discharge were noted.

Statistical analyses were performed using IBM® SPSS® version 22 (SPSS Inc., Chicago, IL, USA) software. The conformity of the variables to the normal distribution was examined using analytical methods (Kolmogorov-Smirnov / Shapiro-Wilk's tests). Descriptive analyses were conducted, with mean ± SD for continuous data and counts (n) and percentages (%) for categorical variables. To compare paired groups, t-test was used for normally distributed independent groups. Pearson's correlation analysis was used to compare the relationship between EFS score and length of stay and similar comparisons. Cases with a p-value below 0.05 were considered statistically significant.

RESULTS

A total of 137 patients, 68 (49.6%) males and 69 (50.4%) females, were included in this study. According to gender, there were no statistically significant differences between the groups in terms of age, duration of operation, and length of hospital stay (day). The EFS was higher in females (4.4 ± 3.4) than in males (3.1 ± 2.6) and this difference was statistically significant between the groups ($p = 0.017$). When the relationship between EFS and age was evaluated, it was found that EFS increased as age increased, and this positive correlation was statistically significant ($p = 0.004$).

According to the classification used for frailty in this study, 91 patients were non-frail, 16 patients were apparently vulnerable, 20 patients were mildly frail, 4 patients were moderately frail, and 6 patients were severely frail.

The question that had the most impact on the EFS in the test was: "Functional independence assessment". It was evaluated by "With how many of the following activities do you require help? (meal preparation, shopping, transportation, telephone, housekeeping, laundry, managing money, taking medications)".

The distribution of the cases included in the study according to the surgical groups is summarised in Table I. The most common type of operation in the study was urological surgery (n = 35). It was followed by general surgery operations (n = 33).

When the relationship between the operation departments and EFS was examined, the patients with the highest EFS underwent neurosurgical operations (EFS: 6.45). It was followed by interventional radiology procedures (EFS: 5.33) and gastroenterological procedures, respectively (EFS: 4.88). Patients that had the least EFS (EFS: 1) had gynaecology operations. There was no statistically significant correlation between the duration of the operation and the EFS ($r = 0.066$, $p = 0.445$). However, there was a statistically significant and positive correlation between EFS and the length of hospital stay ($p < 0.001$, $r = 0.313$).

While the mean EFS was 2.6 ± 2.4 in patients with an ASA score of 2 and below, the mean EFS was 6.3 ± 2.8 in the group of patients with an ASA score of 3 and above. EFS values increased as the ASA score increased and this positive correlation was statistically significant ($p < 0.001$). There was no statistically significant correlation between EFS and the type of surgery (ambulatory surgery *versus* hospital-based outpatient departments) ($p = 0.093$).

The relationship of CDCG with EFS and operation times are shown in Table II and these relationships are statistically significant.

The relationship between anaesthesia type, EFS score, surgery type, the patients' ASA score, and CDCG are shown in Table III. CDCG was highest in the general anaesthesia group according to anaesthesia type which was not statistically significant. According to EFS group's mildly frail category, according to the type of surgery performed in hospital-based outpatient departments, and according to ASA score, ASA score >=3 has the highest CDCG scores and these are statistically significant.

According to the present study, the mean EFS scores of the patients either readmitted or not readmitted to the hospital after discharge from the hospital were 6.0 ± 3.4 and 3.2 ± 2.8, respectively ($p = 0.004$), indicating a statistically significant difference. The rate of re-admission to the hospital was 8.9% and 75% in the normal patient group and severely frail group according to the EFS classification, respectively ($p = 0.006$). As frailty increases, the probability of returning to the hospital within 1 month after discharge also increases, and this increase is statistically significant.

Table I: Comparing EFS Score between operation departments.

Department	Mean		95% [CI] for Mean		Min	Max	p-value
	n	SD	Lower Bound	Upper Bound			
General Surgery	33	4.4 3.2	3.28	5.57	0	12	
Brain Surgery	11	6.5 3.4	4.18	8.73	2	12	
Gynaecology and Obstetrics	3	1.0 0.0	1	1	1	1	
Urology	35	1.9 2.1	1.15	2.56	0	8	
Gastrology	8	4.9 2.0	3.24	6.51	2	8	<0.001
Ear Nose Throat	1	3.0 -	-	-	3	3	
Ophthalmology	14	3.4 2.4	2.06	4.8	1	9	
Plastic Surgery	6	1.2 0.8	0.38	1.96	0	2	
Orthopaedia	14	4.4 3.2	2.61	6.25	1	11	
Interventional	12	5.3 3.2	3.32	7.35	1	10	
Radiology	13	3.7 3.1	3.19	4.22	0.	12	
Total	7						

ANOVA was used and p <0.05 was considered statistically significant. CI; Confidence interval.

Table II: Comparing EFS and operation time between CDCS groups.

Variables		CDCG	Mean	SD	95% [CI] for Mean		Min	Max	p-value
					Lower Bound	Upper Bound			
EFS									
	1	8	2.0	1.8	1.6	2.4	0	9	
	2	0	5.4	2.7	4.47	6.38	1	11	<0.001
	3	1	7.3	2.3	6.07	8.6	3	12	
	>=4	9	7.0	3.7	3.94	10.06	2	12	
Duration of surgery									
	1	8	1.9	1.0	1.64	2.09	1	4	0.001
	2	5	2.5	1.0	2.1	2.81	1	4	
	3	1	2.1	0.6	1.78	2.49	1	3	
	>=4	9	3.3	1.4	2.09	4.41	1	5	

ANOVA was used and p<0.05 was considered statistically significant. CDC; Clavien-Dindo Classification, CI; Confidence interval.

Table III: Comparing variables between CDC groups.

Varables	Sub Group	CDS Groups, n (%)					p-value
		1	2	3	4	5	
Anaesthesia type							
	General	35 (43.8)	19 (57.6)	7 (46.7)	6 (75.0)	1 (100)	
	Regional	25 (31.3)	9 (27.3)	3 (20.0)	1 (12.5)		
	Block	1 (1.3)	0 (0)	1 (6.7)	0 (0)	0.692	
EFS groups	Sedoanalgaesia	19 (23.8)	5 (15.2)	4 (26.7)	1 (12.5)	0 (0)	
	Normal	72 (90.0)	15 (45.5)	1 (6.7)	2 (25.0)	1 (100)	<0.001
	Apparently vulnerable	5 (6.3)	6 (18.2)	4 (26.7)	1 (12.5	0 (0)	
Anaesthesia type							
	General	35 (43.8)	19 (57.6)	7 (46.7)	6 (75.0)	1 (100)	
	Regional	25 (31.3)	9 (27.3)	3 (20.0)	1 (12.5)		
	Block	1 (1.3)	0 (0)	1 (6.7)	0 (0)	0.692	
EFS groups							
	Sedoanalgaesia	19 (23.8)	5 (15.2)	4 (26.7)	1 (12.5)	0 (0)	
	Mildly frailty	2 (2.5)	8 (24.2)	7 (46.7)	3 (37.5)	0 (0)	
	Moderately frailty	1 (1.3)	2 (6.1)	1 (6.7)	0 (0)	0 (0)	
	Severely frailty	0 (0)	2 (6.1)	2 (13.3)	2 (25.0)	0 (0)	
	Mildly frailty	2 (2.5)	8 (24.2)	7 (46.7)	3 (37.5)	0 (0)	
	Moderately frailty	1 (1.3)	2 (6.1)	1 (6.7)	0 (0)	0 (0)	
	Severely frailty	0 (0)	2 (6.1)	2 (13.3)	2 (25.0)	0 (0)	
Type of surgery							
	Ambulatory surgery	37 (46.3)	8 (24.2)	0 (0)	2 (25.0)	1 (100)	
	Hospital-based outpatient departments	43 (53.8)	25 (75.8)	15 (100)	6 (75.0)	0 (0)	0.003
ASA score							
	=<2	75 (93.8)	16 (48.5)	1 (6.7)	3 (37.5)	0 (0)	<0.001
	>=3	5 (6.3)	17 (51.5)	14 (93.3)	5 (62.5)	1 (100)	

Pearson's Chi-square test was used and p <0.05 was considered significant.

DISCUSSION

Preoperative evaluation, especially in the geriatric population, is important in determining the postoperative complications, the length of hospital stay and mortality. In this study, the authors investigated the postoperative complications and mortality rates in patients aged over 65 years by the Edmonton Frailty Index and compared this with the ASA score. Results demonstrated that as ASA scores increased, the EFS values increased statistically. While ASA scores and EFS values were not associated with the duration of surgery, EFS values were found to be associated with length of hospital stay, unlike the ASA score. Both EFS values and ASA scores were correlated with the Clavien-Dindo Score.

Frailty is defined as increased susceptibility to stress factors and general functional loss as a result of multisystemic loss of physiological reserves.[9] It increases the need for the help of older individuals and makes them vulnerable to negative consequences.[10] Some studies performed to date in geriatric patient groups undergoing major surgery have shown the relationship between frailty level and mortality, postoperative complications, and prolonged hospitalisation.[11,12]

Studies on the level of frailty have reported different rates according to age, geographical region, and level of development. Although the mean EFS score is found to be relatively low in some studies, there are studies in which the frailty rate is found to be high.[13,14]

Some studies that were conducted in the authors' country stated that the severe frailty rates of individuals over the age of 65 are 13.1%.[15] According to this study results, only 4.4% of the patients were found to be severely frail. The lower severe frailty rate observed in this study compared to other studies, may be related to the sociocultural development level of the patients and the region where the hospital is located.

Studies investigating the relationship between gender and frailty have reported that while some studies indicated that gender has no effect on frailty scores,[16] some studies indicated higher frailty scores in the female gender.[17]

Likewise, studies investigating the relationship between age and frailty have also found controversial results. Contrary to studies showing that frailty is not associated with age,[10] there are studies showing that frailty increases with age.[18]

A review reported that frailty was the most important factor that increases the risk of postoperative complications. According to this review, age and ASA scoring were not associated with increased postoperative complications.[17] The first study in the literature that evaluated frailty and postoperative outcomes, stated that frailty was identified as an independent risk factor for surgical complications, and the complication rate was found to be higher in frail patients. The risk of complications increased as the invasiveness of surgery increased in frail patients.[4] In another study, it was found that major surgeries affect frail patients more than minor surgeries.[19] In a study that searched the postoperative period after major (carotid endarterectomy) and minor surgery (carotid stenting), reported that frailty score was shown to be an independent risk factor for hospital readmission in the first month postoperatively. While the frailty score after major surgery and the rate of re-admission to the hospital in the first month postoperatively were high and no significant correlation was found between minor surgical intervention and the rate of re-admission to the hospital in the first month postoperatively.[20] In a study that investigated patients after oncological pancreaticoduodenectomy, which was accepted as a major surgery, it was found that frailty increases postoperative complications[21] and re-admissions to the hospital within 30 days.[22] However, the authors did not report a correlation between major / minor surgery and frailty score.

Besides, the use of multiple medicines and increased age also increase the likelihood of developing postoperative complications.[23] A study reported that there was a relationship between frailty score and postoperative complication rates.

According to Clavien-Dindo test that was used to evaluate complications and readmissions within the postoperative period and the first month after discharge, there was a statistically significant correlation between CDCG scores and frailty, ASA scores, and surgery type. When the relationship between operation types and CDCG was evaluated, CDCG levels were statistically higher in general surgery, neurosurgery, and urological operations. There was a statistically significant positive correlation between CDCG and operation time. This situation can be explained as major surgical operations as stated in previous studies. The limitation of this study is that all patients over 65 years of age were included in the study, regardless of operation type or anaesthesia type etc.

CONCLUSION

This study has demonstrated that frailty assessed by EFS has a statistically significant correlation with the ASA score and the CDCG scores of the patients. EFS value was associated with length of hospital stay, unlike the ASA score. Both EFS and ASA scores were correlated with the CDCG. Preoperative evaluation, especially in geriatric patients, is very important in determining postoperative complications, mortality, and length of hospital stay. However, it was perceived that only the ASA score in preoperative evaluation is insufficient, but adding frailty assessment tests such as the EFS score may be useful to determine postoperative complications. Further studies are needed on this subject.

ETHICAL APPROVAL:

Ethical approval for this study was obtained from the Medical

School of Tinaztepe University, prior to the initiation of the research work (Approval No: 20.01.2021, No: 8).

PATIENTS' CONSENT:
Written informed consents were taken from all the patients participating in this study.

COMPETING INTEREST:
The authors declared no conflict of interest.

AUTHORS' CONTRIBUTION:
SC, FYB: Statistical analysis and interpretation of data, drafting of the work, and revising the manuscript critically for important intellectual content.
SC, CE: Data collection, significant contribution to the manuscript writing.
All authors approved the final version of the manuscript to be published.

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