Original Article

Evaluation of the Appropriateness of ERAS Protocols and Their Impact on Patient Outcomes in Cardiovascular Surgery Patients: A Descriptive Observational Study

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Abstract
This descriptive observational study was aimed to evaluate the appropriateness of ERAS protocols in cardiovascular surgery patients and their effects on patient outcomes. The sample consisted of a total of 42 patients hospitalized in the cardiovascular surgery departments of two hospitals in Batman. Face-to-face interviews and observational methods were used for data collection. For data collection, patient sociodemographic characteristics, perioperative ERAS protocol evaluation and patient outcomes follow-up forms were used. It was determined that 76.2% of patients received education for preoperative optimization 4-8 weeks before surgery, 64.3% underwent preoperative HgbA1c measurement, and all patients had their albumin levels measured. Additionally, 95.2% received antimicrobial prophylaxis one hour before surgery, and all patients underwent mechanical bowel preparation. During the perioperative period, normothermia was maintained in all patients, skin preparation protocols were applied to reduce surgical site infections, and surgical site shaving was performed using an electric razor. Regarding postoperative recovery, 54.8% of patients had their first fluid intake one day after surgery, and early mobilization was implemented in 64.3% of patients one day after surgery. The mean ERAS protocol scores for the preoperative, intraoperative, and postoperative periods were 5.09±1.12, 4.00±0.00, and 9.19±0.67, respectively. According to the results, the overall mean ERAS protocol score for all surgical periods was 18.28±1.33. It was found that 21.4% of patients were readmitted to the hospital and underwent reoperation due to postoperative complications. The mean score for postoperative patient follow-up and outcomes was 4.07±1.67. Based on the study results, it can be concluded that ERAS protocols during the surgical period in cardiovascular surgery patients were applied appropriately and at a moderate-to-high level. While careful implementation of all elements of the ERAS protocols in cardiovascular surgery patients is believed to improve patients outcomes, it is alo thought to reduce the risk of developing complications.

Keywords: ERAS Protocol, Cardiovascular Surgery, Patient Outcomes

ERAS protocols are standardized perioperative programs designed to reduce surgical stress, improve recovery, and have the patients return to functional health status more quickly (ERAS Society). Cardiovascular diseases are currently the most common cause of sudden death among adults. According to the World Health Organization (WHO), in 2019, 17.9 million people died from cardiovascular diseases, accounting for 32% of global deaths.

In Turkey, data from the Turkish Statistical Institute (TÜİK) shows that circulatory system diseases were the leading cause of death at 36.8%. Among these, ischemic heart

diseases (39.1%), cerebrovascular diseases (22.2%), other heart diseases (25.7%), and hypertensive diseases (7.9%) were the most prevalent. It is projected that by 2030, cardiovascular diseases will cause 22 million deaths worldwide, with the majority occurring in developing countries, including Turkey. (Dulek et al., 2018, TÜİK, 2018). Traditional approaches to postoperative care in cardiovascular surgery vary across institutions, leading to a growing need for evidence-based, standardized practices. These aim to reduce stress responses, functional losses, hospital stays, and complications while promoting early mobilization, enteral nutrition, faster recovery, and lower morbidity and mortality. To enhance recovery and control metabolic trauma and inflammatory stress after surgery, Enhanced Recovery After Surgery (ERAS) protocols were developed. ERAS is a multimodal, evidence-based approach covering the entire perioperative process, from preoperative preparation to discharge. Initially introduced in colorectal surgery, ERAS has since been successfully applied in gynecology, cardiac, thoracic, vascular, orthopedic, urologic, and other surgical fields (Celebi, 2019, Kirik, 2018, Ljungqvist et al., 2017, Zora, 2019, Yildirim 2017). The core principle of ERAS is to reduce the inflammatory stress response after major surgeries, prevent organ dysfunction, and facilitate the patient's rapid recovery through a series of standardized perioperative approaches (Boga & Aydin., 2021, Hughes et al., 2014, Kubitz et al., 2020).

ERAS in cardiac surgery is a relatively recent development. In 2017, the American Association for Thoracic Surgery established updated guidelines outlining evidence-based interventions covering preoperative, intraoperative, and postoperative phases. These recommendations aim to standardize care and improve recovery outcomes in cardiovascular surgery (Boga & Aydin., 2021, Engelman et al., 2019, Ljungqvist et al., 2018). In cardiovascular surgeries, the preoperative period of ERAS protocols includes: detailed patient assessment and education (smoking-alcohol consumption, nutrition-diet program, breathing exercises), regulation of preoperative fasting duration and oral carbohydrate loading instead of preoperative fasting, preoperative bowel preparation, ensuring preoperative optimization, premedication before anesthesia, thromboembolism prophylaxis, antimicrobial prophylaxis (Celebi, 2018, Erdem, 2018, Salihoglu, 2018), and HbA1c and albumin measurements (Engelman et al., 2019). The intraoperative period consists of: ensuring standard anesthesia protocol, maintaining normothermia, selection of surgical incisions, ensuring intravenous fluid management (avoiding fluid overload), use of nasogastric tubes and drains (Celebi, 2018, Erdem, 2018), reducing surgical site infection, rigid sternal fixation, and use of tranexamic acid or epsilon aminocaproic acid (Engelman, et al., 2019). The postoperative period includes: glycemic control-insulin infusion, persistent hypothermia, chest tube patency, kidney stress and acute kidney injury (Engelman, et al., 2019), multimodal management of nausea-vomiting, early mobilization, use of non-opioid analgesia for pain management, early removal of catheters, ensuring intravenous fluid amount, avoiding routine NG (nasogastric) and peritoneal drains (Celebi, 2018, Erdem, 2018), early oral/enteral nutrition, early extubation approach, prevention of delirium-convulsions (Salihoglu, 2018), alleviation of fatigue, monitoring of outcomes, and the period until discharge (Celebi, 2018, Erdem, 2018).

The implementation phase of ERAS protocols, covering the period from the patient's admission to discharge, is a multifaceted, multidisciplinary team effort involving many actors (Erdem, 2018, Kirik, 2018). These implementation stages are an approach born from the coordinated collaboration of surgeons, anesthesiologists, nurses, dietitians, physiotherapists, and other healthcare personnel to organize patient care (Afsar, 2020, Akpolat, 2018). Patients undergoing cardiovascular surgery are a patient population that experiences a very high rate of inflammatory physiological stress response in the postoperative period and harbors the highest cost center (Li et al., 2018, Coleman et al., 2019). It has been determined that the application of ERAS principles in

cardiac surgery reduces both the length of hospital stay and costs in healthcare institutions (Ozbay, 2020). In cardiovascular surgery, where complication rates are high, the application of ERAS principles appears to have benefits for all healthcare personnel, especially nurses, and for the institution. In this context, the protocol demonstrates its benefits and feasibility by reducing mortality-morbidity and the frequency of complications (Ozbay, 2020), ensuring standardization in patient care, enabling patients to have a good surgical experience, and ensuring they leave the hospital satisfied. Indeed, from an institutional perspective, it has been found to reduce the length of hospital stay, costs, and bed requirements (Coleman et al., 2019). The implementation of ERAS protocols in cardiovascular surgery patients has the potential to reduce mortality and morbidity rates by improving the quality of patient care. Therefore, raising awareness among healthcare professionals about ERAS protocols and integrating these protocols into surgical care processes is of great importance.

Aim: This study was aimed to evaluate the appropriateness of ERAS protocols in cardiovascular surgery patients and their effects on patient outcomes.

Methods

Study design: This descriptive observational study was carried out in the cardiovascular surgery clinics of Batman Training and Research Hospital and Private Batman World Hospitals between March 2021 and June 2023. The study population consisted of patients who were scheduled for open-heart surgery. The study sample included patients aged 18 and over, scheduled for elective cardiac surgery, able to communicate in Turkish language, cooperative, and with an extubation duration of less than 24 hours in the postoperative period. The sample size was determined as 42 patients using the G*Power program, with an effect size of 0.50, an α value of 0.05, and 80% power.

Data Collection: The data collection forms included:

1. Patient Sociodemoghraphic Characteristics Form: Age, gender, marital status, income level, education level, employment status, place of residence, surgical history, comorbidities, regular medication use, and smoking/alcohol consumption.
2. Perioperative ERAS Protocol Evaluation Form: The Preoperative Form: patient education about the postoperative period, smoking and alcohol cessation 4-8 weeks before surgery, exercise programs (e.g., breathing exercises), nutritional improvement, and preoperative analgesia information, cessation of solid foods 6 hours before surgery and liquids 2 hours before surgery, preoperative oral carbohydrate loading, HbA1c measurement, serum albumin measurement, an antimicrobial prophylaxis 1 hour before surgery, premedication 45 minutes before surgery, mechanical bowel preparation and preoperative nutritional support. The intraoperative ERAS Protocol Evaluation Form: nausea-vomiting prophylaxis, use of short-/long-acting anesthetic agents, maintain normothermia, skin preparation protocols to reduce surgical site infections lectric shaving of the surgical area by an electric machine. The postoperative ERAS Protocol Evaluation Form: Multimodal analgesia, time to first oral liquid intake post-surgery, time to first solid food intake, time to first mobilization, protocols for drain/catheter and tube removal, time of drain removal, time of urinary catheter removal plasma glucose monitoring and insulin infusion if needed, fluid therapy based on central venous pressure, thromboembolic prophylaxis, risk assessment for delirium and seizure prevention and anesthetic-analgesic agent selection, implementation of early discharge criteria, evaluation of all early discharge criteria, post-discharge patient follow-up and post-discharge patient education.
3. Patient Outcome Follow-up Form: Preoperative hospital stay duration, duration of surgery, intubation and stay in ICU, number of postoperative mobilizations (per day), first-day postoperative mobilization duration, time of first postoperative defecation, early and late postoperative complications and reoperation status.

Data Collection Process: Data were collected through face-to-face interviews, observations, and follow-ups. Clinical nurses,

operating room nurses, and specialist physicians were verbally informed about the data collection process. Upon hospital admission, patients were informed about the study, and written/verbal consent was obtained. Patient identification data were collected via interviews and recorded. ERAS evaluation data were gathered through interviews with patients, nurses, and physicians. Post-discharge follow-up data were obtained via phone calls and clinician interviews over one month. Each item in the ERAS and outcome forms was scored as 0 (not applied/complication occurred) or 1 (applied/no complication). Preoperative ERAS total score determined between 0-10, intraoperative ERAS total score: 0-5, postoperative ERAS total score: 0-16, overall ERAS score 0-31, and Outcome follow-up score: 0-5.

Ethical Approval: Approval was obtained from Canakkale Onsekiz Mart University Clinical Research Ethics Committee (47960527-771-670, 22.03.2022) and hospital administrations (2200138701, 27.06.2022). Written and verbal consent was secured from participants.

Data Analysis: Data were analyzed using SPSS 22.0. Descriptive statistics (mean ± SD for quantitative variables; frequency/percentage for qualitative variables) and normality tests (Skewness-Kurtosis :-1.5 to +1.5) were performed. Parametric tests (independent t-test, ANOVA) were used for normally distributed data, with a significance level of $p < 0.05$.

Results

It was determined that 64.3% of the patients were ≥ 65 years of age, 61.9% were male, 97.6% were married, 74.4% had income equal to expenditure, 35.7% had primary/secondary education, and 8% lived in provinces. It was determined that 54.8% of the patients had undergone surgery before, 78.6% had a comorbidity, and the most common comorbidity was HTN+DM with a rate of 31%. It was found that 76.2% of the patients were continuously taking medication, 64.3% were smokers, and no patient used alcohol. It was determined that 95.2% of the patients had Coronary Artery Bypass (CABG).

A 76.2% of the patients were given education/counseling about the postoperative period (pain, oral food intake, early mobilization, etc.) in the preoperative period, 76.2% of the patients were given information about quitting smoking and alcohol use, exercise programs (breathing exercises, etc.), improving nutrition, preoperative analgesia until 4-8 weeks before surgery to ensure preoperative optimization, and 52.4% of the patients received this information by receiving face-to-face education. It was determined that 64.3% of the patients underwent preoperative HgbA1c measurement and 45.2% of the patients had a HgbA1c value of 6.5% and above. Preoperative albumin measurement was performed in all patients and 83.3% of the patients had a value between 3.4-5.4%. Antimicrobial prophylaxis was administered one hour before surgery in 95.2% of the patients and mechanical bowel preparation was performed preoperatively in all patients. It was determined that short/long-acting anesthetic agents were used in 100% of the patients during the operation period, necessary precautions were taken to maintain normothermia during the operation period, skin preparation protocols were performed to reduce surgical site infections in patients during the operation period, and surgical site shaving was performed with an electric machine in male patients to reduce surgical site infections during the operation period. None of the patients received postoperative prophylaxis for nausea and vomiting (PONV) (Table 1).

Multimodal (balanced) analgesia was applied for pain management in the postoperative period, 54.8% of the patients took their first fluid intake one day after surgery, 42.9% took it 8 hours after surgery, and 71.4% took solid foods one day after surgery. It was determined that the early mobilization process in the postoperative period was applied to 64.3% of the patients in the 24-48th hours after surgery, and the protocol applied to 100% of the patients for the removal of postoperative drains/catheters and inserted tubes. It was determined that the postoperative drain was removed on the 2nd postoperative day in 47.6% of the patients and the urinary catheter

was removed on the 3rd postoperative day in 38.1% of the patients. Plasma glucose monitoring and insulin infusion were performed in all patients in the postoperative period and fluid therapy was applied for central venous pressure. Risk group assessment to prevent delirium and convulsions, anesthetic-analgesic agent selection to reduce the risk and thromboembolic prophylaxis were not performed in any of the patients. It was determined that early discharge criteria for discharge were discussed in all patients, patient follow-up was performed after discharge and patients were informed about coming to the clinic in the first week after discharge (Table 2).

A 26.2% of the patients developed complications in the early period, 9.5% of these complications were surgical site infection, 2.4% postoperative bleeding, 7.1% pleural effusion, 2.4% impaired cognitive functions, 2.4% chest tube obstruction and 2.4% surgical site infection + pleural effusion. Late complications developed in 2.4% of patients and the complication was cardiac tamponade. It was determined that 21.4% of the patients were hospitalized due to postoperative complications, all (21.4%) of the hospitalized patients were operated on, and all patients were informed to come to the clinic on postoperative days 7-10. The mean duration of the operation was 5.44±1.40, the mean duration of intubation was 11.13±2.20, the mean duration of ICU stay was 3.47±1.83 days, the first mobilization of 54.8% of the patients occurred on the 2nd day of the operation, the mean duration of the first mobilization was 3.00±2.06 minutes, the mean duration of mobilization on the day they were mobilized after surgery was 8.52±3.18 minutes, and the mean duration of the first defecation after surgery was 4.24±1.87 days (Table 3).

In the reults related to the ERAS protocol application and the mean of the ERAS protocol for the preoperative, intraoperative and postoperative periods, the mean ERAS protocols for the preoperative, intraoperative and postoperative periods were 5.09±1.12, 4.00±.00 and 9.19±.67, respectively. The mean ERAS protocol for the operation periods was 18.28±1.33. The mean for postoperative patient follow-up and outcomes was 4.07±1.67.

There was no significant difference between the ERAS protocol form mean score and the variables of age, gender, previous surgical experience, type of comorbidity, duration of surgery, duration of intubation and mobilization days ($p>0.05$). It was determined that there was a significant difference between the smoking status of the patients and the mean score of the ERAS protocol form ($p<0.05$), and the mean scores of non-smokers were higher than the mean scores of smokers. There was a significant difference between the mean score of the ERAS protocol form and the comorbidity status of the patients ($p<0.05$), and the mean scores of the patients with comorbidity were higher than the mean scores of the patients without comorbidity. There was a significant difference ($p<0.05$) between the mean score of the ERAS protocol form and the patients' continuous medication use, and the mean scores of the patients who used continuous medication were higher than the mean scores of the patients who did not use continuous medication. There was a significant difference between the duration of preoperative hospitalization and the mean score of the ERAS protocol form ($p<0.05$). It was determined that the mean scores of patients with a preoperative hospitalization period of 1 day were higher than the mean scores of patients with a preoperative hospitalization period of more than 1 day. There was a significant difference between the duration of stay in the intensive care unit and the mean score of the ERAS protocol form ($p<0.05$). It was determined that the mean scores of patients whose length of stay in the intensive care unit was over 2 days were lower than the mean scores of patients whose length of stay was 2 days or less. There was a significant difference between the mean score of the ERAS protocol form and the mobilization time of the patients ($p<0.05$), and the mean scores of patients mobilized for 5-8 minutes were higher than the mean scores of patients mobilized for less than 5 minutes and more than 8 minutes (Table 5).

When the differences between the sociodemographic characteristics of the patients and the patient follow-up-result form were examined, it was determined that patients younger than 65 years of age, males, patients who were not working, single patients, patients whose income was equal to their expenses, patients with primary and secondary school education and patients living in the district had higher scores on the patient follow-up-result form.

No statistically significant difference was found between age, gender, smoking status, surgical experience, comorbidity, continuous medication use, type of comorbidity, preoperative hospitalization, duration of surgery, duration of intubation, days of mobilization, and duration of mobilization and the patient follow-up-result form ($p>0.05$). It was found that the averages of non-smoking patients, patients with no previous surgical experience, patients with comorbidities and continuous medication use, patients with HTN disease, patients with more than 1 day of hospitalization before surgery, patients who were intubated for more than 6 hours, and patients with mobilization for more than 8 minutes were higher. There was a significant difference between the duration of stay in the intensive care unit and the mean scores of the patient follow-up-result form ($p<0.05$). It was determined that the mean scores of patients who stayed in the intensive care unit for 2 days or less were higher than those of patients who stayed for more than 2 days (Table 5).

Table 1. Results Regarding the ERAS Evaluation Process in the Preoperative and Intraoperative Periods

Perioperative Period	Substances		n	%
Preoperative Period	Did you receive education/counseling in the preoperative period regarding the postoperative period (such as pain management, oral food intake, early mobilization, etc.)?	Yes	32	76.2
		No	10	23.8
	Were you informed about preoperative optimization, including smoking and alcohol cessation 4-8 weeks before surgery, exercise programs (such as breathing exercises), nutritional improvement, and preoperative analgesia?	Yes	32	76.2
		No	10	23.8
	If your answer is yes, in what way did you receive this education?	Face-to Face	22	52.4
		Face-to Face and brochure	10	23.8
		No Trained	10	23.8
	Was the discontinuation of solid foods 6 hours before surgery implemented for patients?	Yes	0	0
		No	42	100
	Was the discontinuation of liquid foods 2 hours before surgery implemented for patients?	Yes	0	0
		No	42	100
	Was oral carbohydrate loading administered to patients in the preoperative period?	Yes	0	0
		No	42	100
	Was preoperative HgbA1c measurement performed?	Yes	27	64.3
		No	15	35.7
	What was the measured HgbA1c value?	<%6.5	8	19
		≥%6.5	19	45.2

		Not measured	15	35.7
	Was preoperative albumin measurement performed?	Yes	42	100
		No	0	0
	What is the measured albumin value?	<34	7	16.7
		34-54	35	83.3
	Was antimicrobial prophylaxis administered one hour before surgery?	Yes	40	95.2
		No	2	4.8
	Was antimicrobial prophylaxis administered one hour before surgery?	Yes	42	100
		No	0	0
	Was preoperative nutritional support provided in the preoperative period?	Yes	0	0
		No	42	100
Intraoperative Period	Was postoperative nausea and vomiting (PONV) prophylaxis applied to the patient after cardiovascular surgery?	Yes	0	0
		No	42	100
	Were short-acting/long-acting anesthetic agents used during the surgical period?	Yes	42	100
		No	0	0
	Were the necessary measures taken to maintain normothermia during the surgical period (such as the use of external warmers during surgery, warming IV fluids to body temperature, and using blankets)?	Yes	42	100
		No	0	0
	Were skin preparation protocols implemented to reduce surgical site infections during the surgical period?	Yes	42	100
		No	0	0
	Was the surgical site shaved using an electric razor to reduce surgical site infections during the surgical period? (For male patients, n=26)	Yes	26	100
		No	0	0

Table 2. Results Regarding the ERAS Evaluation Process in the Postoperative Period

Substances		**n**	**%**
Was multimodal (balanced) analgesia applied for pain management in the postoperative period?	Yes	42	100
	No	0	0
When was the first oral fluid intake after surgery?	2 hours after surgery	0	0
	8 hours after surgery	18	42.9
	1 day after surgery	23	54.8
	2day after surgery	1	2.4
When was the first oral solid food intake after surgery?	1 day after surgery	30	71.4
	2 day after surgery	12	28.6
When was the early mobilization process initiated in the postoperative period?	Within the first 24 hours after surgery	3	7.1

	24-48 hours after surgery	27	64.3
	48-72 hours after surgeryicinde	10	23.8
	72-96 hours after surgery	1	2.4
	After 96 hours post-surgery	1	2.4
Is there a protocol for the removal of drains/catheters and inserted tubes in the postoperative period?	Yes	42	100
	No	0	0
When was the drain inserted after surgery removed?	1 day after surgery	16	38.1
	2day after surgery	20	47.6
	3 day after surgery	3	7.1
	On and after the 4th day after surgery	3	7.1
When was the urinary catheter removed after surgery?	Within the first 24 hours after surgery	1	2.4
	1 day after surgery	4	9.5
	2day after surgery	8	19
	3 day after surgery	16	38.1
	On and after the 4th day after surgery	13	31
Was plasma glucose monitoring and insulin infusion performed in the postoperative period?	Yes	42	100
	No	0	0
Was fluid therapy applied based on central venous pressure?	Yes	42	100
	No	0	0
Was a risk group assessment conducted for the prevention of delirium and convulsions in the postoperative period, and were anesthetic-analgesic agents selected to reduce the risk?	Yes	0	0
	No	42	100
Were early discharge criteria considered?	Yes	42	100
	No	0	0
Was adequate oral food intake ensured for early discharge?	Yes	42	100
	No	0	0
Was sufficient analgesia provided for early discharge?	Yes	42	100
	No	0	0
Was the return of bowel function ensured for early discharge?	Yes	42	100
	No	0	0
Was patient mobilization ensured for early discharge?	Yes	42	100
	No	0	0
Were the absence of infection and symptom findings confirmed for early discharge?	Yes	42	100
	No	0	0
Were comorbid diseases managed for early discharge?	Yes	42	100
	No	0	0
Was post-discharge patient follow-up conducted?	Yes	42	100
	No	0	0
Were thromboembolic prophylaxis methods (such as the use of thromboembolism stockings and anti-embolic treatments) applied to the patients?	Yes	0	0
	No	42	100
	Yes	42	100

Were patients informed about visiting the clinic in the first week after discharge?	No	0	0
Did the patient return to the hospital due to complications after surgery?	Yes	9	21.4
	No	33	78.6
Was the patient hospitalized due to complications after surgery?	Yes	9	21.4
	No	33	78.6
Was the patient reoperated due to complications after surgery?	Yes	9	21.4
	No	33	78.6
Were patients informed about visiting the clinic on postoperative days 7-10?	Yes	42	100
	No	0	0

Table 3. Results Regarding the Postoperative Patient Follow-up/ Outcomes

Substances		**n**	**%**
Did early postoperative complications develop?	Yes	11	26.2
	No	31	73.8
Which complications that occurred in the early period	SSI	4	9.5
	Hemorrhage	1	2.4
	Pleural Effusion	3	7.1
	Impairment of Cognitive Functions	1	2.4
	Chest tube obstruction	1	2.4
	SSI+ Pleural Effusion	1	2.4
Did late postoperative complications develop?	Yes	1	2.4
	No	41	97.6
Which complication occurred in the late period?	Kalp tamponadı	1	2.4
Did the patient return to the hospital due to postoperative complications?	Yes	9	21.4
	No	33	78.6
Was the patient hospitalized due to postoperative complications?	Yes	9	21.4
	No	33	78.6
Was the patient reoperated due to postoperative complications?	Yes	9	21.4
	No	33	78.6
Time of the first mobilization after surgery:	n	%	
Day 1	14	33.3	
Day 2	23	54.8	
Day 3	3	7.1	
Day 4	1	2.4	
Day 5	1	2.4	
	Mean± SD		
Duration of surgery	5.44±1.40 hours		
Duration of intubation	11.13±2.20 hours		
Length of stay in the ICU	3.47±1.83 days		
Time of the first mobilization after surgery	3.00±2.06 min		
How many times per day was the patient mobilized after surgery?	3.00±2.06 times		
The mean duration of mobilization on the day after surgery	8.52±3.18 min		
Time of the first defecation after surgery	4.24±1.87 days		

Table 5. Comparison of Sociodemographic characteristics and ERAS Protocol Mean Scores of Patients (n=42)

Variables	n	Mean	t* f**	P
Age				
<65	27	18.14±.50	-.897*	.375
≥65	15	18.53±.48		
Sex				
M	26	18.23±.50	.337*	.738
W	16	18.37±.51		
Smoking				
Yes	15	17.60±.51	-2.669*	.011
No	27	18.66±.49		
Previous Surgery Experience				
Yes	23	18.47±.47	0.877*	.308
No	19	18.05±.50		
Comorbidity				
Yes	33	18.57±.47	2.948*	.005
No	9	17.22±.44		
Continuous Medication Use				
Yes	32	18.56±.48	2.572*	.014
No	10	17.40±.48		
Comorbidities				
HTN	9	18.66±.44		
DM	9	18.22±.14	3.633**	.073
HTN+DM	13	18.76±.37		
HTN+DM+COPD	2	18.50±.00		
No	9	17.22±.52		
Preoperative Hospitalization				
1 day	29	18.75±.47	1.016*	.002
> 1 day	13	17.23±.48		
Operation time				
≤ 4 hours	6	17.33±.40	-1.958*	.057
> 4 hours	36	18.44±.48		
Duration of Intubation				
≤ 6 4 hours	2	18.00±.70	-.308*	.760
> 6 4 hours	40	18.30±.50		
Length of Stay in ICU				
≤ 2 day	11	19.27±.52	3.163*	.003
> 2 day	31	17.93±.49		
Mobilization Day				
!st day	14	18.71±.51	1.498*	.142
2nd & other days	28	18.07±.50		
Mobilization Time				
< 5 min	11	18.00±.50		
5-8 min	7	19.42±.48	3.493**	.040
> 8 min	24	18.08±.44		

* t test **Anova

Table 5. Comparison of the Sociodemographic characteristics and Mean Scores of Follow-up/ Outcomes Form (n=42)

Variables	n	Mean	t* f**	P
Age				
<65	15	4.33±1.49	1.376*	.177
≥65	27	3.60±1.91		
Sex				
M	26	4.30±1.56	-1.172*	.248
W	16	3.68±1.81		
Smoking				
Yes	15	3.93±1.86	-.395*	.695
No	27	4.14±1.58		
Previous Surgery Experience				
Yes	23	3.82±1.77	-1.047*	.302
No	19	4.36±1.53		
Comorbidity				
Yes	33	4.18±1.57	.815*	.420
No	9	3.66±2.06		
Continuous Medication Use				
Yes	32	4.15±1.58	.583*	.563
No	10	3.80±1.98		
Comorbidities				
HTN	9	4.77±0.66		
DM	9	4.00±1.73	.722**	.583
HTN+DM	13	4.07±1.75		
HTN+DM+COPD	2	3.00±0.51		
No	9	3.66±2.06		
Preoperative Hospitalization				
1 day	29	4.00±1.69	-.409*	.685
> 1 day	13	4.23±1.69		
Operation time				
≤ 4 hours	6	3.83±1.60	-.373*	.711
> 4 hours	36	4.11±1.70		
Duration of Intubation				
≤ 6 4 hours	2	3.00±2.82	-.926*	.360
> 6 4 hours	40	4.12±1.63		
Length of Stay in ICU				
≤ 2 day	11	5.00±0.16	2.246*	.030
> 2 day	31	3.74±1.84		
Mobilization Day				
!st day	14	4.00±1.83	-.193*	.484
2nd & other days	28	4.10±1.61		

Mobilization Time				
< 5 min	11	3.36±1.96		
5-8 min	7	4.42±1.51	2.325**	.086
> 8 min	24	4.51±1.86		

* t test **Anova

Discussion

The implementation of ERAS protocols in cardiovascular surgery reduces mortality, morbidity, complication rates, and length of hospital stay, thereby improving the quality of patient care. Therefore, raising awareness among healthcare professionals about ERAS and integrating these protocols into care processes is of great importance (Coleman et al., 2019, Ozbay, 2020). At present study we aimed to evaluate the appropriateness of ERAS protocols in cardiovascular surgery patients and their effects on patient outcomes.

When examining the age distribution of the patients in the study, it was found that 64.3% were aged 65 years or older. Studies in the literature (Bjornnes et al., 2016, Kara & Yilmaz, 2020, Tamdogan, 2015) have reported similar average ages. These findings indicate that cardiac surgery is predominantly performed on middle-aged and older individuals. Among the patients participating in the study, 61.9% were male, and 97.6% were married. Consistent with other studies in the literature (Bjornnes et al., 2016, Tamdogan, 2015) male gender and being married appear to increase susceptibility to cardiovascular diseases. It is stated that the estrogen hormone in women delays the onset of cardiovascular diseases and that being married plays a supportive role in postoperative care.

It was determined that 71.4% of the patients had an equal balance of income and expenses. Similar results are found in the literature (Kara & Yilmaz, 2020, Tamdogan, 2015, Cakir et al., 2018). Socioeconomic status is noted as an important variable in coping with cardiovascular problems (Chauvet Gelinier & Bonin, 2017). Regarding education level, 40.5% of the patients were illiterate, while 35.7% had completed primary or secondary school. The data on education level align with findings in the literature (Bjornnes et al., 2016, Kara & Yilmaz, 2020). It is thought that as education levels increase, awareness of post-discharge care improves. A total of 78.6% of the patients had chronic diseases, with the most common combination being HTN and DM. Studies in the literature (Bjornnes et al., 2016, Tamdogan, 2015) report similar results. Diabetes and hypertension are identified as factors that increase the risk of coronary artery disease (Irmak et al., 2021). Smoking prevalence was found to be 64.3%, while none of the patients consumed alcohol. When compared with the literature (Bjornnes et al., 2016; Tamdogan, 2015), smoking rates show variation, whereas alcohol consumption rates are similar. Among the patients included in the study, 95.2% underwent CABG. Similar rates are reported in the literature (Bjornnes et al., 2016, Yava et al., 2013). In the preoperative period, 76.2% of the patients received education on preoperative optimization; however, preoperative nutritional support for malnutrition was not provided. Studies in the literature (Girgin et al., 2022, Tuncel, 2022) indicate that preoperative optimization and nutritional support positively impact postoperative recovery. It appears that ERAS protocol applications are not fully integrated into clinical practice.

During the surgical process, measures were taken to maintain normothermia in all patients, short-acting anesthetic agents were used, and skin preparation was performed to prevent surgical site infections. When compared with the literature (Girgin et al., 2022, Karalipillia et al., 2011, Lazar et al., 2016, Saad & Aladawy, 2013, Tuncel, 2022), adherence to ERAS protocol recommendations was observed in this process. In the postoperative period, all patients received multimodal analgesia support, 54.8% resumed oral fluid intake on

postoperative day 1, 71.4% transitioned to solid food intake, and 64.3% mobilized within 24-48 hours. Similar findings are reported in the literature (Girgin et al., 2022, Macisaac & Jerums, 2011, Moghissi et al., 2009, Selvin et al., 2004, Van den Berghe et al., 2001, Tuncel, 2022, Wick et al., 2017). The absence of delirium screening and lack of post-discharge patient follow-up indicate incomplete adherence to the ERAS protocol. It was determined that 47.6% of the patients' drains were removed on postoperative day 2, while 38.1% had their urinary catheters removed on postoperative day 3. Mueller et al. (2000) reported that early drain removal reduces pain, while Andreasen et al., (2016) stated that early drain removal may be associated with pleural and pericardial effusion development. While the ERAS protocol does not provide a clear recommendation regarding the timing of drain and urinary catheter removal, some studies suggest removal based on ultrasound findings or when the fluid becomes serous (Gercekoglu et al., 2003; Li et al., 2018). Postoperatively, 26.2% of patients experienced early complications, with surgical site infections being the most common (9.5%). The literature states that postoperative infections are among the leading causes of hospital readmission (Hannan et al., 2011).

Initial mobilization occurred on postoperative day 2 in 54.8% of patients and on day 1 in 33.3%. The average mobilization time was 3±2.06 days, which is longer than the durations reported in the literature (Ay, 2019, Cakir, 2023). According to the ERAS protocol, early mobilization accelerates recovery, increases patient participation in self-care, and reduces anxiety (Aygin et al., 2022, Morton-Bailey et al., 2021). The mean surgery duration was 5.44±1.40 hours, which is longer than the durations reported in the literature (Ay, 2019, Li et al., 2018, Yava et al., 2013). Although the ERAS protocol does not provide a specific recommendation on surgery duration, shorter durations may expedite patient recovery and reduce complications. The mean ICU stay was 3.47±1.83 days. The literature indicates that ERAS protocol implementation reduces ICU stays (Li et al., 2018, Navarro-Garcia et al., 2011, Tuncel, 2022). However, in this study, ICU stays were longer, possibly due to incomplete implementation of ERAS components. The mean extubation time was 11.13±2.20 hours. The ERAS protocol recommends extubation within 6 hours postoperatively. However, this study found prolonged extubation times. The literature suggests that early extubation reduces ICU stay and complication risks (Flynn et al., 2019, Rajakaruna et al., 2005).

In conclusion, this study largely aligns with the literature regarding the sociodemographic characteristics of cardiac surgery patients and their preoperative, intraoperative, and postoperative processes. However, full adherence to the ERAS protocol was not achieved in areas such as preoperative nutritional support, postoperative delirium screening, and patient follow-up. Overall compliance with the ERAS protocol was found to be moderate to high. The compliance scores for the preoperative, intraoperative, and postoperative phases were 5.09±1.12, 4.00±0.00, and 9.19±67, respectively. Themean patient follow-up and outcome form score was 4.07±1.67, indicating that while ERAS protocol adherence is generally observed, certain deficiencies remain.

Limitation: The limitations of the study were the decrease in the number of elective cases due to the fact that the study was conducted during the COVID-19 pandemic process, the patients not volunteering to participate in the study, the separation of cardiovascular specialist physicians in the hospital where the study was conducted before the start of the study, and the fact that the study could not be generalized throughout the country by conducting the study only with patients in Batman province.

Conclusion: The ERAS protocol score for the cardiovascular surgical periods was low to moderate. It was determined that the score related to postoperative patient follow-up-follow-up and results was high.

Considering the complications and reoperation situations that develop in the postoperative period, it is thought that the application of ERAS protocols at low-

medium level during the operation periods is related to patient outcomes. While careful implementation of all elements of the ERAS protocols in cardiovascular surgery patients is believed to improve patients outcomes, it is alo thought to reduce the risk of developing complications.

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