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Original Article

Effect of Fast-Track Postoperative Recovery on Patients Outcome in Conventional Adult Cardiac Surgery

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ABSTRACT

Background: Enhanced recovery after surgery [ERAS] is defined as multimodal perioperative measures designed to achieve safe and early recovery after major surgery. It involves multidisciplinary evidence-based measures.

Aim of the work: To assess the impact of applying a fast-track recovery protocol on patients' outcomes in conventional adult cardiac surgery and compare it with conventional routine peri-operative management.

Patients and Methods: This is a single-center retrospective observational and comparative study including 300 cases scheduled for elective cardiac surgery at the Cardiothoracic Surgery Department, Tanta University from January 2019 to January 2023. Cases were divided into 2 groups: Group A [conventional management group; n=150] with routine perioperative management and Group B [early recovery group; n=150] who received the fast-track protocol.

Results: The study revealed highly significant differences between the 2 groups favoring the ERAS group, which proved superior to the conventional management group regarding total hospital stay [6.06 ± 0.48 days vs 7.99 ± 0.79 days; P < 0.001], intensive care unit stay [53.91 ± 3.55 hours vs 79.97 ± 7.85 hours; P < 0.001], time of mechanical ventilation [20.2 ± 1.49 hours vs 50.49 ± 3.58 hours; P < 0.001], intensive care unit readmission rate [4 cases vs 30 cases; P <0.001], reintubation rate [3 cases vs 23 cases; P < 0.0001], incidence of gastrointestinal complications [4 cases vs 16 cases; P = 0.005] and degree of patient satisfaction [P < 0.001].

Conclusion: Applying an ERAS protocol to cardiac surgery patients achieved better results regarding morbidity and mortality compared to conventional management.

Keywords: Conventional cardiac surgery; Early recovery programs; ERAS protocol; Post-operative management.

INTRODUCTION

Enhanced Recovery After Surgery [ERAS]-Cardiac is an evidence-based protocol that includes multi-specialty and multi-modal bundle of peri-operative care measures to elective adult cardiac surgical cases. ERAS protocol had been constructed and planned to minimize the patients' physiological stress; it combines multiple evidence-based practices during the peri-operative management to achieve synergistic improvements to the patients' results [1].

The ERAS protocol is an evolution of the "fast-track" post-operative recovery protocol. "fast track" program first introduced in 1994 to decrease the duration of intensive care unit [ICU] stays following coronary bypass surgeries [CABG] [2]. It gained support from **Bardram *et al.*** [3] and **Kehlet** [4] in colorectal surgery, who reported significant shortening of patients' recovery time from [9 to 10] days to [2] days.

The term "ERAS" had been introduced in 2001 upon the evolution of the ERAS Study Group [5]. The ERAS protocol aims to modify the routine intra-operative and post-operative patient management to the "fast-track" protocols to achieve a faster recovery and an early discharge from the hospital. ERAS works for a better quality of recovery via shorter ICU stay, shorter hospital stay and reducing the incidence of postoperative complications and through the use of opioid-sparing multi-modal analgesia, individualized patient fluid management and increase of degree of patients' satisfaction [6].

The ERAS protocol rapidly expanded, with the evolution of the ERAS Society, which publishes up-to-date evidence-based guidelines across several specialties including surgery, anesthesia, nursing and health care professionals. Favorable results, together with cost-savings, are the main targets for the ERAS protocol implementation [7].

The ERAS Cardiac Society newly published its first expert-consensus guideline for peri-operative care of cardiac surgery [8].

PATIENTS AND METHODS

This study is a single-center retrospective observational and comparative study of 300 cases of elective conventional adult cardiac surgery who were admitted at the Cardiothoracic Surgery Department, Tanta University from January 2019 to January 2023.

The studied cases included 150 cases of valve surgery, 130 cases of coronary artery bypass surgery [CABG] and 20 cases of combined surgery CABG plus valve surgery. The studied patients were divided into 2 groups: Group A [non-ERAS group] comprised 150 cases who had routine perioperative patient management and Group B [ERAS group] included 150 patients who had the ERAS protocol applied in their management. No randomization was done as this retrospective study as it depended on obtaining retrograde data from the patients' profiles and sheets registry.

Inclusion criteria

Adult [≥18-year-old] patients who were scheduled for elective conventional cardiac surgery. We included all the patients who had CABG, aortic, mitral, tricuspid valve, or combination processes.

Exclusion criteria

Elderly patients and patients with several uncontrolled co-morbidities such as uncontrolled diabetes mellitus [DM] and cancer patients and patients who had urgent and emergency cardiac surgery and percutaneous interventions such as transcatheter heart valve implantation [TAVI].

Methods of the study

The studied cases were analyzed regarding their basic demographic data, intervention details and pre-anesthesia measures and intra-operative measures.

Group A [Non-ERAS]: Conventional management group had the routine ordinary peri-operative patients management where the patients remain fasting with no-thing per mouth [NPO] for [6 to 8 hours] before surgery, extubation was routinely done during an average of [12 hours to 48 hours] after surgery and post-operative pain management depending mainly on parenteral opioid analgesics.

Group B: Patients who were enrolled in the [ERAS] group followed the components of the [ERAS] protocol which included the following:

1. Pre-operative ERAS strategies including: [A] Pre-operative risk stratification via glycosylated blood hemoglobin level and serum albumin level measurement, [B] Pre-operative correction of nutritional deficiency and nutritional optimization, [C] Consumption of clear liquids is continued up to [2 to 4 hours] before general anesthesia, [D] Preoperative carbohydrate loading, [E] Rehabilitation as patient education, exercise training, and anxiety

reduction, and [F] Smoking cessation and abstinence from alcohol drinking.

2. Intra-operative ERAS strategies including: [A] Surgical site infection reduction and topical intra-nasal therapies to eradicate staphylococcus colonization and prophylactic intravenous cephalosporins antibiotics, and [B] Avoidance of hyperthermia during rewarming on cardiopulmonary bypass [CPB].

3. Postoperative ERAS strategies including: [A] Insulin infusion to achieve strict glycemic control, [B] Pain management via the use of multi-modal opioid-sparing pain management approaches which depend on small doses of opioids enhanced by the synergistic or additive impacts of several analgesics such as Non-Steroidal Anti-inflammatory Drugs, intravenous acetaminophen, Tramadol, Pregabalin, gabapentin, intravenous dexmedetomidine and ketamine, [C] Prevention of post-operative hypothermia by using forced-air warming blankets, enhancing room temperature and warming the intravenous fluids, [D] Chest tube patency by active Chest tube clearance to avoid obstruction without breaking the sterile field, [E] Thrombo-prophylaxis via the use of compression stockings and prophylactic anticoagulation, [F] Early extubation strategies within [6 hours] after surgery, [G] Goal-directed fluid therapy via giving fluids, vasopressors and inotropes to prevent hypotension and low cardiac output.

4. Other important ERAS elements: [A] Pre-operative anemia investigation and correction, [B] Intraoperative anesthetic and perfusion considerations to maintain adequate renal blood flow, [C] Goal-directed perfusion strategies, [D] Protective mechanical ventilation strategy, [E] Early postoperative enteral feeding and mobilization after surgery.

Statistical analysis

Data were collected, tabulated, and statistically analyzed using SPSS version 26.0 for Windows [SPSS Inc., Chicago, IL, USA]. Qualitative data were expressed as numbers and percentages. Quantitative data were characterized using range [minimum and maximum], mean, standard deviation, and median. Every statistical comparison used a two-tailed significance test. P-values ≤ 0.05 indicated significant differences, while $P > 0.05$ denoted insignificant differences. Tests used included the chi-square [X2] test of significance to compare proportions among qualitative parameters and the independent t-test to compare two independent groups with parametric quantitative data.

RESULTS

There was no variation between the 2 groups regarding basic demographic data such as age, gender, diseased coronary vessels, weight, or body mass index [Table 1].

There was no difference between the two groups regarding comorbidities. None of the studied cases needed dialysis, although acute kidney injury occurs in many cardiac surgery cases. In our study, acute kidney injury was detected early by frequent intraoperative and postoperative laboratory investigations including blood urea level, serum creatinine level and blood urea nitrogen level, in addition to meticulous follow-up, watchful observation and monitoring of patients' urine output, correction of central venous pressure, monitoring and correction of fluid balance, judicious use of diuretics, and adjustment of doses for drugs excreted by the renal pathway. Although smoking is a common cause of COPD, the number of COPD cases was larger than the number of current smoker cases as several COPD patients in this study were ex-smokers who had stopped smoking years ago. So, the number of smoking patients in this study refers to the actual number of current smokers while the COPD patients number included both ex-smokers and current smokers [Table 2].

There was a high difference between the 2 groups regarding length of hospital stay, length of ICU stay and time of mechanical ventilation [Table 3].

There were significant differences between both groups in ICU readmission rates, reintubation rates, GIT complications, and degree of patient satisfaction. The GIT complications that occurred in the studied patients were related to postoperative medications; especially anticoagulant medications given after cardiac surgery. Indications for reintubation in cases that needed it included postoperative respiratory compromise, carbon dioxide retention and hypoxia, and respiratory acidosis as revealed by arterial blood gas [ABG] analysis; almost all reintubated patients were COPD patients with lower respiratory reserve [Table 4].

Table [1]: Comparing the studied groups as regard the demographic data

		Group A [Non-ERAS group]	Group B [ERAS group]	Test	P -value
Age [years]	Mean ± SD	55.38 ± 3.79	55.34 ± 3.69	1.05	0.7
	Median [Min. -Max.]	55 [49-63]	56 [49-63]		
Sex, n [%]	Male	93 [62%]	90 [60%]	0.12	0.72
	Female	57 [38%]	60 [40%]		
Weight [Kg]	Mean ± SD	72.06 ± 5.88	72.75 ± 5.17	1.29	0.11
	Median [Min. -Max.]	71.5 [63-84]	72 [63-84]		
Body mass index [kg/m^2]	Mean ± SD	25.14 ± 1.42	25.19 ± 1.51	1.13	0.45
	Median [Min. -Max.]	25.1 [22.4-28.1]	25.2 [22.4-28.3]		
Diseased coronary vessels [CAD]	One-vessel CAD	29	29	-	1
	Two-vessel CAD	54	54		
	Multi-vessel CAD	67	67		

Table [2]: Comparing between the 2 groups as regard co-morbidities

	Group A [Non-ERAS group]	Group B [ERAS group]	Test	P-value
Diabetes Mellitus [DM]	111	108	0.15	0.69
Hypertension [HTN]	125	119	0.79	0.37
Chronic obstructive lung disease [COPD]	124	121	0.20	0.65
Previous myocardial infarction [MI]	47	45	0.06	0.8
Stroke	1	0	1.003	0.31
Dialysis	0	0	-	-
Smoking	82	78	0.21	0.64
NYHA class III-IV	79	77	0.05	0.81

Table [3]: Comparison between both groups as regard the length of hospital stay, the length of ICU, and the time on a ventilator

		Group A [Non-ERAS group]	Group B [ERAS group]	Test	P-value
Length of hospital stay [Days]	Mean ± SD	7.99 ± 0.79	6.06 ± 0.48	2.7087	**<0.001**
	Median [Min. -Max.]	8 [7-10]	6 [5-7]		
Length of ICU [Hours]	Mean ± SD	79.97 ± 7.85	53.91 ± 3.55	4.88	**<0.001**
	Median [Min. -Max.]	79 [67-96]	54 [48-61]		
Time on ventilator [Hours]	Mean ± SD	50.49 ± 3.58	20.2 ± 1.49	5.772	**<0.001**
	Median [Min. -Max.]	50 [44-58]	20 [18-23]		

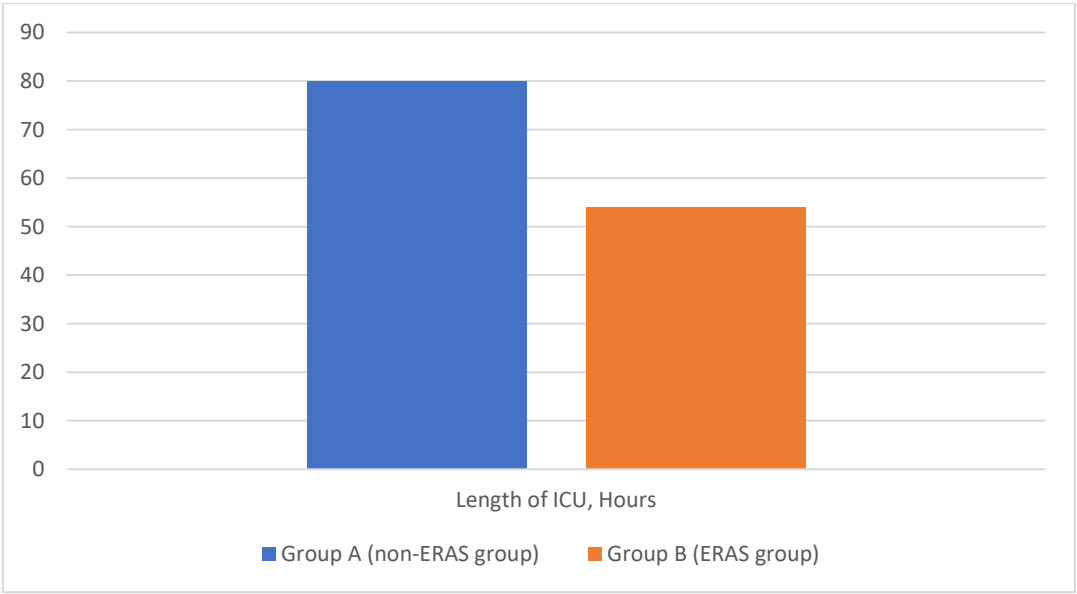

Figure [1]: Comparison among 2 groups as regard length of ICU stay, Hours

Table [4]: Comparison between both groups as regard ICU readmission, Reintubation rate, GI complications, and Patient satisfaction

	Group A [Non-ERAS group]	Group B [ERAS group]	Test	P-value
ICU re-admission	30	4	22.4	**<0.001**
Re-intubation rate	23	3	17.47	**<0.001**
Gastrointestinal [GIT] complications.	16	4	7.714	**0.005**
Patient Satisfaction			7.71	**<0.001**
Positive	67	133		
Negative	83	17		

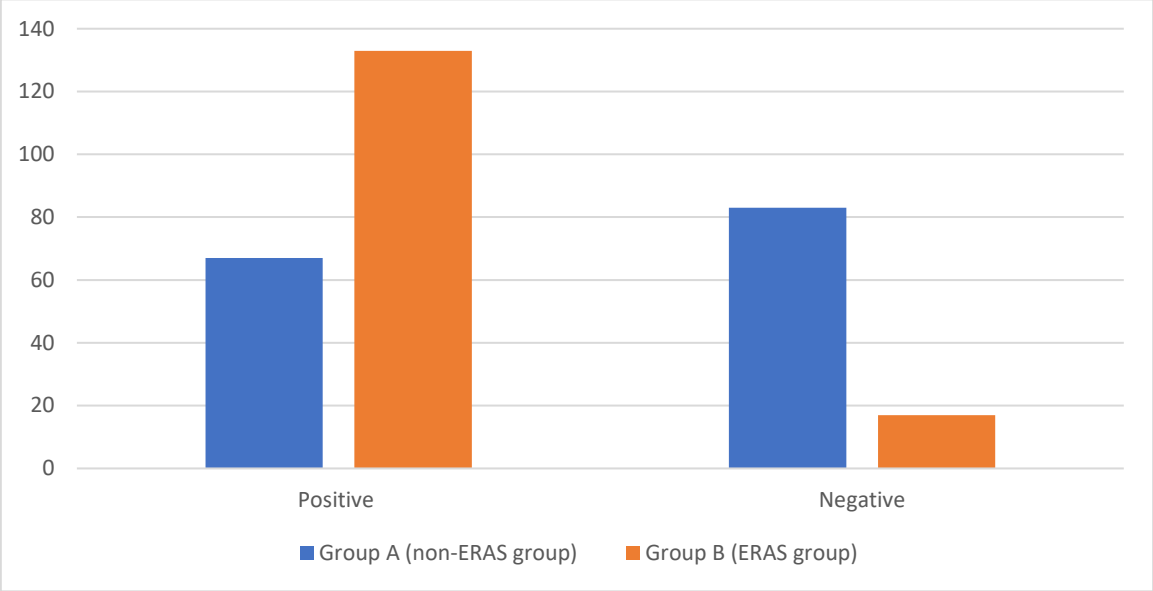

Fig [2]: Comparing among 2 groups as regards the degree of patient satisfaction

DISCUSSION

Our study results revealed a significant difference between the two groups of patients. Specifically, the ERAS group was superior to the conventional management group regarding the length of hospital stay, length of ICU stay, the time needed for mechanical ventilation, rate of ICU readmission, the reintubation rate, the incidence of GIT problems and the degree of patient satisfaction.

These results agree with findings from the study by **Meisler and Midyette** [9], who also found a reduction in the rate of ICU readmission and reintubation for patients with ischemic heart disease who underwent CABG surgery due to applying the ERAS protocol.

However, our results do not agree with the study by **Cheng *et al.*** [10], who prospectively monitored 120 CABG surgery cases and found no association between early extubation rates and reintubation rates.

Our findings are consistent with the study by **Carreno *et al.*** [11] as well, who found that time spent in the intensive care unit and total hospital stay were shorter for the ERAS group since they were extubated earlier than the non-ERAS group. Additionally, our results align with a retrospective study [12] that discovered considerably shorter hospital stays [10 days [8-12] vs. 11 days [9-14], p<0.01] and intermediate care unit stays [21 hours [17-39] vs. 26 hours [19-49], p < 0.01].

Similarly, our study results are in agreement with **Fleming *et al.*** [13], who found that post-operative pain scores on the first three post-operative days were lower in the ERAS group [p < 0.01, p < 0.05, p < 0.01]. The duration of intubation from 1 to 14 hours was significantly reduced [p < 0.01]. A shorter stay in the intensive care unit was attributed to a fast-track recovery pathway. Moreover, the incidence of postoperative problems such as hospital-acquired infections, acute kidney injury, atrial fibrillation, respiratory failure, cardiac tamponade, and myocardial infarction

was lower in the ERAS group [50.3% vs. 19.2%, p < 0.01] compared to the conventional management group. Furthermore, **Wong *et al.*** [14] reported lower postoperative ICU stay, total hospital stay, and 24-hour chest tube drainage in the ERAS group versus controls [p < 0.001].

Our study is also in line with **Lima *et al.*** [15], who found that the rate of re-intubation was significantly lower in the ERAS group compared to the control group [p = 0.009 and p = < 0.001, respectively]. Postoperative complications were also lower in the ERAS group [p = 0.014], and both the length of hospital stay and ICU stay were reduced, leading to decreased hospital costs and substantial public health savings. Likewise, **Bianchi *et al.*** [16] associated early patients extubation with shorter postoperative length of stay in higher dependency care units [ICU or HDU] before transferring patients to ward-based care [48 hours [range, 45–50] versus 50 hours [range, 47–69]; P=0.004]. This was driven by the shorter length of stay in the ICU for the ERAS group compared to the conventional management group [P<0.0001].

Finally, **MacLeod *et al.*** [17] found that patients who were fast-tracked had a shorter median first ICU stay [7.8 h vs. 20.4 h, p < 0.0001] and shorter time to initial extubation [4.3 h vs. 5.6 h]. Compared to patients who received standard therapy, fast-tracked patients had lower 30-day rates of composite outcomes [42.4% vs. 51.5%, p = 0.008].

Study limitations

The limitations of our study are attributed to its retrospective, single-center nature, which resulted in a limited cohort of studied patients. This study does not imply that all patients should be subjected to ERAS based on its better outcomes. Instead, the patients selected for ERAS should fulfill the inclusion and exclusion criteria as mentioned in the patients and methods section.

Conclusion

This study concluded that the application of the ERAS protocol to cardiac surgical patients resulted in better outcomes in terms of morbidity and mortality compared to the conventional patient management protocol. The ERAS group of patients experienced earlier postoperative mobilization, quicker restoration of gastrointestinal function, and shorter stays in the intensive care unit, leading to significantly reduced postoperative complications, fewer reintubations, decreased rates of ICU readmission, and earlier discharge from the hospital compared to patients managed using the conventional protocol.

Ethics of research

Research Ethics Committee at Tanta University, Faculty of Medicine approved the study under Code: [36264PR102/2/23]. The study involved a retrospective analysis for comparative and observational research. Data were obtained from the patients' registry and files. All participants provided written consent after being informed of the potential benefits and risks. Any unforeseen risks that emerged during the trial were promptly communicated to participants and the ethical committee, and necessary steps were taken to mitigate these risks. The use of individual code numbers for each participant throughout the research process served as an effective measure to ensure the confidentiality of participants' data. The findings of this investigation were used solely for scientific purposes.

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