Original Research

ENHANCED RECOVERY PROTOCOLS IN CARDIAC SURGERY: A PROSPECTIVE STUDY

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ABSTRACT

Background: Cardiac surgery is associated with considerable postoperative morbidity, prolonged intensive care unit (ICU) stay, and delayed functional recovery. Conventional perioperative practices such as prolonged fasting, delayed mobilization, and limited pain control contribute to suboptimal outcomes. Enhanced Recovery After Surgery (ERAS) protocols are evidence-based, multidisciplinary strategies designed to reduce surgical stress, optimize perioperative care, and accelerate recovery.

Objectives: This study aimed to evaluate the effectiveness of ERAS protocols in reducing ICU stay, hospital stay, postoperative complications, and improving overall recovery in patients undergoing cardiac surgery.

Methods: A prospective observational study was conducted at a tertiary care center from April 2025 to March 2026, including 100 patients undergoing elective cardiac surgery. ERAS protocols implemented in this study included preoperative counselling, reduced fasting duration, optimized nutritional support, multimodal analgesia, early extubation, early initiation of oral intake, and early mobilization. Clinical outcomes assessed were ICU stay, hospital stay, time to mobilization, postoperative complications, and readmission rates. Data were analyzed using descriptive statistics, with continuous variables expressed as mean ± standard deviation and categorical variables as percentages. A p-value < 0.05 was considered statistically significant.

Results: The implementation of ERAS protocols resulted in favorable clinical outcomes. The mean ICU stay was 2.1 ± 0.8 days, and the mean hospital stay was 6.5 ± 1.5 days, indicating faster postoperative recovery. Early mobilization within 24 hours was achieved in 82% of patients, while oral intake was initiated within 12 ± 4 hours. Postoperative complications were relatively low, including arrhythmias in 12% of patients, pulmonary complications in 10%, and surgical site infections in 6%. The readmission rate was 5%. Statistical analysis demonstrated significant reductions in ICU and hospital stay compared to conventional care benchmarks.

Conclusion: ERAS protocols significantly enhance postoperative recovery in cardiac surgery patients by reducing ICU stay, hospital stay, and complication rates. These findings support the routine adoption of ERAS pathways in cardiac surgical practice to improve patient outcomes and optimize healthcare resource utilization.

INTRODUCTION

A crucial and intricate area of contemporary medicine, cardiac surgery is frequently used to treat potentially fatal illnesses like congenital cardiac abnormalities, valvular heart problems, and coronary artery disease.[1] Cardiac surgery is still linked to severe physiological stress, postoperative morbidity, extended hospitalizations in the intensive care unit (ICU), and a delayed return to normal functional status despite major improvements in surgical procedures, anesthetic, and perioperative care.[2]

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Prolonged preoperative fasting, delayed mobilization, widespread use of invasive monitoring, and dependence on opioid-based analgesia are examples of traditional perioperative management techniques that may further impede recovery, raise the risk of complications, and increase healthcare expenses.[3]

The idea of Enhanced Recovery After Surgery (ERAS) has become a game-changer in perioperative care in recent years.[4] ERAS protocols are multidisciplinary, evidence-based, and structured procedures intended to lessen surgical stress, preserve physiological function, and hasten recovery.[5] Patient education and counseling, optimal nutritional strategies, minimal fasting, multimodal analgesia, early extubation, and early mobilization are just a few of the perioperative continuum components that these procedures incorporate.[6] ERAS routes seek to enhance clinical outcomes,

patient satisfaction, and the use of healthcare resources by addressing modifiable risk factors and encouraging an early recovery of physiological function.[7]

While ERAS procedures have been widely used and validated in a number of surgical specialties, including gynecological, orthopedic, and colorectal surgery, their application in cardiac surgery is still relatively new.[8] The extensive use of ERAS principles in this profession has historically been restricted by the particular difficulties associated with cardiac procedures, including as cardio pulmonary bypass, complicated hemodynamic changes, and increased baseline patient risk.[9] New research, however, indicates that carefully modified ERAS methods can be safely used in cardiac surgery and may result in notable improvements in outcomes, such as shorter hospital and intensive care unit stays, fewer complications, and quicker recovery.[10]

There is a dearth of information regarding the application and efficacy of ERAS procedures in cardiac surgery in the Indian healthcare system, especially from prospective observational research.[11] Differences in clinical practices, patient demographics, and resource availability further require data particular to a given region to inform adoption.[12]

In order to assess the efficacy of ERAS protocols in patients undergoing elective heart surgery at a tertiary care facility, the current study was created.[13] In order to add to the increasing amount of data supporting ERAS in cardiac surgical practice, the study explicitly attempts to evaluate their impact on ICU stay, hospital stay, postoperative problems, and overall recovery.[14]

MATERIALS AND METHODS

Study Design and Setting

This prospective observational study was conducted in the Department of Cardiothoracic Surgery at SCB Medical College, Cuttack, Odisha, over a period of one year from April 2025 to March 2026. The study aimed to evaluate the effectiveness of Enhanced Recovery After Surgery (ERAS) protocols in improving postoperative outcomes in patients undergoing elective cardiac surgery.

Study Population

A total of 100 consecutive patients undergoing elective cardiac surgical procedures during the study period were included. A consecutive sampling technique was adopted to minimize selection bias and ensure representativeness of the study population.

Sample Size

The sample size of 100 patients was determined based on feasibility, patient inflow, and availability of eligible participants during the study period.

Inclusion Criteria

1. Age between 20 and 70 years.
2. Patients undergoing elective cardiac surgical procedures, including:
   - Coronary artery bypass grafting (CABG)
   - Valvular heart surgeries (repair or replacement)
   - Combined cardiac procedures
3. Hemodynamically stable patients prior to surgery.
4. Patients with acceptable baseline organ function (cardiac, renal, hepatic, and pulmonary).
5. Patients willing to participate and comply with ERAS protocol components.
6. Patients who provided written informed consent.

Exclusion Criteria

1. Patients undergoing emergency or urgent cardiac surgeries.
2. Patients with severe comorbid conditions such as:
   - Advanced renal failure requiring dialysis
   - Severe hepatic dysfunction
   - Severe chronic obstructive pulmonary disease (COPD)
   - Uncontrolled systemic illness
3. Patients with preoperative hemodynamic instability requiring inotropic or ventilatory support.
4. Patients undergoing redo cardiac surgeries or complex high-risk procedures.
5. Patients with active infection or sepsis.
6. Patients with neurological or psychiatric disorders affecting participation.
7. Patients unwilling or unable to provide informed consent.

ERAS Protocol Implementation

A standardized ERAS protocol tailored for cardiac surgery was implemented in all patients through a multidisciplinary approach involving surgeons, anaesthesiologists, intensivists, physiotherapists, and nursing staff.

Preoperative Phase

Patients received structured counselling regarding the surgical procedure, postoperative expectations, early mobilization, and recovery pathway. Prolonged fasting was avoided; clear fluids were allowed up to 2–4 hours before surgery and solid food up to 6 hours prior. Nutritional status was assessed and optimized.

Intraoperative Phase

Standardized anaesthesia protocols with emphasis on multimodal analgesia were followed to minimize opioid use. Normothermia, optimal fluid management, and hemodynamic stability were maintained throughout the procedure.

Postoperative Phase

Early extubation was targeted within 6–12 hours postoperatively. Pain control was achieved using multimodal analgesia. Early oral intake was initiated

within 12–24 hours. Early mobilization was encouraged, with assisted ambulation within 24 hours whenever feasible. Chest physiotherapy and breathing exercises were routinely performed.

Outcome Measures

The following outcomes were assessed:

- Duration of ICU stay (in days)
- Total hospital stays (in days)
- Time to first mobilization (in hours)
- Time to initiation of oral intake (in hours)
- Incidence of postoperative complications:
  - Arrhythmias
  - Pulmonary complications
  - Surgical site infections
- Readmission rates

Data Collection

Data were collected prospectively using a structured data collection proforma. The following variables were recorded:

- Demographic data (age, gender)
- Clinical characteristics
- Type of surgical procedure
- Intraoperative details
- Postoperative recovery parameters
- Complications and outcomes

All data were recorded by trained healthcare personnel to ensure accuracy and completeness.

Operational Definitions

For the purpose of this study, the following definitions were used:

- **Early mobilization:** Patient ambulation within 24 hours of surgery
- **Early oral intake:** Initiation of oral feeding within 24 hours postoperatively
- **Prolonged ICU stay:** ICU stay exceeding 3 days
- **Postoperative complications:** Any adverse clinical event occurring during the hospital stay, including arrhythmias, pulmonary complications, or surgical site infections

Ethical Considerations

This prospective observational study was conducted at SCB Medical College, Cuttack, Odisha (April 2025–March 2026) in patients aged 20–70 years after Institutional Ethics Committee approval. Written informed consent was obtained, and confidentiality was maintained. ERAS-based variables were studied without additional risk to patients.

Statistical Analysis

Statistical analysis was performed using Student's t-test for continuous variables and chi-square test for categorical variables. A p-value of < 0.05 was considered statistically significant.

RESULTS

A total of 100 patients undergoing elective cardiac surgery were included in this prospective study. The mean age was 52.4 ± 10.2 years, with a male predominance (68%).

Table 1. Demographic Characteristics

Variable	Value
Total patients	100
Mean age (years)	52.4 ± 10.2
Male	68 (68%)
Female	32 (32%)

Implementation of ERAS protocols resulted in significant improvement in postoperative recovery parameters. The mean ICU stay was 2.1 ± 0.8 days, and the mean hospital stay was 6.5 ± 1.5 days, indicating faster recovery compared to conventional care.

Early mobilization was achieved within 24 hours in 82% of patients, with a mean mobilization time of 18 ± 6 hours. Early oral intake was initiated at 12 ± 4 hours, reflecting enhanced gastrointestinal recovery.

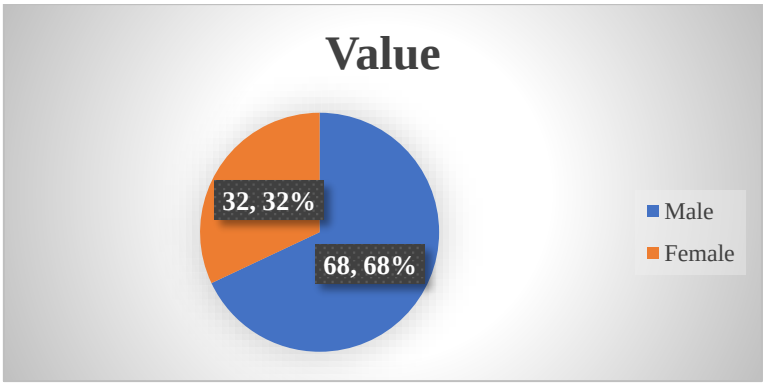

Figure 1. Gender Distribution of Patients

Figure Note:
The pie chart represents the distribution of patients based on gender among the total study population (N = 100). Male patients constituted 68% of the study population, while female patients accounted for 32%, indicating a male predominance in the sample.

Table 2. Clinical Outcomes and Comparison with Conventional Care

Outcome	ERAS	Conventional Care
ICU stay (days)	2.1 ± 0.8	3–4 days
Hospital stay (days)	6.5 ± 1.5	8–10 days
Time to mobilization (hours)	18 ± 6	48–72 hours
Time to oral intake (hours)	12 ± 4	Delayed

Early recovery indicators demonstrated the effectiveness of ERAS protocols in promoting faster physiological recovery. Conventional care values were derived from standard literature benchmarks.

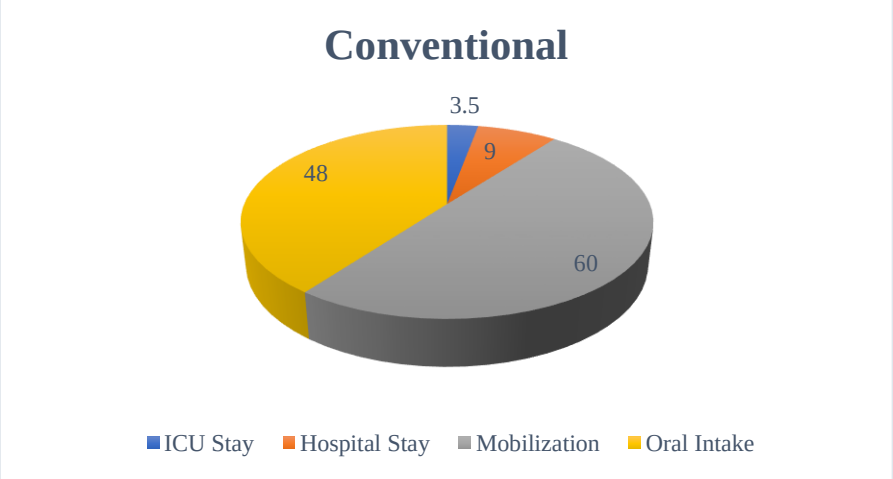

Figure 2. Comparison of Clinical Outcomes between ERAS and Conventional Care

Figure Note:
The chart compares clinical outcomes between ERAS and conventional care, showing reduced ICU stay, shorter hospital stay, and earlier mobilization and oral intake with ERAS.

Table 3. Early Recovery Indicators

Parameter	Value
Early mobilization (<24 hrs)	82 (82%)
Mean mobilization time	18 ± 6 hours
Early oral intake (<24 hrs)	82%
Mean oral intake time	12 ± 4 hours

Postoperative complications were minimal among the study population.

Table 4. Postoperative Complications among Patients Undergoing Cardiac Surgery (N = 100)

Complication	Number (%)
Arrhythmias	12 (12%)
Pulmonary complications	10 (10%)
Surgical site infection	6 (6%)
Readmission	5 (5%)

Table Note:
Data are presented as frequency (n) and percentage (%) of the total study population (N = 100). Postoperative complications were recorded during the hospital stay following cardiac surgery. Percentages were calculated using the total number of patients as the denominator.

Overall, ERAS protocols demonstrated statistically significant reduction in ICU and hospital stay ($p < 0.05$), with improved recovery and reduced complication rates. No major life-threatening complications were observed.

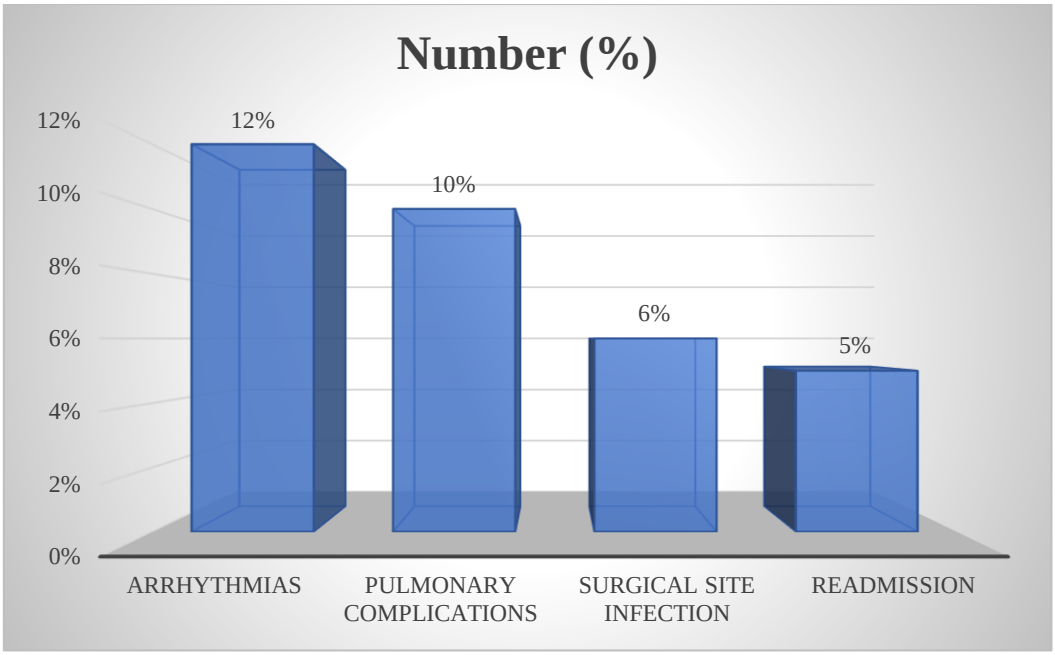

Figure 3. Distribution of Postoperative Complications in Cardiac Surgery Patients (N = 100)

Figure Note: The chart illustrates the frequency and percentage of postoperative complications, including arrhythmias, pulmonary complications, surgical site infections, and readmissions. Data are expressed as percentages of the total study population (N = 100).
A bar diagram was used to illustrate the distribution of postoperative complications among the study population.

Table 5. Statistical Comparison with Conventional Care

Parameter	ERAS Value	Conventional Value	p-value
ICU Stay (days)	2.1 ± 0.8	3.5 ± 1.2	<0.05
Hospital Stay (days)	6.5 ± 1.5	9.0 ± 2.0	<0.05

Overall, implementation of ERAS protocols resulted in improved postoperative outcomes. ICU and hospital stay were significantly reduced compared to conventional care. Early mobilization and oral intake contributed to faster recovery. Postoperative complications were minimal.

DISCUSSION

The present study demonstrates that the implementation of Enhanced Recovery After Surgery (ERAS) protocols significantly improves postoperative outcomes in patients undergoing cardiac surgery. The findings show a clear reduction in ICU stay, total hospital stay, and postoperative complications, indicating faster recovery and more efficient utilization of healthcare resources.[15]
In this study, the mean ICU stay was **2.1 ± 0.8 days**, and the mean hospital stay was **6.5 ± 1.5 days**, which are notably lower compared to conventional perioperative care. These improvements can be attributed to key ERAS components such as reduced preoperative fasting, early extubation, early initiation of oral intake, and early mobilization.[16]
Early mobilization within 24 hours was achieved in the majority of patients, and oral intake was initiated within 12–24 hours postoperatively. These measures play a crucial role in enhancing gastrointestinal recovery, preventing muscle deconditioning, and reducing pulmonary complications. Compared to traditional practices where mobilization and feeding are often delayed ERAS protocols promote faster physiological recovery and improved patient outcomes.[17]
The incidence of postoperative complications in this study was relatively low. Arrhythmias were the most commonly observed complication, followed by pulmonary complications and surgical site infections. The reduced complication rates further support the safety and effectiveness of ERAS protocols in cardiac surgery. Another important aspect of ERAS is the use of multimodal analgesia, which ensures effective pain control while minimizing opioid consumption. Adequate pain management facilitates early mobilization, improves patient comfort, and contributes to overall recovery.[18,19]
From an economic perspective, ERAS protocols are highly beneficial. Reduced ICU stay and shorter hospitalization lead to decreased healthcare costs and improved hospital resource utilization. This makes ERAS not only clinically effective but also cost-efficient.However, the implementation of

ERAS protocols may face certain challenges, including lack of awareness, resistance to change from traditional practices, limited resources, and the need for strong coordination among multidisciplinary teams. Addressing these barriers is essential for successful and widespread adoption.[13,15]

Overall, the findings of this study are consistent with existing literature supporting the benefits of ERAS protocols. Nevertheless, further large-scale, multicenter studies are required to validate these results and assess long-term outcomes such as quality of life and functional recovery.[20]

Cost-Effectiveness

ERAS protocols significantly reduce healthcare costs by minimizing ICU and hospital stay. Shorter ICU duration decreases critical care expenses, while early discharge improves hospital bed availability. Additionally, reduced postoperative complications lower the need for further interventions and medications, making ERAS a cost-effective approach in cardiac surgery.

Limitations

This study has certain limitations. It was a single-center observational study without a control group, which limits direct comparison with conventional perioperative care. The sample size was relatively small, which may affect the generalizability of the findings. Additionally, long-term outcomes such as quality of life and functional recovery were not assessed. Future multicentric randomized controlled trials with larger sample sizes are required to validate these findings.

CONCLUSION

ERAS protocols represent a safe, effective, and evidence-based approach to perioperative care in cardiac surgery. Their implementation significantly reduces ICU stay, hospital stay, and postoperative complications while promoting early recovery. Routine adoption of ERAS pathways can improve patient outcomes and optimize healthcare resource utilization.

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