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Clinical efficacy and economic impact of an enhanced recovery after cardiac surgery program for early discharge

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ABSTRACT

Background: Early discharge (ED) is becoming a crucial component of an enhanced recovery after cardiac surgery (ERACS) program. The aim of this study was to investigate the safety and health resource utilization of an ED pathway implementation in patients undergoing coronary artery bypass grafting and/or valve surgery.
Methods: An ED protocol implemented in 2020 used a set of standard definitions to identify patients eligible for hospital discharge on post-operative days (POD) 3 or 4. Retrospective chart reviews and data collection were conducted.
Results: A total of 392 patients were enrolled during the study period. Their median STS mortality risk was 3.3%, and STS risk for long length of stay was 1.3%. Half of the patients were discharged to a step-down unit on POD 1. Moreover, 88 (22%) patients were discharged from hospital on POD 3. The rate of re-hospitalization at 30 days was 3.5%, compared to 4.7% in a control group of similar patients from 2019. All patients were alive at 30 days. Savings in post-operative hospitalization costs amounted to 2,923,200$ CAD over the year during the study period.
Conclusions: Implementation of an ED protocol can shorten hospital stays without increasing readmission rates while saving costs on post-operative hospitalization. These findings corroborate previous studies. Telephone monitoring following ED is crucial as it can provide ongoing reassurance on post-operative progress and may help alleviate utilization of emergency services in the early post-operative period.

KEYWORDS

Enhanced recovery after cardiac surgery; Early discharge; Health resource utilization; Post-operative hospitalization costs; Re-hospitalization

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Introduction

Fast-track or enhanced recovery after surgery (ERAS) represents a widely recognized and evidence-based approach to optimizing patient outcomes throughout the perioperative period. This approach is characterized by a set of standardized practices tailored to specific surgical specialties, with the overarching goal of enhancing recovery and minimizing post-operative complications. This ERAS pathway is systematically applied across the three crucial phases of the surgical process: preoperative, perioperative, and post-operative [1]. In recent years, ERAS has emerged as a pivotal framework in perioperative care, demonstrating effectiveness across various surgical disciplines. These "fast-track" programs were shown to reduce post-operative pain while reducing opioid consumption, decrease hospital stay, and improve overall patient satisfaction [2-8]. The implementation of comprehensive ERAS protocols has been slower in cardiac surgery compared to other surgical specialties, but it has recently gained momentum [9]. Despite this increase in popularity, few enhanced recoveries after cardiac surgery (ERACS) protocols have been reported, especially regarding early discharge. The rationale behind incorporating early discharge into cardiac surgery protocols stems from the desire to optimize resource utilization without compromising patient safety. By facilitating early recovery milestones, such as extubation, mobilization, and discharge, the program aims to curtail the duration of hospitalization, reducing associated costs and enhancing patient satisfaction. The local ERACS program's commitment to early discharge is not only rooted in clinical goals but is also aligned with the broader objectives of ERAS, which emphasize evidence-based practices for improved perioperative care. In 2020, an early discharge pathway was implemented as part of a local ERACS program. This protocol identifies patients who can safely be discharged home on post-operative days 3 or 4 after cardiac surgery. Therefore, the primary objective of this study is to evaluate the safety and cost-saving implications of the implemented early discharge protocol within the local ERACS program. Specifically, we seek to assess the impact on post-operative outcomes, re-hospitalization rates, and overall healthcare costs associated with cardiac surgery patients enrolled in the early discharge pathway.

Methods

Study design

We conducted a retrospective, single-institution chart review of all adult patients who underwent coronary artery bypass grafting (CABG) and/or valve repair and/or valve replacement either via midline sternotomy or a minimally invasive approach during 2020. Further, data collection was performed for patients who were included in the early discharge pathway

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following surgery. Early discharge was defined as discharge from the hospital to home after the third or fourth day of surgery, the earliest being after 4 pm on postoperative day 3 without any health care assistance at home. For an early discharge, these are the following criteria: stable cardiac rhythm with an unremarkable electrocardiogram, no active infection, no fever, hemoglobin level >80 g/dL, white blood cell count should be in the normal range, creatinine at baseline level and a satisfactory chest X-ray. Patients also had to mobilize safely and independently prior to discharge, as established by a physiotherapist. Patients who were considered for an early discharge typically succeeded in the early extubation, early mobilization, and early discharge from the intensive care unit (ICU) components of the ERACS pathway. An assisted transfer to a chair within 6 hours of surgery and a monitored ambulation within 24 hours is considered as early mobilization, and similarly, an early discharge from ICU means a transfer to a step-down unit on post-operative day 1. Patients considered for early discharge also had to live within a 1-hour drive from the hospital. A simple checklist is followed by patients throughout their post-operative stay and helps the primary care team monitor their progression with the multiple components of the ERACS pathway (Figure 1). Follow-up calls were done 24 hours, 48 hours, and 30 days after hospital discharge by dedicated ERACS nurses.

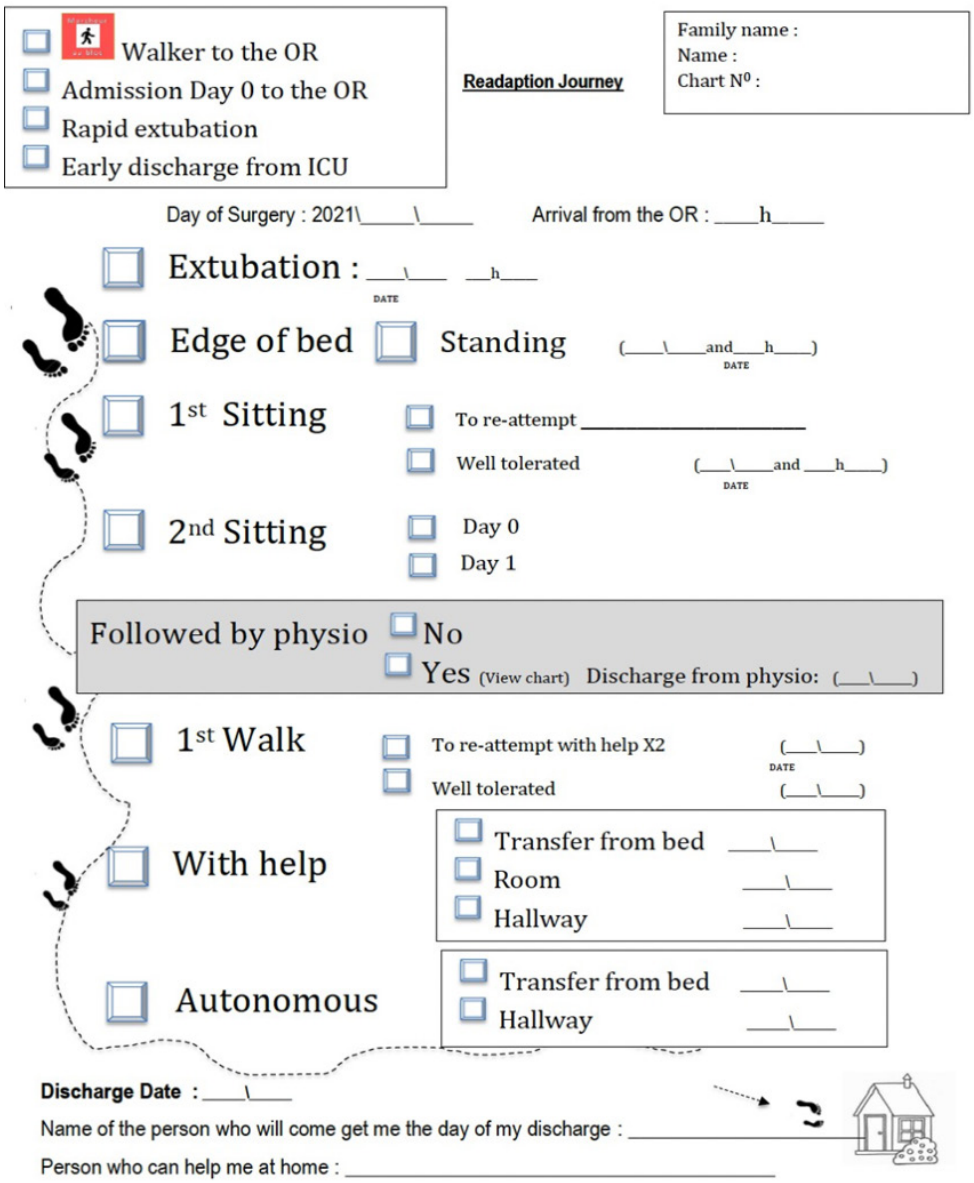

Figure 1. Bedside tool for a safe early discharge plan after cardiac surgery.

Furthermore, the median hospital length of stay, the rate of re-hospitalizations, the rate of emergency room visits, and the median post-operative hospitalization cost were compared between the early discharge cohort from 2020 and a similar group of patients from 2019, which predated the implementation of the early discharge protocol. The cohort from 2019 represented patients who underwent CABG and/or valve replacement and/or valve repair, who had an uncomplicated post-operative course, and who would have otherwise been considered for an early discharge had they been

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operated on after the implementation of that protocol in 2020.

The post-operative hospitalization cost comprises the cost of the hospital stay, starting from the ICU admission after surgery to the discharge from the hospital. These included the cost of the hospital room (ICU and step-down unit), the inpatient services provided by nurses, nursing assistants, respiratory therapists, and physiotherapists, as well as diagnostic imaging. The salaries of the dedicated ERACS nurses were also added for the early discharge cohort.

The protocol of the study was submitted to the institutional review board. Based on local ethics policies, it was determined that the proposed activity did not constitute "human subjects research" but rather a quality improvement initiative and consequently was done under a waiver of informed consent.

Statistical analysis

We reported categorical variables as counts with percentages and continuous variables as median with interquartile range (IQR).

Results

In 2020, a total of 1981 cardiac procedures were performed, out of which 1401 CABGs, valve repairs, and/or replacements were performed. Among them, 392 patients were discharged home on post-operative day 3 or 4 as part of the early discharge protocol (Figure 2). Patients of the early discharge cohort had a median age of 66 (60-71) years; 83% were male, and 37% were active smokers. The mean STS mortality score was 1.29%. Their mean STS long length of stay (LOS) score was 3.3%. Other baseline characteristics are shown in Table 1.

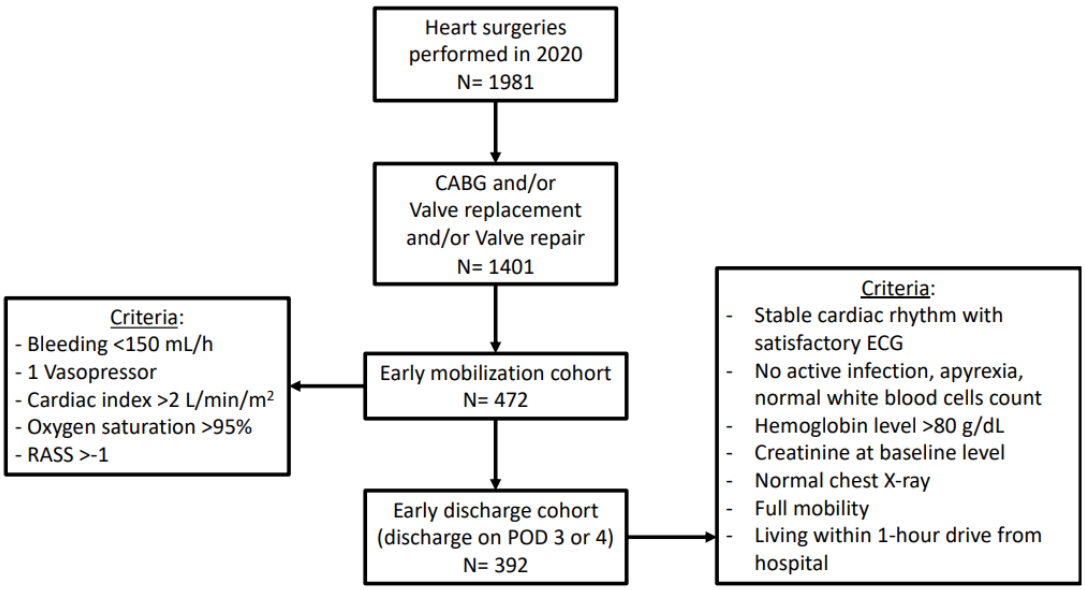

Figure 2. Study flowchart.

Table 1. Baseline characteristics of the early discharge cohort.

Median (IQR) or n (%)	Early discharge cohort (N=392)
Age, years	66 (60;71)
Male gender	325 (83)
Active smoking	145 (37)
COPD	32 (8)
Hypertension	276 (70)
Dyslipidemia	268 (68)
Diabetes	109 (28)
BMI>30	105 (27)
Previous stroke	17 (4)
Atrial fibrillation	55 (14)
Urgent procedure	87 (22)
Redo surgery	8 (2)
STS score - risk of mortality, %	3.3 (2.1-5.2)
STS score - long LOS, %	1.3 (0.8-2.0)

BMI: body mass index; COPD: LOS: length of stay; STS: Society of Thoracic Surgeons.

Early mobilization and discharge

The median intubation time was 155 (115-210) minutes. In addition, 43% (n=170) of the patients were able to safely transfer from their bed to a chair within the first hour following extubation. On postoperative day 1, 49% (n=193) of patients were able to ambulate and were discharged to a step-down unit. A total of 304 (77%) patients were discharged home on postoperative day 4, while 88 were discharged on postoperative day 3. Among patients who were discharged 3 days after surgery, 65 (74%) had isolated CABG, 17 (19%) had aortic valve replacement, and 6 (7%) had mitral valve repair. The median hospital stay length for patients in the 2019 cohort was 6 days (5.1-7.1), whereas it was 4 days (4-4.2) for the early discharge cohort. Between 2019 and 2020, the proportion of patients that were discharged home on postoperative day 3 or 4 increased by 59% and 18%, respectively.

Emergency visits and re-hospitalizations

The rate of re-hospitalization at 30 days was 4.7% in the 2019 cohort and 3.5% in the early discharge cohort. The rate of emergency room visits at 30 days was 11.7% in the 2019 cohort and 12.4% in the early discharge 2020. No mortality was observed in the two cohorts.

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Cost savings

The median post-operative hospitalization cost per patient was 25,736 CAD in the 2019 cohort and 21,183 CAD in the early discharge cohort of 2020. In comparison, the median cost for a non-early discharged patient in 2020 was 30,927 CAD. With the implementation of the early discharge protocol in 2020, cost savings for post-operative hospitalization totaled 2,923 200$CAD, including the salary of the dedicated ERACS nurses.

Discussion

This retrospective study evaluated the impact of adding an early discharge protocol to a local ERACS program on safety and health resource utilization. The results showed a reduction in the duration of hospitalization without an increase in readmission rate and a relative cost saving compared to a control group of patients undergoing similar uncomplicated surgeries the year prior.

These findings corroborate previous studies. More than two decades ago, Loubani et al. explored the safety of hospital discharge on postoperative day 4 after CABG [10]. Their prospective study, which involved 198 patients, showed that in spite of a longer hospital stay, patients in the non-early discharge group were more likely to be readmitted compared to the early discharge group (8.4% vs 3.8%, respectively) [10]. Postoperative morbidity was similar in both groups [10]. In a survival analysis at 5 years, Afflu et al. found that patients undergoing isolated CABG who were discharged home on post-operative day 4 (n = 1148) had a similar survival compared to a matched non-early discharge cohort (n=2286) [11]. More recently, the safety of an ERACS protocol with an early discharge component at post-operative day 3 was evaluated using propensity score matching in 92 patients [12]. No significant differences in mortality and post-operative complications were recorded between the early discharge and the non-early discharge groups [12]. The authors also identified post-operative atrial fibrillation and renal failure as predictors of a post-operative stay > 5 days [12]. Although our study did not include prediction testing, by experience, atrial fibrillation and acute kidney injury represent major obstacles to early discharge. These post-operative complications can create a paradox among younger patients undergoing robotic mitral valve repair end up having a longer hospital stay than older patients who undergo CABG via midline sternotomy, precisely because of the development of post-operative atrial fibrillation in the former group.

Early extubation is a very important component of an ERACS program as it can streamline the process of early discharge. Early extubation can also decrease the use of fluids and inotropic or vasopressor support in the post-operative period [13]. As anesthetics are weaned more rapidly, their hypotensive effect dissipates. Furthermore, when patients are extubated, they go from positive pressure ventilation to negative pressure ventilation, which alleviates the physiological effects of positive pressure ventilation on intrathoracic pressure and left ventricular stroke work [14]. Considering these advantages of early extubation, some authors have been studying the safety of ultra-fast-track extubation and day zero discharge from ICU [13,15].

On the other hand, our results showed a 0.7% increase in visits to the emergency department in the early discharge cohort, with no resultant increase in re-hospitalizations or mortality. This observation could be explained by many factors. First, patients in the early discharge cohort might have developed COVID-19 symptoms, prompting them to represent the hospital. Second, speed of discharge is a common concern for patients [16]. Despite the reassurance provided by the primary care team, certain patients might have felt worried following their early discharge and had a low threshold for representing the hospital. Furthermore, early discharge patients have a relatively short traveling distance to the hospital, as it is a prerequisite for early discharge. This may, in part, explain the increased utilization of emergency services [17]. The frequent telephone monitoring of our patients conducted after early discharge, especially at 24 hours and 48 hours following discharge, was implemented to alleviate the stressful transition to post-operative recovery at home. Telenursing is a crucial part of ERACS programs as it can provide ongoing reassurance on post-operative progress.

Successful ERACS program implementation is not an easy task. It is certainly not achieved by simply discharging low-risk patients at post-operative days 3 or 4 days. Without an increase in infrastructure specific to ERACS patients to provide them with an adapted continuum of care after discharge, an early discharge pathway could possibly be dangerous. We believe that the close proximity of early-discharge patients to the hospital is an important criterion as it allows them to receive immediate emergency care when required. In addition, ERACS programs need increased intervention from ERACS-specific personnel, including nurses, nursing assistants, respiratory therapists, and physiotherapists. ERACS nurses require additional education, training, and familiarity with ERACS patients. Therefore, an ERACS program may not be realistically implemented in any hospital setting in its present form and may take time to be shaped in its optimal potential, starting from fast-track extubation and mobilization with Swan-Ganz catheters, chest tubes, and femoral arterial lines to ventilated ambulation and an increase in the physiotherapy workforce.

Limitations

This study used a retrospective design at a single institution. In addition, it only studied a very selective group of patients who were suitable for only one component of an ERACS program, namely an early discharge protocol, which was based on local criteria. Therefore, the results do not apply to any ERACS program. Furthermore, we did not use propensity score matching to generate the 2019 cohort that was used as a comparator. In terms of cost savings, indirect costs were not included, and a cost-effectiveness analysis was not performed. Lastly, the study did not include an evaluation of patients' satisfaction, which is an important measure of healthcare quality.

Conclusions

An early discharge pathway can be safely incorporated to an ERACS program for select cardiac surgery patients and may lead to significant cost savings and a decrease in re-hospitalizations. These results provide further support for the use of ERACS in cardiac surgery.

Disclosure statement

No potential conflict of interest was reported by the authors.

Author contributions

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The authors, Myriam Bellemare and Olina Dagher have equally contributed to the work and share the first co-authorship.

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