

Serious about C-ERAS (Cardiac ERAS)

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Abstract

Enhanced Recovery After Surgery (ERAS) incorporates multi-modal interventions that synergistically improve patient outcome. Its goals include improving patients functionally pre-operatively, reducing the stress of surgery intra-operatively to facilitate early return to daily activities. We conducted a pilot study at our unit recruiting patients undergoing elective coronary artery bypass grafting (CABG) into the Cardiac ERAS (C-ERAS) pilot and compared them with the patients undergoing CABG meeting the ERAS criteria but who not included the C-ERAS pilot (Control).

Materials and Methods: 122 C-ERAS patients were compared to 91 control patients who underwent CABG only from the period of July 2015 to September 2016. All C-ERAS patients received pre-operative counselling by a dedicated ERAS Practitioner to manage expectations of the patient journey, health promotion and pre-operative optimisation advice. Emphasis was made on educating the patient on daily goals for recovery and patients were followed up daily by the ERAS practitioner post-operatively.

Results: There were 122 patients in the C-ERAS group and 91 patients in the control group. The mean age was 63.6±9.9 years. 181(85%) of the patients were males. After adjusting for the abovementioned confounders, C-ERAS patients had a shorter length of stay that was statistically significant. (2.36 days shorter (95% CI; 1.01-3.7 days; p<0.01). The difference in mean bed day costs was £1153.70 (95% CI, £553.70-£1753.7; p<0.01) less in the C-ERAS cohort.

Conclusion: This study highlighted that C-ERAS is a safe and feasible pathway to reduce in-hospital stay with no difference in complications and readmission rates compared to routine management of patients. There was also a significant cost saving with the C-ERAS pathway mimicking the results in enhanced recovery programmes in the other surgical specialities.

List of Abbreviations

C-ERAS: Cardiac Enhanced Recovery After Surgery

CABG: Coronary Artery Bypass Grafting

BMI: Body Mass Index

NYHA: New York Heart Association Functional Classification of Symptoms

CCS: Canadian Cardiovascular Society grading of angina pectoris

LV: Left Ventricle

ICU: Intensive Care Unit

Introduction

Enhanced Recovery after surgery was a concept introduced by

Henrik Kehlet¹ with protocols aimed to ameliorate the stress response to surgery by employing multimodal means with a summation of gains to optimise post-operative recovery. These processes begin in the pre-operative phase with a view to reduce the length of stay, promote earlier mobilisation, empower patients to be a part of their own recovery, and reduce morbidity and post-operative pain as demonstrated by a multitude of randomised trials²⁻⁶ and meta-analyses⁷⁻¹⁰ across the surgical specialties, thereby reshaping models of care.

Key outcomes measured in most ERAS programmes include patient satisfaction scores, reduction in hospital costs and an earlier return to pre-operative function when compared to conventional surgical pathways.

Despite the ubiquity of ERAS across the surgical specialties, there is a scarcity in data for ERAS post-cardiac surgery. Extrapolation of data from other specialties have enabled the formation of an ERAS programme (C-ERAS) at our unit.

C-ERAS is currently implemented to both elective and emergency patients following its evolution in other surgical specialties¹¹. Since its implementation, over 100 patients have benefited from this pathway. We undertook a pilot study to look at the early outcomes of the C-ERAS programme at the largest cardiac surgical unit in Scotland.

Materials and Methods

A prospectively collected local cardiothoracic database was retrospectively interrogated. 122 C-ERAS patients were compared to 91 control patients who underwent CABG only from the period of July 2015 to September 2016. All C-ERAS patients received pre-operative counselling by a dedicated ERAS Practitioner to manage expectations of the patient journey, health promotion and pre-operative optimisation advice. Emphasis was made on educating the patient on daily goals for recovery and patients were followed up daily by the ERAS practitioner post-operatively. They are also given a C-ERAS booklet and shown a video delineating the care pathway of the patient. The control group received education but did not have this focused support. The study was approved by the clinical governance department (ID: 1427).

C-ERAS patients were seen by a dedicated physiotherapist on admission to reiterate the post-operative exercises.

Intraoperatively

Both groups underwent routine induction as per anaesthetist preference. Cardiopulmonary bypass was instituted by normothermia (37°C) for the C-ERAS patients and mild hypothermia (32°C) in the control group. Cardioplegia administration, termination of bypass and administration of protamine were similar in both groups.

Post-operatively

C-ERAS patients were extubated within 6 hours post-surgery by Nurse-led extubation under the supervision of the duty intensivist. Opioid infusions, IV paracetamol and IV fluids were discontinued when oral intake established (<12 hours postoperatively). Post-operative mobilisation was encouraged in the C-ERAS group. This included being up to sit in a chair 12 hours post-surgery and mobilising within 24 hours postoperatively.

Patients in the control group were extubated when appropriate with IV infusions stopped as per direction of the respective surgeons. IV fluids and infusions were stopped 24 hours post-operatively or as per surgeons' instructions.

C-ERAS patients who met the discharge criteria from ICU were discharged directly to the wards bypassing the High Dependency Unit (HDU). The protocol is as follows.

- Patient has been up to sit in chair
- Diet established
- Stable blood sugars
- Kardex reviewed and updated
- Satisfactory pain control established – oral analgesia (4 doses post-op Modified Release Oxycodone)
- Drains removed
- Hb>8
- Creatinine within normal range for patient
- Urine output >30ml/hr (or >40ml/hr in patients >80kg)
- Stable rhythm – not pacing dependant
- No inotropic support
- Arterial line removed
- Central line in situ, capped off.
- Fluid balance to continue, catheter in-situ
- No cognitive impairment
- Weaning O2 and decreasing requirements

Outcomes measured were length of hospital stay, bed costs, post-operative complications (new onset Atrial Fibrillation requiring medical treatment, Acute Kidney Injury (with a raised creatinine level of more than 1.5 from the preoperative level¹²; respiratory failure (requiring non-invasive ventilation or reintubation, myocardial infarction, cerebrovascular event, hospital acquired infections and death.

Statistical Analysis

Comparison of patient characteristics between

groups were made using the 2 sample students t-test for parametric continuous variables, Mann-Whitney U test for non-parametric continuous variables and the χ^2 -test for categorical variables. A multivariate linear regression model was used to compare the differences in the length of stay and bed-day costs, the potential confounders that were adjusted for in our study include: Euroscore, age at operation, smoking status, gender, BMI, NYHA class, Canadian Cardiovascular Society (CCS) angina classification, diabetes mellitus, urgent/elective procedures and left ventricular function to eliminate potential confounding differences in the patient populations within the 2 cohorts.

Results

There were 122 patients in the C-ERAS group and 91 patients in the control group. The mean age was 63.6±9.9 years. 181(85%) of the patients were males.

After adjusting for the abovementioned confounders, C-ERAS patients had a shorter length of stay that was statistically significant. (2.36 days shorter (95% CI; 1.01-3.7 days; p<0.01). The difference in mean bed day costs was £1153.70 (95% CI, £553.70-£1753.7; p<0.01) less in the C-ERAS cohort.

Table 1. Patient Demographics of the C-ERAS and Control Groups (unadjusted)

Details	C-ERAS (n=122)	Control (n=91)	p-Value
Age (years)	66.7±9.9	61.2±9.4	0.000
Sex			
Male	111	91	
Female	11	15	0.302
BMI(kg/m ²)	29.17±4.4	30.6±6.0	0.241
Smoking	7	15	0.017
NYHA class of heart failure	1.8±07	1.9±07	0.477
CCS grading for angina	1.6±1.1	1.7±1.1	0.496
Euroscore*(Q1-Q3)	1.56 (1.01-2.57)	2.45(1.61-4.27)	0.000
Diabetes	28	30	0.108
LV Function			
Normal	99	74	
Moderate	23	15	
Poor	0	2	0.974
Urgent	9	14	
Elective	113	77	0.075

Table 2. Perioperative Variables of the C-ERAS and the Control Groups (Unadjusted)

Details	C-ERAS(n=122)	Control (n=91)	p-Value
Bypass time (mins)	84.9±26.2	79.8±20.3	0.133
Cross-clamp time(mins)	59.3±17.6	46.8±15.7	0.000
Theatre time (mins)	232.4±52.6	219.9±73.8	0.178
Temp on arrival at ICU (°C)	36.5±0.57	35.9±0.55	0.000
Ventilation Time (hours)*	4.17(3.0,5.8)	5.00(4.0,7.0)	0.004
No of Grafts	3.3 ±0.84	2.8±0.71	0.000
Cross-Clamp Time/Graft	17.4±3.1	16.6±4.5	0.149

Table 3. Post-operative complications and length of stay of the C-ERAS group and the Control Group (unadjusted)

Details	C-ERAS (n=122)	Control (n=91)	p-Value
ICU Stay (days)	1.1±0.5	1.4±0.5	0.011
HDU Stay (days)*	1.00(1.00,2.00)	1.25(1.00,2.08)	0.001
Hospital LOS (days)*	7(6,8)	8(7,11)	0.000
Respiratory complications	9	4	0.835
Acute Kidney Injury	1	1	0.834
Arrhythmias	11	21	0.004
Other	9	11	0.244
Reopened for bleeding	1	1	0.834

Table 4. Multivariable analysis after adjustment

Multivariable analysis	Mean	95% Confidence Interval	p-value
Difference in Length of Stay (Days)	2.36	1.01 - 3.7	<0.01
Bed Day Cost(£)	1153.70	553.70-1753.70	<0.01

Discussion

This study strongly elucidates the benefits of an enhanced recovery program (C-ERAS) in cardiac surgery. Early intervention in the pre-operative stage was highlighted by ERAS programmes in other surgical specialties that have been extrapolated to the cardiac surgery cohort. This includes early mobilisation, avoidance of prolonged fasting periods, early termination of intravenous fluids, earlier mobilization and enteral nutrition.

There are several challenges to implementing an enhanced recovery intervention. As an aggregation of minimal gains from each facet of care is needed for the success of a 'fast-tracked' pathway, a cohesive multidisciplinary team is obligatory to facilitate pre-operative assessment, peri-operative care, intra-operative adjustments, post-operative care and follow-up post discharge. The importance of having an ERAS practitioner cannot be understated. ERAS practitioners provide training and ensure consistent implementation of care as well as auditing results. The significant change in practice may involve an increase in use of resources. However, this may be offset in the long run with shortened ICU and HDU stays as well as overall hospital stay, notwithstanding a reduction in post-operative complications. Schuster et al estimated that a simple intervention like gum chewing after colectomy could save \$118 828 000 per year in the United States¹³.

A measure of the health economic outcomes of an enhanced recovery programme however, has not been exhaustively examined. As there is a greater emphasis on care within the community, the benefits of may be over-estimated if the cost creates a greater burden of care within the community or if there is a deterioration in quality of care in the community as opposed to conventional in-hospital.

Bernard et al conducted questionnaires on this matter and noted that post-discharge ERAS patients lacked appropriate support¹⁴. However, on commencement of a phone-in follow up clinic, majority of the patients in their colorectal cohort did not need additional input while convalescing and recovered well. The phone clinic therefore was probably more useful to patients in terms of offering reassurance and advice. It however cannot be assumed that an earlier discharge for ERAS patients equates to freedom from complications, or minor surgery. One potential reason for the perceived lack of post-operative support is the plethora of channels for a patient to access. The contact numbers available include general practitioners, district nurses, hospital ward telephone numbers, the ERAS practitioner and the nearest accident and emergency department. Blazeby et al highlighted that need for clear process for seeking help post discharge¹⁵. They conducted qualitative assessments of 20 patients from their enhanced recovery programmes following elective colonic resection to explore patients' experiences and views about the process. The main finding was the appreciation of a planned short hospital stay. However, some patients commented on feeling vulnerable at home shortly after major surgery.

One of the limitations of the study include the lack of long term follow up of patients in both cohorts. As mentioned above, the cost-benefit analysis of implementation of enhanced recovery programmes may shift the burden of care from the hospitals to the community and therefore be counter intuitive should there be complications.

This is one of the few studies to look at the implementation in ERAS patients outside a strictly elective list of patients in cardiac surgery. After a successful pilot with the elective cohort at our unit, we felt patients on the urgent list may also benefit from ERAS pathways. A non-randomised matched proof of concept study in colorectal surgery based in Bangkok compared the outcomes of standard of care treatment and ERAS in a cohort of patients undergoing emergency surgery for acutely obstructed colorectal adenocarcinoma¹⁶. They concluded that ERAS was safe in the emergency setting with earlier discharge, earlier passing of flatus and time to resumption of normal diet and earlier initiation of adjuvant chemotherapy.

Despite this, ERAS is still currently in its infancy in cardiac surgery. To date, varying practices as well as preferences (on pump vs off-pump, total arterial vs single mammary, minimally invasive vs sternotomy and many more) may preclude a generic pathway for patients undergoing coronary artery bypass surgery. However with iterative learning, common benefits in the peri-operative period may be universally applied to all centres for a multicentre study to truly investigate the benefits of ERAS.

Conclusion

This study highlighted that C-ERAS is a safe and feasible pathway to reduce in-hospital stay with no difference in complications and readmission rates compared to routine management of patients. There was also a significant cost saving with the C-ERAS pathway mimicking the results in enhanced recovery programmes in the other surgical specialities. A larger randomised multicentre study would be needed to allow greater generalisability of results. The bedrock of any enhanced recovery programme includes a cooperative multidisciplinary team of pre-admission staff, ERAS coordinator, physiotherapists, surgeons, anaesthetists, intensivists, nutritionists and nurses. All team members should be familiar with the ERAS ethos of the aggregations of minimal gains to a common goal and alter it accordingly.

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