Enhanced Recovery After Cardiac Surgery Reduces Duration of Ventilation and Likelihood of Re-Intubation Following Urgent and Emergency Isolated Coronary Artery Bypass Surgery

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Background

- Enhanced recovery after surgery protocols (ERAS) are evidence-based, perioperative pathways for multi-disciplinary care coordination that have been demonstrated to improve early mobilization and reduce the cost of care for patients undergoing elective surgery.[1]
- Recent research has demonstrated that ERAS may also be beneficial and safe for patients undergoing emergency non-cardiac surgery.[2]
- The effects of ERAS in urgent/emergency cardiac surgery have not been previously reported.

Study Design and Methods

- We conducted a 5-year retrospective study for consecutive adults undergoing urgent/emergency coronary artery bypass surgery (CABG) at an urban, tertiary care teaching hospital.
- Data were collected from the Society of Thoracic Surgery (STS) Adult Cardiac Surgery Database and hospital medical records.
- Analyses were performed for two periods:
  1) Pre-ERAS (2016-2017).
  2) Post-ERAS (2018-2020).
- Statistical comparisons used chi-square tests for categorical variables, t-tests for continuous variables, and a Mann Whitney U test when continuous variables did not meet assumptions for normal distribution.
- Using 80% power and alpha = .05, 190 patients in each cohort were required to detect statistical significance based on a reported reduction in readmission rate associated with enhanced recovery implementation.[1,3]
- Statistical analyses were performed with SPSS 21.0 (SPSS, Chicago, Illinois).

Results

Table 1. Baseline demographic and clinical comparisons of Pre-ERAS and Post-ERAS patients. Significant differences between cohorts have bolded *P*-Values.

Parameter (mean ± SD, or n(%))	Urgent/Emergency, Pre-ERAS (n = 348)	Urgent/Emergency, Post-ERAS (n = 664)	*P*-Value
Demographic data			
Age, years, mean ± SD	67.1 ± 9.7	60.4 ± 10.1	.493
Male, n (%)	279 (80.2)	510 (76.8)	.232
Body mass index, kg/m², mean ± SD	30.2 ± 6.2	29.8 ± 6.5	.326
Cardiovascular risk factors			
Diabetes, n (%)	161 (46.3)	334 (50.3)	.355
Hypertension, n (%)	300 (86.2)	591 (89.0)	.221
Dyslipidemia, n (%)	319 (91.7)	544 (81.9)	**<.001**
Family history of coronary disease, n (%)	62 (17.8)	107 (16.1)	.535
Smoking			.062
Never, n (%)	117 (33.6)	244 (36.8)	
Former, n (%)	148 (42.5)	287 (43.2)	
Current, n (%)	80 (23.0)	133 (20.0)	
Unknown, n (%)	3 (0.9)	0 (0.0)	
Prior cardiac interventions			
Prior percutaneous coronary intervention, n (%)	66 (19.0)	187 (28.2)	**.001**
Prior coronary artery bypass, n (%)	5 (1.4)	11 (1.7)	.790
Prior valve surgery, n (%)	1 (0.3)	7 (1.1)	.276
Comorbidities			
Prior transient ischemic attack, n (%)	15 (4.3)	25 (3.8)	.735
Prior stroke, n (%)	20 (5.8)	61 (9.2)	.067
Chronic obstructive lung disease, n (%)	82 (23.6)	160 (24.1)	.850
Atrial fibrillation			.341
None, n (%)	318 (91.4)	604 (91.0)	
Paroxysmal, n (%)	21 (6.0)	50 (7.5)	
Persistent, n (%)	9 (2.6)	10 (1.5)	
Peripheral vascular disease, n (%)	43 (12.4)	93 (14.0)	.465
Liver disease, n (%)	4 (1.2)	31 (4.7)	**.004**
Cancer diagnosis within 5 years, n (%)	25 (7.2)	49 (7.4)	.910
History of mediastinal radiation, n (%)	6 (1.7)	13 (2.0)	.999
Immunosuppression therapy, n (%)	12 (3.5)	32 (4.8)	.336

Parameter (mean ± SD, or n(%))	Urgent/Emergency, Pre-ERAS (n = 348)	Urgent/Emergency, Post-ERAS (n = 664)	*P*-Value
Medication use			
Preoperative beta blockers, n (%)	326 (93.7)	618 (93.1)	.563
Postoperative beta blockers, n (%)	328 (94.3)	637 (95.9)	.227
Cardiac catheterization data, disease vessels			.128
1 vessel disease, n (%)	7 (2.0)	12 (1.8)	
2 vessel disease, n (%)	63 (18.1)	97 (14.6)	
3 vessel disease, n (%)	278 (79.9)	548 (82.5)	
Echocardiography data			
Left ventricle ejection fraction, %, mean ± SD	48.5 ± 13.9	51.6 ± 13.6	**.001**
Aortic stenosis, n (%)	12 (3.5)	49 (7.4)	**.012**
Aortic insufficiency, n (%)	99 (28.4)	154 (23.2)	.067
Mitral stenosis, n (%)	0 (0.0)	9 (1.4)	**.017**
Mitral regurgitation, n (%)	273 (78.4)	505 (76.1)	.391
Tricuspid regurgitation, n (%)	254 (73.0)	445 (67.0)	.051
STS Risk Score*, mean ± SD	2.42 ± 3.46	2.64 ± 4.32	.415
Operative details			
Cross clamp duration, minutes, mean ± SD	73.1 ± 27.7	66.9 ± 23.8	**.001**
Perfusion time, minutes, mean ± SD	98.3 ± 34.2	92.6 ± 32.1	**.011**
Intra-aortic balloon pump, n (%)	20 (5.7)	77 (13.6)	**<.001**
Internal mammary harvest, n (%)			**.015**
Both	24 (6.9)	14 (2.5)	
Left	308 (89.0)	519 (93.3)	
Right	11 (3.2)	17 (3.1)	
Neither	3 (0.9)	6 (1.1)	
Vein anastomoses, mean ± SD	2.13 ± 1.16	2.07 ± 0.86	.821
Arterial anastomoses, mean ± SD	1.57 ± 0.97	1.55 ± 0.84	.397
Intraoperative transfusion, n (%)	73 (33.2)	182 (32.9)	.942
Postoperative transfusion, n (%)	121 (34.8)	193 (29.1)	.062

Table 2. Clinical outcomes for Pre-ERAS and Post-ERAS patients. Significant differences between cohorts have bolded *P*-Values.

Parameter (mean ± SD, or n(%))	Urgent/Emergency, Pre-ERAS (n = 348)	Urgent/Emergency, Post-ERAS (n = 664)	*P*-Value
Primary ERAS Outcomes			
Extubation < 6 hours	132 (37.9)	291 (43.8)	.081
Ventilation, hours	7.5 (5.4–13.7)	6.5 (5.1–10.3)	**.018**
Prolonged ventilation	30 (8.6)	44 (6.6)	.247
Re-intubated	21 (6.0)	16 (2.4)	**.004**
ICU length of stay, hours	43.8 (23.6–76.0)	45.2 (23.1–77.8)	.554
Postoperative length of stay, days	5 (4–8)	5 (4–7)	.116
Secondary ERAS Outcomes			
Total MME, PODs 1 and 2	100.1 ± 61.1	75.4 ± 65.8	**<.001**
30-Day CABG Outcomes			
Stroke	5 (1.4)	12 (1.8)	.663
Renal failure	9 (2.6)	13 (2.0)	.515
Deep sternal wound infection	6 (1.7)	22 (3.3)	.143
Re-exploration for bleeding	9 (2.6)	12 (1.8)	.409
Postoperative atrial fibrillation	110 (31.6)	188 (28.3)	.275
Discharge home	261 (77.2)	478 (72.9)	.305
30-day readmission	42 (12.1)	92 (13.9)	.127
30-day mortality	8 (2.3)	9 (1.4)	.267

Table 1 / Table 2 Abbreviations: ERAS, enhanced recovery after surgery protocol; CABG, coronary artery bypass graft surgery; ICU, intensive care unit; POD, postoperative day; SD, standard deviation; IQR, interquartile range; MME, morphine milligram equivalents; STS, Society of Thoracic Surgery.

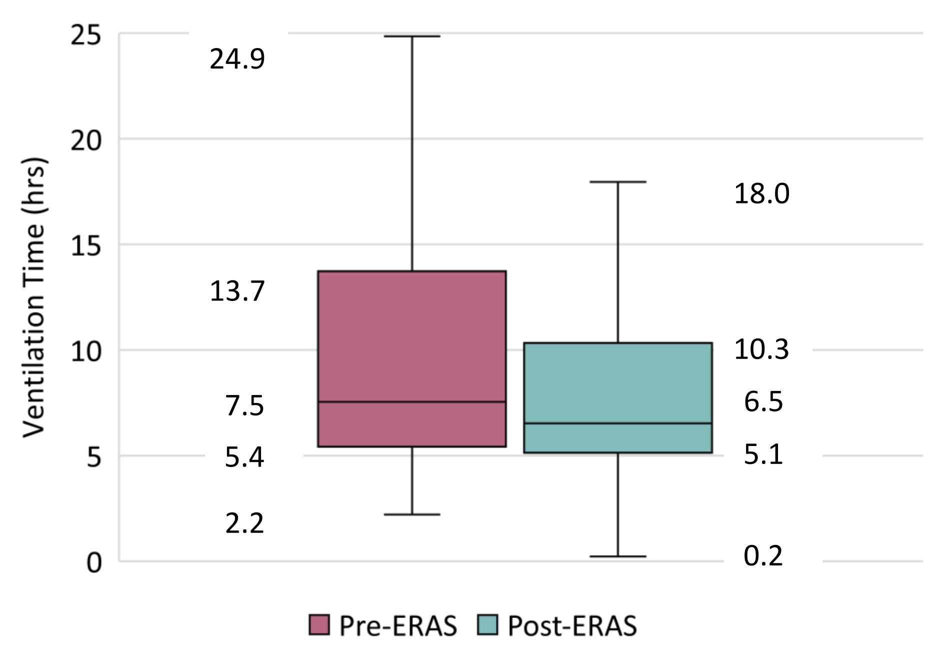

Figure 1. Ventilation time Pre-ERAS vs. Post-ERAS, Urgent/Emergency (*P* = .018).

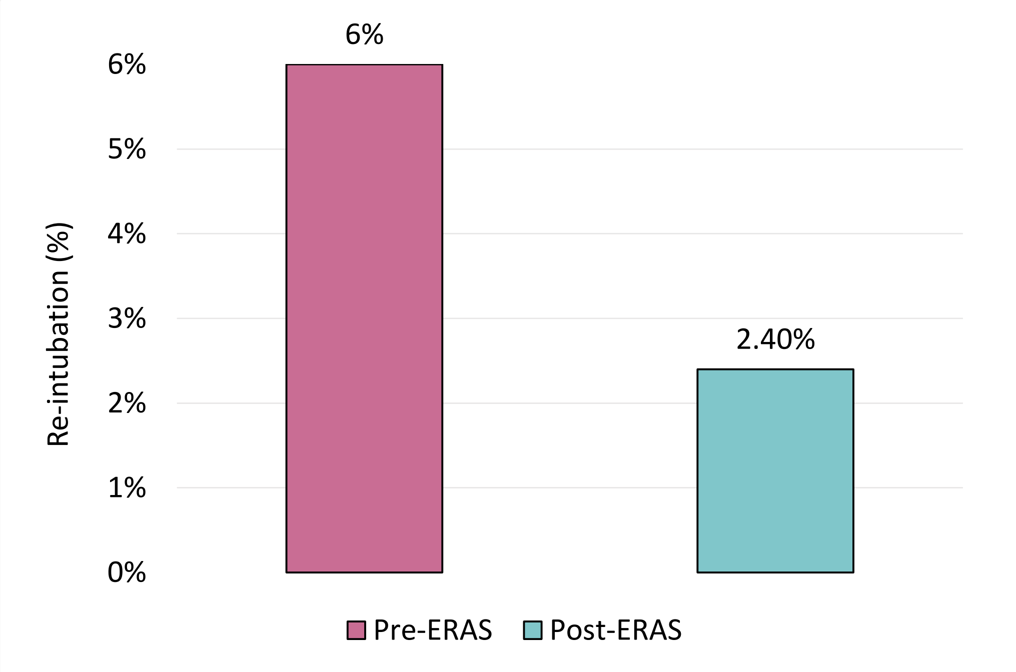

Figure 2. Percentage re-intubated Pre-ERAS vs. Post-ERAS, Urgent/Emergency (*P* = .004).

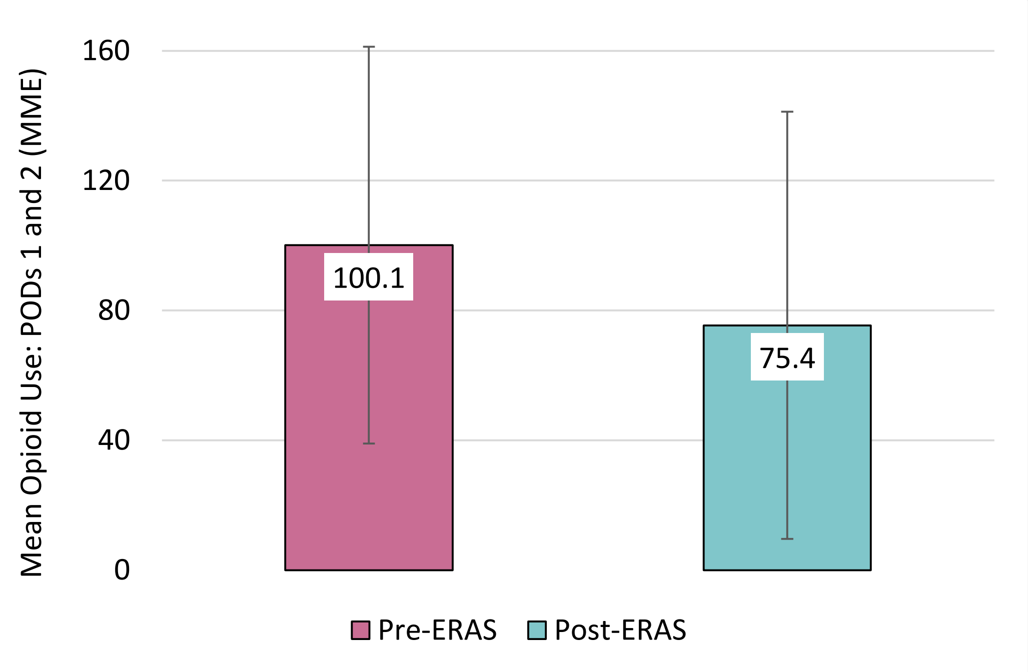

Figure 3. Mean opioid use on postoperative days 1 and 2. Error bars are standard deviation. Urgent/Emergency (*P* < .001).

Analysis

- The Pre-ERAS and Post-ERAS cohorts were similar for relevant demographic characteristics and STS Risk Score.
- There were no differences in 30-day CABG outcomes between the Pre-ERAS and Post-ERAS cohorts.
- The Post-ERAS cohort had shorter ventilation time, lower likelihood of re-intubation, and decreased morphine milliequivalent consumption.

Conclusions

- These data provide a novel report that ERAS may be feasible for urgent/emergency CABG surgery.
- Prospective studies are required to determine which ERAS protocol elements confer benefits for urgent/emergency CABG.
- Future studies should evaluate the effects of ERAS in other urgent and emergency cardiac surgery procedures.

References

1. Anesth. Analg. 118:1052-61, 2014.
2. Bull. Emerg. Trauma. 5(2): 70-78, 2017.
3. ClinCalc: https://clincalc.com/stats/samplesize.aspx. Updated July 24, 2019. Accessed September 30, 2021.