Enhanced Recovery Protocol Improves Hospital Length of Stay After Robot Assisted Pancreaticoduodenectomy

Dustin L. Dillon, BS[1], Michael A. Mederos, MD[1,2], Joon Park, MD[1,2] Mark D. Girgis, MD[1,2,3]

[1]David Geffen School of Medicine at UCLA
[2]Department of Surgery, UCLA
[3]Division of Surgical Oncology, UCLA

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Learning Objective

- Determine if UCLA's Pancreaticoduodenectomy Enhanced Recovery After Surgery (ERAS) protocol is associated with improved short-term post-operative outcomes.

Background

- **Pancreatic adenocarcinoma** (PDAC) is the 3rd leading cause of cancer-related deaths in the United States [1].
- **Pancreaticoduodenectomy** (PD, also known as the **Whipple** procedure), the only curative intervention for cancers in the head of the pancreas, is associated with significant lengths of stay and readmissions especially for patients with preexisting conditions [2].
- **Enhanced Recovery After Surgery** (**ERAS**) protocols use evidence based, patient-centered perioperative guidelines to optimize surgical outcomes [3].
- UCLA recently implemented an ERAS protocol for all patients undergoing PD in late 2019. The outcomes following implementation are not yet characterized.

Methods

- The National Surgical Quality Improvement Program (NSQIP) database was queried to identify all patients that underwent PD from January 2017 to December 2020 at Ronald Reagan UCLA Medical Center. Patients who underwent PD prior to and after October 16th 2019 were placed in pre-ERAS and ERAS cohorts respectively, and used to compare 30-day perioperative outcomes of ERAS implementation (Figure 1)
- Our primary outcomes assessed were readmissions/reoperations within a 30-day post-op period, length of stay (LOS), and discharge destinations. Secondary outcomes measured were 30-day standard perioperative complications (i.e., sepsis, superficial infection, etc.) as well as pancreas-specific outcomes such as fistula, delayed gastric emptying, and post-op percutaneous drain procedures.
- Additional sub-analysis was performed on subgroups of the two cohorts to assess whether ERAS had differential effect on patients with specific baseline characteristics.
- Categorical outcomes were compared using chi-square tests and Fisher's Exact tests. Non-parametric continuous variables were compared using Mann-Whitney U tests and Kruskal-Wallis H tests. All statistical tests were 2 sided and differences were considered significant when $p < 0.05$.

Results

- The ERAS cohort presented more frequently with higher ASA class, ($p = 0.044$), and medium duct size 3-6mm ($p < 0.001$) (Table 1). Other studied demographic characteristics were similar between the two cohorts.
- Univariate analysis of the pre-ERAS and ERAS cohorts showed no significant difference in rates primary and secondary outcomes (Table 2, Figure 2).
- Subgroup analysis demonstrated that in the Robot Assisted PD (RAPD), LOS was shorter in the ERAS cohort (5 days vs 7 days, p-value 0.047), whereas there was no comparable significant difference in LOS for PD performed via an open approach (Table 3, Figure 3). There were no significant differences in secondary outcomes in the RAPD subgroup pre and post ERAS protocol implementation.

Figures/Tables

Figure 1: Consolidated Standards Of Reporting Trials (CONSORT) diagram of study design

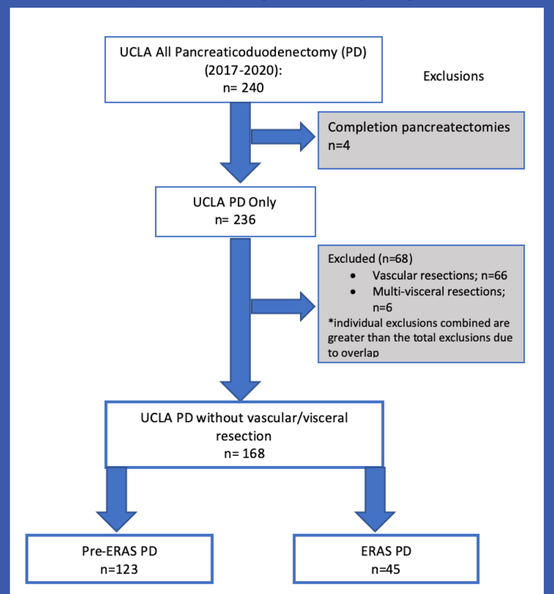


Table 1: Patient Characteristics for Pre-ERAS and ERAS Cohorts. Red bolded values indicate statistical difference (p-value <0.05).

Variable	Pre-ERAS (n=123)	ERAS (n=45)	*p-value*
Age (med, IQR)	66 (61-73)	70 (65-76)	0.243
Female (%)	53 (43.1)	23 (51.1)	0.355
Race (%)			0.446
White	83 (67.5)	29 (64.4)	
Black	4 (3.3)	4 (8.9)	
Asian	19 (15.4)	4 (8.9)	
American Indian	1 (0.8)	0 (0)	
Hawaiian/Pacific Islander	1 (0.8)	0 (0)	
Unknown	15 (12.2)	8 (17.8)	
BMI (med, IQR)	24.7 (22.9-28.6)	23.8 (21.8-27.6)	0.296
Diabetes (%)	33 (26.8)	9 (20.0)	0.365
Smoking (%)	11 (8.9)	1 (2.2)	0.185
Hypertension (%)	62 (50.4)	26 (57.8)	0.397
Pre-operative Biliary Drainage (%)	62 (50.4)	26 (57.8)	0.397
ASA (%)			**0.044**
1	1 (0.8)	0 (0)	
2	32 (26.0)	3 (6.7)	
3	87 (70.7)	41 (91.1)	
4	3 (2.4)	1 (2.2)	
5	0 (0)	0 (0)	
Pre-operative Chemotherapy (%)	14 (11.4)	9 (20.9)	0.150
Pre-operative Radiation (%)	1 (0.8)	0 (0)	1.0
Benign pathology (%)	38 (30.9)	12 (26.7)	0.596
Pancreatic adenocarcinoma (%)	75 (61.0)	29 (64.1)	0.682
Duct size (%)			
<3 mm	54 (47.4)	9 (20.9)	**0.003**
3-6 mm	46 (40.4)	32 (74.4)	**<0.001**
>6 mm	14 (12.3)	2 (4.7)	0.238
Gland texture (%)			
Soft	73 (64.6)	25 (62.5)	0.812
Intermediate	5 (4.4)	3 (7.5)	0.431
Hard	35 (31.0)	12 (30.0)	0.909

Table 2: Rates of 30 day Readmission, Reoperations, Discharge to Home, Mortality, Length of Stay for Pre-ERAS PD versus ERAS PD. No statistical differences found (p-value <0.05).

Variable	Pre-ERAS (n=123)	ERAS (n=45)	*p-value*
Readmissions (%)	16 (13.0)	7 (15.6)	0.671
Reoperations (%)	7 (5.7)	0 (0)	0.191
Discharge to Home (%)	108 (89.3)	41 (95.3)	0.358
LOS (med, IQR)	9 (8-12)	8 (6-11)	0.155

Figure 2: Rates of Complications for Pre-ERAS PD versus ERAS PD. No statistically significant differences were found (p-value <0.05).

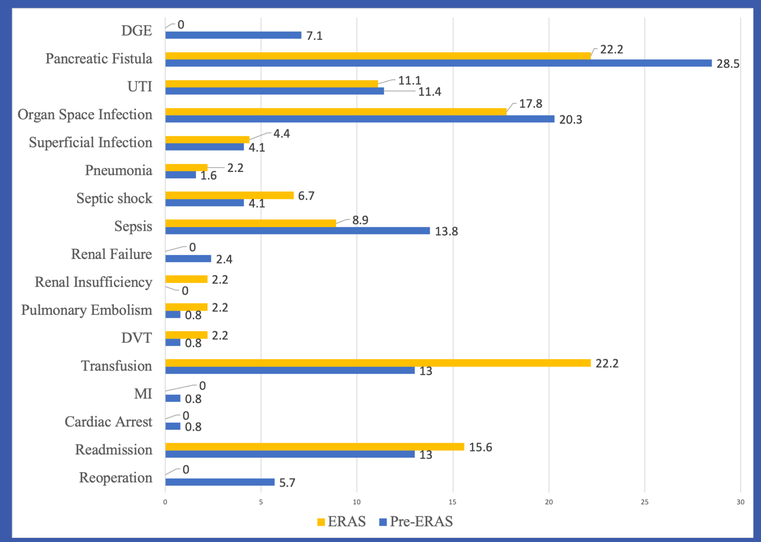
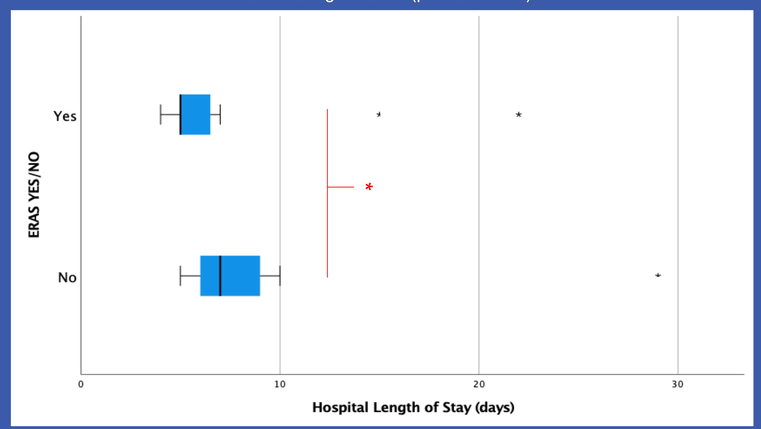


Table 3: Effect of ERAS on rates of 30 day Readmission, Reoperations, Discharge to Home, Mortality, Length of Stay for Robotic and Open Surgical approaches. Red bolded values indicate statistical difference (p-value <0.05).

Variable	Robotic Pre-ERAS (n=18)	Robotic ERAS (n=11)	*p-value*	Open Pre-ERAS (n=105)	Open ERAS (n=34)	*p-value*
Readmissions (%)	2 (11.1)	1 (9.1)	1.0	14 (13.3)	6 (17.6)	0.533
Reoperations (%)	0 (0)	0 (0)	N/A	7 (6.7)	0 (0)	0.194
Discharge to Home (%)	14 (77.8)	9 (81.8)	1.0	94 (91.3)	32 (100)	0.115
LOS (med, IQR)	7 (6-9)	5 (5-7)	**0.047**	9 (8-13)	9 (8-12)	0.651

Figure 3: Box and Whisker plot illustrating the effect of ERAS implementation on LOS in patients undergoing RAPD. Black asterisks indicate outliers. Red asterisk indicates statistical significance (p-value <0.05)



Discussion/Conclusion

In this study, short-term outcomes were compared for patients undergoing PD pre-ERAS and post-ERAS implementation. Surprisingly LOS, rates of readmission, and discharge destination, and post-operative complications were not significantly different between ERAS cohorts.

Enhanced Recovery After Surgery Pathways have previously been associated in PD with shorter length of stay, and decreased rates of delayed gastric emptying in PD procedures [4], but these benefits did not manifest in this study. PD is a complex procedure with a high rate of perioperative complications that contribute to longer hospitalizations [2]. UCLA is an academic tertiary medical center with a large volume of PD performed every year. It is feasible that high volume and surgeon expertise already resulted in optimized perioperative outcomes prior to ERAS implementation. For instance, in a recent meta-analysis of the application of ERAS in PD, the mean LOS of the pre-ERAS groups was 20.8 days and post-ERAS resulted in an improvement to 15.3 days [4]. In comparison, the UCLA pre-ERAS mean LOS was already only 10.8 days [4].

Interestingly, in the RAPD subgroup, patients had a significantly shorter median LOS following ERAS implementation. A similar benefit was not seen in open PD cases. RAPD has previously been shown to be associated with shorter LOS when compared to open PD, and a recent study in RAPD and ERAS demonstrated a similar improvement in LOS [5]. We hypothesize that ERAS works in concert with minimally invasive approaches such as RAPD to magnify the reduction in surgical stress on the body and accelerate recovery.

With the incidence of PDAC rising and with surgical resection offering the only possibility of a cure [1], pancreatic surgeons will increasingly be faced with decisions about the surgical management and recovery of PDAC patients suffering from the disease. This study demonstrates that Enhanced Recovery protocols may improve post-operative recovery for patients undergoing RAPD.

Limitations

- Sample sizes in some analyses are relatively small, and thus could bias the effects of ERAS implementation at UCLA on select outcomes.
- This study focuses on ERAS implementation in a single high volume medical institution, and as such conclusions drawn from this data may not be applicable to other medical settings.
- A retrospective comparison of prospectively maintained databases is limited by potential selection bias. These findings would need to be validated in a randomized trial.

References

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