Published in final edited form as:

Ann Surg. 2019 December ; 270(6): e69–e71. doi:10.1097/SLA.0000000000003409.

Postoperative Opioid Use Before and After Enhanced Recovery After Surgery Program Implementation

Vincent X. Liu, MD, MS^{*,†,✉}, Abigail Eaton, PhD^{*}, Derrick C. Lee, MD[†], Vivian M. Reyes, MD[†], Shirley S. Paulson, DNP, MPA, RN, NEA-BC[‡], Cynthia I. Campbell, PhD, MPH^{*}, Andy L. Avins, MD, MPH^{*,†}, Stephen M. Parodi, MD[†]

^{*}Kaiser Permanente Division of Research, Oakland, CA

[†]The Permanente Medical Group, Oakland, CA

[‡]Kaiser Foundation Hospitals and Health Plan, Oakland, CA

Opioids are a cornerstone of surgical pain management; however, opioid exposures during healthcare may also persist into long-term use.^{1–3} Although multidisciplinary protocols designed to improve surgical recovery—enhanced recovery after surgery (ERAS) programs^{4–6}—can reduce the inpatient use of opioids, their impact on longer term use is poorly understood. We evaluated how ERAS program implementation at 20 hospitals within Kaiser Permanente Northern California (KPNC) impacted postsurgical opioid use up to 180 days after surgery.

METHODS

This study was approved by the KPNC Institutional Review Board. In 2014, KPNC implemented an ERAS program targeting 2 populations—elective colorectal and nonelective hip fracture surgical patients—which altered care processes, reduced inpatient opioid use, and improved outcomes when compared with contemporaneous comparator patients (elective abdominal and emergent orthopedic surgery, respectively).^{4,7} After ERAS implementation, hip fracture patients typically received the following nonopioid adjuncts: a peripheral nerve block, scheduled intravenous acetaminophen, and optional celecoxib. Colorectal surgery patients typically received scheduled acetaminophen and nonsteroidal anti-inflammatory drugs, local anesthetics, and optional gabapentin. Before and after ERAS implementation, we assessed patients' ongoing opioid use after 7, 30, 90, and 180 days and through 365 days after surgery to assess whether implementation was associated with decreased postoperative use based on medication dispensing records from KPNC pharmacies. We used generalized linear models adjusted for age, comorbid disease burden, and opioid use in the prior 90 days to estimate the impact of ERAS on post-180-day opioid use.

✉ Vincent.x.liu@kp.org.

The authors report no conflicts of interest.

RESULTS

We included 3468 ERAS-targeted elective colorectal and 3885 emergent hip fracture surgical patients along with 5097 abdominal and 1218 orthopedic comparator patients (Table 1). After ERAS implementation, opioid fill rates were substantially lower in all groups (180-day opioid fill rate: 20.9% after vs 31.3% before; $P < 0.001$) and they displayed monotonic decreases over time (Fig. 1). The adjusted rate ratio (RR) of 180-day opioid fills among patients treated in the final quarter of the year after implementation was 0.53 [95% confidence interval (CI): 0.42–0.66, $P < 0.001$] in colorectal/abdominal patients and 0.29 (95% CI, 0.17–0.50, $P < 0.001$) in hip fracture/orthopedic patients, compared with the year before. Effects were of a similar magnitude among patients with high comorbid illness burden, whereas the reduction in 180-day opiate fills was more pronounced among patients aged 70 or older (colorectal/abdominal RR: 0.22, 95% CI, 0.07–0.69 and hip fracture/orthopedic RR: 0.20; 95% CI, 0.07–0.60).

However, there was no significant reduction in 180-day opiate fills among patients with presurgical opioid use. For example, in the colorectal/abdominal patients, the RR was 1.17 (95% CI, 0.73–1.87), whereas it was 1.12 (95% CI, 0.81–1.57) in the hip fracture/orthopedic patients. Presurgical opioid use was the factor most strongly associated with 180-day postoperative fills for both colorectal/abdominal (RR: 2.76, 95% CI, 2.57–2.96; $P < 0.001$) and hip fracture/orthopedic (RR: 3.23, 95% CI, 2.95–3.53; $P < 0.001$) patients.

DISCUSSION

The implementation of a health system-wide ERAS program was associated with substantial reductions in the rate of postoperative opioid fills between 180 and 365 days, starting from over 30% before implementation and falling to <10% at 1 year after implementation. The magnitude of change was similar among patients directly targeted by the ERAS protocol as well as contemporaneous patients treated by the same teams but not directly subjected to the protocol. Stable opioid use rates in the year leading up to ERAS implementation followed by steady declines in the period after go-live suggest that the decrease in opioid use resulted, at least in part, from ERAS program implementation. However, given the increasing attention to opioid use, regulation, and prescribing patterns at the health system, state, and national levels, exogenous factors may have also contributed to the observed changes.

There are several important limitations of this study. First, it was conducted within a single healthcare system potentially impacting generalizability. Second, we were unable to control for other health system programs designed to reduce opioid use which overlapped with ERAS implementation. Third, we did not evaluate whether patients had additional surgical procedures during the follow-up period which may have contributed to ongoing opiate use in certain patients. This study did not include data on the impact of reduced long-term opioid use on patient-reported outcomes including pain, which should be a key consideration when defining the optimal management of postsurgical pain.¹

Although the exact mechanism by which ERAS implementation impacted postdischarge opioid use remains unclear, our findings suggest that the benefits were mediated through

improved physician awareness and practice change surrounding pain management. Although the ERAS program was not specifically designed to reduce postdischarge opioid use, the standardized approach to acute surgical pain management seemed to exert a sustained impact on pain management in the early and later periods after discharge. Presurgical opioid use was strongly associated with postoperative use and ERAS did not impact these patterns, highlighting a potential opportunity to further enhance targeted pain management for a particularly high-risk subpopulation.^{8–10}

Acknowledgments

This work was supported by The Permanente Medical Group and NIGMS R35GM128672 (VXL).

REFERENCES

1. Chou R, Gordon DB, de Leon-Casasola OA, et al. Management of Postoperative Pain: A Clinical Practice Guideline From the American Pain Society, the American Society of Regional Anesthesia and Pain Medicine, and the American Society of Anesthesiologists' Committee on Regional Anesthesia, Executive Committee, and Administrative Council. *J Pain*. 2016;17:131–157. [PubMed: 26827847]
2. Sun EC, Darnall BD, Baker LC, et al. Incidence of and risk factors for chronic opioid use among opioid-naïve patients in the postoperative period. *JAMA Intern Med*. 2016;176:1286–1293. [PubMed: 27400458]
3. Barnett ML, Olenski AR, Jena AB. Opioid-prescribing patterns of emergency physicians and risk of long-term use. *N Engl J Med*. 2017;376:663–673. [PubMed: 28199807]
4. Liu VX, Rosas E, Hwang J, et al. Enhanced recovery after surgery program implementation in 2 surgical populations in an integrated health care delivery system. *JAMA Surg*. 2017;152:e171032. [PubMed: 28492816]
5. Spanjersberg WR, Reurings J, Keus F, et al. Fast track surgery versus conventional recovery strategies for colorectal surgery. *Cochrane Database Syst Rev*. 2011;2:CD007635.
6. VISIONI A, Shah R, Gabriel E, et al. Enhanced recovery after surgery for noncolorectal surgery? A systematic review and meta-analysis of major abdominal surgery. *Ann Surg*. 2018;267:57–65. [PubMed: 28437313]
7. Liu VX, Rosas E, Hwang JC, et al. The Kaiser Permanente Northern California Enhanced Recovery After Surgery Program: design, development, and implementation. *Perm J*. 2017;21:17–003.
8. Mudumbai SC, Oliva EM, Lewis ET, et al. Time-to-cessation of postoperative opioids: a population-level analysis of the veterans affairs health care system. *Pain Med*. 2016;17:1732–1743. [PubMed: 27084410]
9. Brummett CM, Waljee JF, Goesling J, et al. New persistent opioid use after minor and major surgical procedures in US adults. *JAMA Surg*. 2017;152:e170504. [PubMed: 28403427]
10. Harbaugh CM, Nalliah RP, Hu HM, et al. Persistent opioid use after wisdom tooth extraction. *JAMA*. 2018;320:504–506. [PubMed: 30088000]

FIGURE 1.

The quarterly percentage of patients with opioid prescription fills at least 30 days (solid lines above) and at least 180 days (dotted lines below) after surgical hospitalization, stratified by whether the patients were targeted by the ERAS program (elective colorectal and emergent hip fracture surgery; blue lines) or were contemporaneous comparator surgical patients (elective abdominal and emergent orthopedic surgery; red lines). Because ERAS program implementation was completed in a staggered fashion based on the hospital and surgical type, the before and after periods are standardized relative to the hospital and surgical type go-live dates (dotted line at zero).

TABLE 1.

Characteristics of Patients by Surgical Type, Including Those Targeted by the Enhanced Recovery After Surgery (ERAS) and Their Respective Comparator Groups

	Elective Abdominal Surgery		Emergent Orthopedic Surgery	
	ERAS Colorectal <i>n</i> = 3,443	Comparator <i>n</i> = 5,062	ERAS Hip Fracture <i>n</i> = 3,846	Comparator <i>n</i> = 1,212
After ERAS program [†]	1,723 (50.0)	2,505 (49.5)	1,907 (49.6)	654 (54.0)
Age, y	62.7 ± 13.8 [*]	54.3 ± 14.9	79.1 ± 11.5 [*]	66.3 ± 16.2
Male	1,653 (48.0) [*]	1,883 (37.2)	1,146 (29.8) [*]	509 (42.0)
COPS2	27 ± 29 [*]	25 ± 29	42 ± 39	44 ± 44
Length of stay	4.3 (3.2–6.3) [*]	2.1 (1.2–3.6)	3.2 (2.6–4.5) [*]	3.7 (2.6–5.0)
Opioid use rates [‡]				
Beyond 7 d				
Before ERAS	850 (49.4)	1,229 (48.1)	1,175 (60.6)	385 (69.0)
After ERAS	745 (43.2)	1,015 (40.5)	997 (52.3)	408 (62.4)
Beyond 30 d				
Before ERAS	737 (42.9)	1,095 (42.8)	923 (47.6)	331 (59.3)
After ERAS	614 (35.6)	888 (35.5)	762 (40.0)	336 (51.4)
Beyond 90				
Before ERAS	637 (37.0)	952 (37.2)	757 (39.0)	263 (47.1)
After ERAS	491 (28.5)	748 (29.9)	559 (29.3)	246 (37.6)
Beyond 180 d				
Before ERAS	525 (30.5)	793 (31.0)	593 (30.6)	209 (37.5)
After ERAS	335 (19.4)	562 (22.4)	366 (19.2)	153 (23.4)

ERAS indicates enhanced recovery after surgery; COPS2, Comorbidity Point Score, version 2 is a scalar, validated measure of chronic disease burden based on patient diagnoses over the year prior to the month of hospital admission with higher values representing increased comorbidity.

[†] After ERAS program indicates the number and percentage of patients who were included in the study in the 1-year period after ERAS program implementation. After ERAS' indicates the 1-year period after ERAS program implementation, defined individually for each surgical type and hospital because program implementation proceeded in a staggered fashion at each hospital over time. Only patients remaining within the KPNC health system for at least 180 days after surgery were included in the study (86.2% of overall cohort).

[‡] All comparisons of 1-year before ERAS and 1-year after ERAS opioid use rates included $P < 0.001$, except for "beyond 7 days" ($P = 0.016$) and "beyond 30 days" ($P = 0.005$) for the orthopedic comparator group. All timing subgroups indicate fills beyond that number of days and 365 days after surgery.

* $P < 0.05$. P values are assessed from comparisons between ERAS colorectal versus abdominal comparator groups or ERAS hip fracture versus orthopedic comparator groups.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript