



What factors are associated with increased risk for prolonged postoperative opioid usage after colorectal surgery?

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Received: 8 September 2017 / Accepted: 28 January 2018
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Abstract

Background Opioid-related deaths have increased substantially over the last 10 years placing clinician's prescription practices under intense scrutiny. Given the substantial risk of opioid dependency after colorectal surgery, we sought to analyze risk of postoperative prolonged opioid use after colorectal resections.

Methods Between 2008 and 2014, patients undergoing abdominopelvic procedure with intestinal resection at a tertiary care facility were retrospectively identified. Patient's postoperative narcotic usage including their prescriptions on discharge and their total opioid medication use was recorded. Patient variables such as demographics, surgical characteristics, and prescription use were evaluated. Finally, we developed multivariate models to identify risk factors for prolonged opioid use (> 30 days after incident surgical procedure).

Results We identified 9423 recorded procedures of which 2173 consisted of abdominopelvic procedures with intestinal resection and survived > 1 year. Of these, 91% ($n = 1981$) were discharged on opioids, and 98% ($n = 1955$) of those patients filled only one prescription. A total of 92 (4%) patients remained on opioids beyond 30 days, and from this group, 25% ($n = 23$ patients) remained at 90 days. We found no association between postoperative complications, stoma formation, and patient's sex with risk of prolonged opioid use. However, younger age and history of chronic pain were associated with an increased risk of prolonged opioid use. The use of minimally invasive techniques also attenuated the risk of prolonged opioid use (Table 2).

Conclusion A small but considerable proportion of patients remain on opioids beyond 30 days. Predictors of opioid use for greater than 30 days include a history of chronic pain and younger age. The use of minimally invasive techniques reduced the risk of prolonged opioid use. We identified several immutable risk factors that predicted prolonged postoperative opioid use; however, surgeons may be able to attenuate prolonged opioid use through the use of minimally invasive techniques.

Keywords Opioid use · Minimally invasive techniques · Postoperative care

The United States of America is in the midst of an opioid overdose epidemic, including prescription opioids and heroin killing more than 33,000 people in 2015, more than any year on record [1]. It is estimated that approximately half of all deaths from opioid overdose are from a prescription medication. In addition, 37% of filled opioid prescriptions

are prescribed following a surgical procedure. Although the majority of patients will take their medication sparingly as prescribed, there are a small, but growing number of patients who will become dependent on opioids [2]. It is unclear what the best management strategy is for this "at-risk" group of patients.

Gastrointestinal surgery is one of the top three subspecialty prescribers of opioids [3]. Major abdominal surgery elicits substantial pain through large incisions, visceral nerve stimulation, increased stimulation of inflammatory cytokines, and cardiovascular stress [4, 5]. In addition, colorectal resections are often performed on patients with chronic illnesses including inflammatory bowel disease, diverticulitis, and other diagnoses—conditions often characterized by chronic pain and the need for analgesics

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[6]. Given the large number of procedures performed for chronic illnesses, challenging prolonged surgeries, and fear of uncontrolled postoperative pain in colorectal surgery patients, we sought to develop an understanding of prolonged opioid use in patients who undergo colorectal surgery resections as well as identify risk factors for prolonged use [1, 7]. In that manner, interventions could be developed to reduce potential opioid abuse.

Methods

Data

We conducted a retrospective chart review of all consecutive patients who underwent an abdominopelvic procedure with intestinal resection from January 1, 2008 through December 31, 2014 at a tertiary care facility. First, all study protocols were reviewed by the institutional review board at the Lahey Hospital & Medical Center. Our cohort was abstracted from the Lahey Hospital & Medical Center prospective colorectal surgery database. We included all open, laparoscopic, and robotic procedures as well as elective and urgent or emergency procedures. We excluded patients who did not have intestinal resection and who did not live beyond 90 days of surgery.

Surgical procedure

All surgical procedures were performed at our main hospital. Mechanical bowel preps were performed for proctectomy patients but not for right colectomy. The use of bowel preparation was at the surgeon's discretion. All patient received intraoperative antibiotics and surgical procedures conducted as per routine.

Postoperative period

Following surgery, patients were placed on patient-controlled analgesia and ibuprofen administered every 8 h while in hospital. Recommendations were given to patients to continue ibuprofen use postoperatively at home. Acetaminophen was used on a prn basis. Opioid prescriptions were written at time of discharge as per patient's wishes. Patients were placed on a colorectal surgery pathway where applicable. Thus, it was standard practice to avoid nasogastric tubes, remove the foley catheter on day 1, and initiate an oral diet of liquids immediately after surgery. Diet was advanced as per the individual surgeon's discretion.

Outcome variable

We determined the patient's postoperative narcotic use including all narcotic prescriptions on discharge and their total opioid medication use from day of discharge to last prescription filled. Narcotic dose and route were recorded. Our electronic medical record permitted access to primary care records of institutional primary care patients, and thus we had complete access to most electronic medical records. These notes were carefully reviewed for current medications. If the patients were on opioids, the record was listed in current medications. We also noted that most patients who were on opioids > 30 days, had their opioid prescriptions called in by their surgeon. Our *primary outcome* variable was prolonged postoperative pain medication use as defined by opioid prescription beyond 30 days after date of surgery.

Covariates

Next, we abstracted the covariates of age, sex, American Society of Anesthesiologists (ASA) score, use of preoperative benzodiazepines, history of chronic pain as documented by physician record, unplanned or emergent surgery as documented by the primary surgeon, surgical access (i.e. laparoscopic open, or robotic procedure), stoma creation including ileostomy or colostomy, and postoperative 30-day complications as defined by the National Surgical Quality Improvement Program [8].

Complications included rehospitalization, unplanned return to the operating room or interventional radiology suite, the need for blood transfusion, myocardial infarction, new onset arrhythmia, sepsis, anastomotic leak or bleed, prolonged postoperative ileus, renal failure, urinary tract infection, pneumonia, deep vein thrombosis, pulmonary emboli, cerebrovascular accident/stroke, as well as superficial, deep, and organ space infections.

Statistical analysis

Data were analyzed using SAS version 9.4 (SAS Institute, Cary, NC). Comparison of predictor variables for patients with prolonged postoperative narcotic use were compared by means of the Student's *t* test for continuous variables and the χ^2 test for categorical variables. We then developed multivariate models to identify predictors of prolonged opioid use (beyond 30-days). Specifically, we included all covariates: age, sex, ASA, emergent versus planned surgery, readmission and presence of postoperative 30-day complication, history of chronic pain, and past and current

use of benzodiazepines. Missing data were classified into an additional category and labeled “null.”

Results

Cohort Characteristics

There were 9423 surgical encounters from January 1, 2008 through December 31, 2014. From that group, we identified 2173 abdominopelvic procedures with intestinal resection and the creation of an anastomosis. Our cohort contained proportionately more women than men, and both sexes were overwhelmingly opioid naïve $n=2011$ (96%). The median age was 67 (± 15) and 10% (CI 9–12%) of procedures were emergent (Tables 1, 2). The most common procedures were ileocolic resection, left colectomy, and anterior resections. The most common diagnoses were diverticulitis, benign neoplasm, and irritable bowel disorder (Table 2).

Primary outcome

Table 3 depicts characteristics of patients classified as prolonged opioid users. Of the total group, 91% ($n=1981$) were discharged on opioids, and 98% ($n=1955$) of this total filled only one prescription. A total of 91 (4%) patients remained on opioids beyond 30 days, and out of this group 25% ($n=23$ patients) remained at 90 days.

Univariate analysis

On univariate analysis, those with a history of depression 11%, a history of taking antidepressants, or a history of benzodiazepine use were more likely to take opioids beyond 30 days. Diagnosis was not a determinant of prolonged opioid use as benign neoplasm was the most common diagnosis in both groups, 48% (CI 38–58%) in the prolonged opioid group versus 52% (CI 50–54%) in the control group.

Table 1 Patient characteristics

	Opioid < 30 days ($n=2082$)	Proportion 95% CI	Opioid > 30 days ($n=91$)	Proportion 95% CI	Total cohort ($n=2173$)	Proportion	<i>p</i> value
Age	67 (± 15)		52 (± 14)		60 (± 15)		0.0001
Median	61		52		60		
ASA (2 or less)	1396	67% (65–69%)	56	62% (51–71%)	1452	67% (65–69%)	0.3
Female sex	1087	52% (50–54%)	49	53% (44–64%)	1163	54% (51–56%)	.8
Opioid naïve	2011	96% (96–97%)	72	80% (70–86%)	2083	96% (95–97%)	<.0001
Use of benzo	219	10% (9–12%)	23	25% (14–35%)	242	11% (9–13%)	<.0001
Hx anxiety	150	7% (6–8%)	11	12% (7–20%)	161	7% (6–9%)	0.08
Hx depression	116	6% (5–7%)	10	12% (6–19%)	126	6% (5–7%)	0.03
Hx of antidepressants	134	6% (5–7%)	15	16% (10–25%)	149	7% (6–8%)	0.0002
Hx substance abuse	19	1% (0–1%)	3	3% (1–9%)	22	1% (.01–2%)	0.02
Hx chronic pain	16	.7% (.04–1%)	10	11% (6–19%)	26	1% (.08–2%)	<.0001

Results include mean \pm SD for continuous variables and proportion \pm 95% CI for categorical variables

Table 2 Diagnoses and surgical characteristics

	Opioid < 30 days ($n=2082$)	Proportion 95% CI	Opioid > 30 days ($n=91$)	Proportion 95% CI	Total cohort ($n=2173$)	Proportion	<i>p</i> value
Diagnosis							
Diverticulitis	590	28% (26–30%)	22	24% (17–34%)	612	28% (26–30%)	0.3
Neoplasm	1092	52% (50–55%)	44	48% (38–58%)	1136	52% (50–54%)	0.4
IBD	400	19% (17–21%)	25	27% (19–37%)	425	19% (18–21%)	0.05
Procedure							
Ileocolic resection	644	31% (29–33%)	17	19% (12–28%)	661	30% (25–32%)	0.02
Left colectomy	577	28% (26–30%)	31	34% (25–44%)	608	28% (26–30%)	0.1
Anterior resection	474	23% (21–25%)	12	13% (7–22%)	474	22% (20–24%)	0.03

Results include mean \pm SD for continuous variables and proportion \pm 95% CI for categorical variables

Table 3 Characteristics of patients classified as prolonged opioid users

Predictors of prolonged opioid use (> 30 days)		
Characteristic	OR (95% CI)	<i>p</i> value
Increasing age	0.96 (0.95–0.98)	0.0001
Female sex	0.94 (0.61–1.46)	0.8
Increase ASA	1.80 (1.09–2.93)	0.02
Use of benzos	2.24 (1.32–3.80)	0.003
History chronic pain	12.70 (5.31–30.19)	0.0001
Emergent surgery	0.77 (0.38–1.57)	0.5
Laparoscopy versus open	0.61 (0.39–0.96)	0.03
Stoma creation	0.73 (0.39–1.34)	0.3
Readmission	1.87 (1.01–3.11)	0.05
Postoperative complication	1.13 (0.69–1.84)	0.6

Results include odds ratio for continuous variables, and proportion \pm 95% CI for categorical variables

Multivariate analysis

In our multivariate analysis, we found no association between postoperative complication-emergent procedures, stoma formation, and/or patient sex with increased risk of prolonged opioid use. However, younger age and prior history of chronic pain (OR 12.7; CI 5.3–30.2) were associated with increased risk of prolonged opioid use. Lastly, use of minimally invasive techniques attenuated the risk of prolonged opioid use (OR 0.6; CI 0.4–0.9) (Table 3).

Discussion

In a methodical review of colorectal surgical cases at a tertiary referral center, we identified a large proportion of patients (91%) who are discharged on opioids. While the majority of patients fill only one prescription, 4% of patients remained on opioids beyond 30 days. In our analysis, we found no association between postoperative complications, stoma formation, and/or sex with the primary outcome of prolonged opioid use. However, we did note that both younger age and history of chronic pain were associated with an increased risk of prolonged opioid use, while the use of minimally invasive techniques seemed to attenuate that risk.

There are numerous postulated explanations for the overuse of postoperative opioids after surgery. Some have shown a correlation between preoperative psychological diagnoses, such as anxiety or depression, with an increased risk of prolonged opioid use [9, 10]. Our data similarly revealed an association between a history of depression and risk of prolonged opioid use after surgery. We also noted that younger age as well as a past medical history of chronic pain were risk factors for prolonged opioid use. Younger age has been

cited as a risk factor for prolonged opioid use in other studies, but the physiologic basis for this finding is unclear [11]. A history of chronic pain as a risk factor was also within the scope of common themes within other studies [11].

Our study did find another link between the use of minimally invasive techniques and reduced likelihood of prolonged opioid use. It can be assumed that patients who undergo minimally invasive techniques, rather than open procedures, have reduced incision length leading to less incisional pain. This phenomenon has been suggested by Kehlet et al., who proposed less postsurgical pain as a result of less surgical nerve injury during a laparoscopic hernia procedure compared to open procedure [12]. Less nerve damage theoretically would lead to less pain, thus a lesser need, dosage, or length of time on any analgesic. Ultimately, less time on pain meds translates to less overall potential that a patient might develop overall dependency on opioids.

Traditionally, open procedures cause greater surgical trauma, which might lead to increased nerve damage through “acute and lasting changes in the injured nerves as well as in neighboring nerves” [13]. It has been theorized that these neurologic effects on the pain pathway lead to the production of chronic postsurgical distress, and thus prolonged use of opioids [13]. However, the value of minimally invasive techniques in reducing postsurgical opioid dependency has not been identified by others. Soneji et al. evaluated 39,140 opioid-naïve patients and did not find a link between minimally invasive techniques and prolonged opioid use. In the Soneji study, similar small proportion of patients remained on medications (3%) at a time interval of 3 months after surgery regardless of surgical access [11]. The difference between our study and the Soneji study is that our study is a pure cohort of colorectal resections, whereas the Soneji study included urologic and thoracic procedures as well as other specialties.

There are limitations in this study which are inherent to all retrospective studies—perhaps the most critical being the chart abstraction which does not allow for direct patient reporting but instead relies only on medical record entry. In our review, we had access to prescriptions prescribed by the treating team or filled in the hospital pharmacy. Some patients may have obtained medication elsewhere or through nontraditional methods. However, our point estimate for prolonged opioid use is consistent with other studies on this subject matter. In addition, prescription practices are changing across the nation because of greater scrutiny to opioid prescriptions; however, we found no differences in practices between the early period and later periods of analysis. It is for these reasons that we believe the conclusion is still germane to the current clinical climate. Finally, the strength of this study is the rich source of clinical data provided by the medical records and our prospective quality-improvement dataset.

In conclusion, a small but considerable proportion of patients remain on postoperative opioids beyond 30 days, and even at the 90-day timepoint. Although there is not a clear explanation as to why some patients' opioid use was prolonged, we did find that patients who underwent minimally invasive techniques had a very low likelihood of requiring opioids beyond 30 days. Ultimately, this may be the only clear mutable factor that surgeons can alter in the hope of minimizing the risk of prolonged opioid use and reducing our impact on the opioid epidemic. Other predictors such as the patient history of chronic pain and history of substance abuse may be helpful to the surgeon to keep in mind when prescribing opioids for postoperative pain. In this manner, a hospital pain service may be of some value to the chronic pain patient before their colorectal surgery procedure.

Compliance with Ethical Standards

Disclosures Ms Caitlin Stafford, Dr. Todd Francone, Dr. Patricia L. Roberts, and Dr. Rocco Ricciaridi have no conflicts of interest or financial ties to disclose.

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