Impact of Perioperative Epidural Placement on Postdischarge Opioid Use in Patients Undergoing Abdominal Surgery

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ABSTRACT

Background: Opioids play a crucial role in providing analgesia throughout the perioperative period; however, patients may become persistent users of these medications months after surgery. Epidurals have been posited to prevent the development of persistent pain, but there are little data on the effect of epidurals on persistent opioid use.

Methods: This study was conducted using a claims database of a large, nationwide commercial health insurer. Opioid-naive patients who underwent open abdominal surgery from January 2004 to December 2013 were included in the study. Propensity scores for epidural placement were calculated accounting for demographic characteristics, resource utilization, and comorbid conditions (including medical, psychiatric, and pain conditions). Time-to-event analysis was used with the primary outcome defined as 30 days without filling an opioid prescription after discharge. In addition, total morphine equivalents dispensed within 90 days of discharge were also calculated for each patient.

Results: A total of 6,432 patients were included in the final propensity score–matched cohort. The Cox proportional hazards ratio was 0.96 (95% CI, 0.91 to 1.01; $P = 0.0910$) for the relation between epidural placement and time till a 30-day gap without filling an opioid prescription. There was no difference in the total morphine equivalents dispensed within 90 days of discharge between the groups ($P = 0.7670$).

Conclusions: Epidural placement was not protective against persistent opioid use in a large cohort of opioid-naive patients undergoing abdominal surgery. This finding does not detract from the other potential benefits of epidural placement. More research is needed to understand the mechanism of persistent opioid use after surgery and its prevention. **(ANESTHESIOLOGY 2016; 124:396-403)**

THERE have been multiple campaigns to increase the awareness among both patients and physicians about the importance of appropriate pain relief.[1,2] The success of these efforts are reflected by the fact that opioids are now one of the most commonly prescribed medications in the United States.[3] These initiatives, while in many aspects laudable, have been accompanied by a concurrent increase in the rate of opioid-related deaths.[4]

The perioperative period presents a unique circumstance that highlights the tension between these two major public health concerns of providing pain relief with a potentially addictive substance. Patients undergoing surgery are subjected to an acute insult that generates a tremendous amount of pain and opioids play a crucial role in providing analgesia throughout the perioperative period.[5] At the same time, prior studies have shown that there is a risk of long-term opioid use postoperatively in opioid-naive patients with rates ranging from 3.1 to 7.7%.[6,7]

What We Already Know about This Topic

- Opioid exposure to treat early postoperative pain may go on to persistent opioid use and abuse
- Whether improved acute pain analgesia and opioid sparing from epidural analgesia during hospitalization could affect the incidence of persistent opioid use is unknown

What This Article Tells Us That Is New

- In a review of over 6,400 patients who underwent open abdominal surgery, propensity-matched analysis showed no effect of use of epidural analgesia on time to discontinuation of opioids after hospital discharge or dose of opioids administered in the first 90 days after discharge

Epidurals represent a potential intervention that can be used by anesthesiologists to provide effective pain relief with limited side effects. It has been posited that by providing preventive analgesia, epidurals can prevent central sensitization

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and stop the transition from acute to chronic pain.[8] Although clinical data demonstrating this effect are limited, epidurals may prevent persistent postoperative pain in some patients undergoing thoracotomy and abdominal surgery.[9] It is also plausible that limiting the exposure to potentially addictive opioids perioperatively through the use of an epidural would translate into decreased opioid use after discharge.

To our knowledge, there are no prior studies examining the relation between epidural placement and postdischarge opioid consumption. The hypothesis of this study is that epidurals will reduce the amount of opioids consumed after discharge and prevent persistent use of these medications.

Materials and Methods

Study Design and Setting

Data for the study were obtained from a deidentified research database called InVision for Data Mart, a product of OptumInsight Life Sciences (USA). The database collects information regarding membership and reimbursement transactions of a large, nationwide commercial health insurer. Transactions captured by the database include pharmacy dispensing, inpatient and outpatient services, and procedures. The study examined members and their dependents who were enrolled in a health plan from January 2004 to December 2013.

The database represents an open cohort with a cross-sectional size that was approximately 14 million persons depending on the study year. Demographics of individuals in the database are similar for all those younger than 65 yr living in the United States with the exception of geographical distribution, which is a function of the market share of the insurer rather than underlying population density. The use of these deidentified data for research was approved by the Partners Institutional Review Board (Boston, Massachusetts).

Study Population

Patients 18 yr or older undergoing one of the following open surgical procedures during the study time period were included in the analysis: colectomy, pancreatectomy/Whipple procedure, nephrectomy, splenectomy, cystectomy, and adrenalectomy. Procedures were identified using current procedural terminology (CPT) codes present during an inpatient admission. These surgeries were selected based on the fact that they are all abdominal procedures, for which anesthesiologists may place an epidural. Furthermore, these procedures either had separate codes for a laparoscopic and open version of the procedure or were unlikely to be performed laparoscopically. This study only considered open procedures, as the risk–benefit of using epidurals in minimally invasive procedures is a debated topic that should be studied separately. Patients were excluded if they had a CPT or *International Classification of Diseases*, 9th Edition (ICD-9) code indicating that a laparoscopic procedure was performed during the index surgical admission. To further decrease the likelihood of misclassifying the type of surgery, patients with an ICD-9 code for laparoscopy (54.21) during the index admission were excluded. A list of CPT and ICD-9 codes used to define surgical procedures can be found in table S1, Supplemental Digital Content 1, http://links.lww.com/ALN/B225.

To be included in the study, a patient must have had at least 6 months of a baseline period of enrollment in the health plan before the index operation. If a patient filled a prescription for an opioid during the baseline period, then he or she was eliminated from the study, as were patients with ICD-9 codes for opioid abuse or dependence, in order to obtain a cohort of opioid-naive patients. Patients with metastatic cancer or a previous palliative care visit were identified using ICD-9 codes and were excluded from the analysis, as opioids are appropriately used in this setting for chronic cancer-related pain. Finally, patients discharged to a location other than home were excluded from the analysis, as opioid consumption could not be tracked during a stay at a rehabilitation or acute care facility.

Definition of Exposure and Outcome

Epidural placement was assessed by the presence of one or more of the following CPT codes: 62318, 62319.[10,11] The primary outcome of the study was the time to discontinuation of opioids. This was defined as a period of 30 days without filling a prescription for an opioid after discharge from the hospital.

Covariates

Covariates were identified using pharmacy billing and ICD-9 and CPT codes present during the 6-month baseline period. Covariates were selected based on identified predictors of persistent postoperative pain and opioid use[6,12] as well as biologic plausibility. There were three groups of potential confounders that were extracted from the database: demographic characteristics, resource utilization, and comorbid conditions (including medical, psychiatric, and pain conditions). The demographic variables included were age, sex, year of procedure, and surgery type. Resource utilization during the baseline period was accounted for by including variables such as the number of prescriptions filled for distinct medications, number of hospitalizations, and days spent in the hospital. These measures serve as markers of the severity of comorbidity of an individual patient and may be related to epidural use and postoperative prescribing patterns.

We adjusted for medical comorbidities including coronary artery disease, heart failure, chronic pulmonary disease, diabetes mellitus, chronic renal failure, and malignancy. As a summary measure of a patient's comorbid conditions, we calculated the Gagne comorbidity score as a covariate.[13] We also included several pain-related and psychiatric disorders including fibromyalgia, back pain, a history of substance abuse, and anxiety disorder. Given that the database has robust pharmacy transactions, the models incorporated covariates based on prescriptions filled for various

medications, which may be the markers of comorbid pain, medical, or psychiatric conditions or their severity. These included possible analgesics such as muscle relaxants, antidepressants, anticonvulsants, benzodiazepines, nonsteroidal antiinflammatories, and gabapentinoids. To further define medical covariates, we also determined whether patients filled a prescription for a β-blocker, angiotensin-converting enzyme inhibitors, nitroglycerin, statins, albuterol, tiotropium, and several other cardiac and pulmonary medications. A complete list of ICD-9 and CPT codes used to generate covariates can be found in table S2, Supplemental Digital Content 1, http://links.lww.com/ALN/B225.

Statistical Analysis

A propensity score (PS) was calculated to predict the probability of receiving an epidural based on the predictors mentioned using a logistic regression model. All covariates were included in the model without further selection. Age was divided into categories and included in the model as a categorical variable. All other continuous variables were divided into tertiles and included as categorical variables to account for nonlinear associations. Each patient who received an epidural was PS matched to two patients who did not receive an epidural. This ratio was selected after examining the number of exposed and unexposed subjects in order to maximize the number of matched patients and ensure the most efficient use of the data. This step was undertaken before any analysis of the data. Matching was achieved by using pairwise nearest neighbor matching with a maximum caliper size of 0.05 using a publically available algorithm.[14,15] Balance of covariates among the exposure groups in the matched cohort was assessed using standardized difference, with a difference of 10% to signify the imbalance between groups.[16]

We then performed a time-to-event analysis on the matched cohort with follow-up beginning on the day of discharge from the hospital. Patients were censored at death, disenrollment from the health plan, a subsequent hospitalization, or a study event. The time to event was defined as 30 days after the last opioid prescription filled or after hospital discharge if no opioid prescription was filled within 30 days of discharge. To determine association, we calculated Cox proportional hazards ratios (HRs) to determine whether the groups had different hazards of persistent opioid use.

Sensitivity Analyses

Given that opioids are often used as needed, we sought to explore whether our effect estimate would be sensitive to changes in outcome definition. As a sensitivity analysis, we redefined the outcome as a 15-day gap of not filling an opioid prescription. We also performed an additional analysis where we incorporated the days supply of the opioid prescription listed in the database and defined the time to event as 30 days after the last day supply of the previous opioid prescription or the 30th day after hospital discharge if no opioid prescription was filled within 30 days of discharge.

The primary analysis used several different surgery types. To ensure that the heterogeneity in surgical procedures did not account for the findings, we limited the cohort to only patients undergoing colectomies and repeated the primary analysis.

We used nonsurvival analytic techniques to determine whether there was any association between epidurals and persistent opioid use within the PS-matched cohort. We estimated the proportion of patients who received more than two opioid prescriptions within 90 days after discharge. The proportion of patients who filled an opioid prescription between 90 and 180 days of discharge was also calculated. These proportions were then compared with a chi-square test to determine whether the difference was statistically significant. In an alternative approach, we assessed the total amount of opioid dispensed. To facilitate comparison across opioid classes, all opioid prescriptions were converted to morphine equivalents,[17,18] and the total amount of opioids dispensed within 3 months of discharge was calculated. These values were then compared with a *t* test.

All analyses were performed in SAS (version 9.3; SAS, USA), with significance defined as a two-tailed *P* value of 0.05. In addition, we felt that a hazard ratio of 0.8 would represent a clinically meaningful difference for the primary analysis.

Results

Primary Analysis

A total of 11,537 patients met all inclusion criteria in the study, of which 2,220 received an epidural (19%). The number of patients excluded for each criterion is displayed in figure 1. A greater proportion of patients with an epidural had a diagnosis of cancer, liver disease, and renal disease. They were less likely to have a hemostatic disorder or have filled a prescription for oral anticoagulants. A complete description of the cohort characteristics can be found in table 1 and table S3, Supplemental Digital Content 1, http://links.lww.com/ALN/B225.

A PS for receiving an epidural was calculated based on all covariates and patients who received an epidural were matched to those who did not in a 1:2 ratio. Of the 2,220 patients who received an epidural, 2,144 were matched to two patients who did not receive an epidural (97%). Characteristics were similar between the two groups after matching, and the maximum absolute standardized difference was less than 2.6% across all covariates. Characteristics of the PS-matched cohort are displayed in table 2 and table S4, Supplemental Digital Content 1, http://links.lww.com/ALN/B225.

The crude Cox proportional HR associated with epidural placement was 0.99 (95% CI, 0.94 to 1.04; $P = 0.6295$) when examining time till a 30-day gap without filling an opioid prescription in the entire cohort before PS matching. The result was similar when performing the analysis in the PS-matched cohort. The Cox proportional HR was 0.96

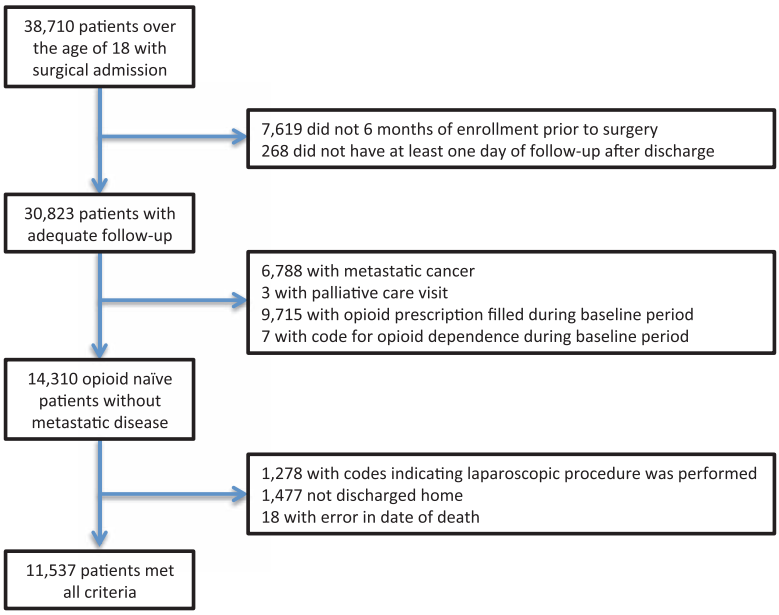

Fig. 1. Flow chart of patient selection.

(95% CI, 0.91 to 1.01; $P = 0.0910$) for the relation between epidural placement and time till a 30-day gap without filling an opioid prescription after PS matching. Time-to-event curves were plotted and were similar between the two groups in the PS-matched cohort (fig. 2). A summary of all the results is displayed in table 3.

Sensitivity Analyses

Additional analyses were performed within the propensity-matched cohort to see whether the effect estimate was sensitive to outcome measurement. When changing the time to event to 15 days without filling an opioid prescription, there was still no difference between the groups (HR, 0.96; 95% CI, 0.91 to 1.01; $P = 0.1401$). When incorporating days supply, there was no difference in the rate of discontinuation of opioids 30 days after the supply ended (HR, 0.97; 95% CI, 0.92 to 1.02; $P = 0.2095$). The primary analysis was repeated in the subgroup of patients who received colectomies and there remained no difference between the groups (HR, 0.97; 95% CI, 0.92 to 1.03; $P = 0.3725$).

There was no difference in the total morphine equivalents dispensed within 90 days of discharge between the groups (mean 606 *vs.* 651; $P = 0.7670$). A larger proportion of patients who had an epidural filled two or more opioid prescriptions within 90 days of discharge compared with those who did not receive an epidural (30.4 *vs.* 27.5%; $P = 0.0138$). There was no difference in the proportion of patients who filled a single opioid prescription between 90 and 180 days after discharge between the groups (11.6% for patients who received an epidural *vs.* 11.5% for patients who did not receive an epidural; $P = 0.9120$). The results of the sensitivity analyses are displayed in table 4.

Discussion

In a large cohort of opioid-naive patients undergoing abdominal surgeries, epidural placement was not protective against persistent opioid use. The results were robust to several sensitivity analyses performed. Although previous studies have investigated the association between epidural placement and chronic pain, this is the first study to our knowledge to examine the impact of epidurals on persistent opioid use.

The incidence of chronic pain after surgery has been estimated to be 5 to 65% depending on the type of procedure and population studied.[12] Furthermore, prior studies have shown that there is a risk of long-term opioid use postoperatively in opioid-naive patients with rates ranging from 3.1 to 7.7%.[6,7] In our study, more than a quarter of patients filled at least two opioid prescriptions within 90 days and 11% filled a prescription between 90 and 180 days after discharge.

The mechanism by which acute postsurgical pain transforms to chronic pain has not been elucidated and is likely multifactorial. It has been hypothesized that by providing preventive analgesia, epidurals can prevent central sensitization and stop this transition.[8] In addition, effective treatment of acute pain has been shown to decrease the risk of chronic postsurgical pain,[19] and it has been demonstrated that epidurals provide superior analgesia in the perioperative period compared with IV patient-controlled analgesia.[20] The ability of epidurals to decrease persistent pain has been demonstrated in patients undergoing abdominal surgery and thoracotomy.[9,21–23] However, the results have not been unequivocal. A study of patients who underwent laparotomy showed no difference in pain outcome 6 months after surgery between patients who did and did not receive an epidural.[24] In another study of patients undergoing

Table 1. Selected Baseline Patient Characteristics of Cohort, Stratified by Whether the Patient Received an Epidural, N (%) or Mean (SD)

	Total	Epidural Placed	No Epidural Placed
Total, n	11,537	2,220	9,317
Surgical procedure			
Adrenalectomy	200 (1.7)	58 (2.6)	142 (1.5)
Cystectomy	196 (1.7)	47 (2.1)	149 (1.6)
Colectomy	7,714 (66.9)	1,316 (59.3)	6,398 (68.7)
Nephrectomy	2,301 (19.9)	610 (27.5)	1,691 (18.2)
Pancreatectomy	367 (3.2)	148 (6.7)	219 (2.4)
Splenectomy	849 (7.4)	63 (2.8)	786 (8.4)
Sex			
Female	5,209 (45.2)	1,007 (45.4)	4,202 (45.1)
Age			
18–39	1,225 (10.6)	167 (7.5)	1,058 (11.4)
40–54	3,577 (31.0)	690 (31.1)	2,887 (31.0)
55–64	4,188 (36.3)	837 (37.7)	3,351 (36.0)
65–74	1,614 (14.0)	323 (14.6)	1,291 (13.9)
75 and older	933 (8.1)	203 (9.1)	730 (7.8)
Resource utilization			
Length of stay during surgical admission (days), mean (SD)	8.35 (7.5)	8.02 (4.9)	8.43 (8.0)
Hospitalization in the 30 days before surgical admission	1,776 (15.4)	343 (15.5)	1,433 (15.4)
Comorbidities			
Gagne comorbidity score	0.83 (1.5)	0.85 (1.4)	0.83 (1.5)
Alcohol or drug abuse/dependence	153 (1.3)	27 (1.2)	126 (1.4)
Asthma	559 (4.9)	114 (5.1)	445 (4.8)
Back pain	1,760 (15.3)	369 (16.6)	1,391 (14.9)
Chronic obstructive pulmonary disease	707 (6.1)	150 (6.8)	557 (6.0)
Cancer	6,235 (54.0)	1,419 (63.9)	4,816 (51.7)
Chronic pain	39 (0.3)	7 (0.3)	32 (0.3)
Fibromyalgia	268 (2.3)	63 (2.8)	205 (2.2)
Hemostatic disorder	375 (3.3)	57 (2.6)	318 (3.4)
Liver disease	1,531 (13.3)	362 (16.3)	1,169 (12.6)
Renal disease	2,964 (25.7)	727 (32.8)	2,237 (24.0)
Medications used during the baseline period			
β-Blocker	2,043 (17.7)	422 (19.0)	1,621 (17.4)
COX-2 inhibitor	182 (1.6)	43 (1.9)	139 (1.5)
Heparin or LMWH	117 (1.0)	16 (0.7)	101 (1.1)
Muscle relaxants	342 (3.0)	57 (2.6)	285 (3.1)
Nonselective NSAIDs	785 (6.8)	127 (5.7)	658 (7.1)
Oral anticoagulants	353 (3.1)	48 (2.2)	305 (3.3)

Values are displayed as N (%), unless otherwise stated, other covariates included in the study are listed in table S3, Supplemental Digital Content 1, http://links.lww.com/ALN/B225.

COX-2 = cyclooxygenase-2; LMWH = low-molecular-weight heparin; NSAID = nonsteroidal antiinflammatory drug.

prostatectomy, epidurals were associated with a difference in pain scores at 9.5 weeks but not at 3.5 and 5.5 weeks after surgery.[25]

We had no method of assessing postoperative pain and thus this measure was not included in the analysis as an outcome. However, the use of a claims database allowed for a much larger cohort than other prior studies examining persistent pain after surgery. Persistent opioid consumption can potentially be considered as a surrogate measure of persistent pain[26] and may indicate even greater functional impairment. The lack of an association found in our study may mean that the difference in the amount of persistent pain between groups is not sufficient enough to manifest as a difference in opioid consumption.

We did note a small increase in the proportion of patients filling a second prescription for an opioid within 90 days of discharge in patients who received an epidural. The difference was small and likely reached statistical significance due to the large sample size of the study. In light of all of the other findings of this study, this single result is unlikely to have any clinical relevance.

The conclusions of this study are supported by the fact that we had detailed information on all filled prescriptions as well as potential confounders that were present before the surgical admission. In addition, this is one of the largest databases of its kind that allowed us to follow patients longitudinally and capture information both pre- and postsurgery. The size of the database allowed us to place several

Table 2. Selected Baseline Patient Characteristics of Cohort, Stratified by Whether the Patient Received an Epidural, after Propensity Score Matching

	Epidural Placed	No Epidural Placed	Standardized Difference (%)
Total, n	2,144	4,288	
Surgical procedure			
Adrenalectomy	57 (2.6)	97 (2.3)	2.6
Cystectomy	45 (2.1)	83 (1.9)	1.1
Colectomy	1,315 (61.3)	2,664 (62.1)	–1.7
Nephrectomy	595 (27.8)	1,204 (28.1)	–0.7
Pancreatectomy	89 (4.2)	158 (3.7)	2.4
Splenectomy	63 (2.9)	114 (2.7)	1.7
Sex			
Female	963 (44.9)	1,941 (45.3)	–0.7
Age			
18–39	166 (7.7)	335 (7.8)	–0.3
40–54	676 (31.5)	1,305 (30.4)	2.4
55–64	803 (37.5)	1,631 (38.0)	–1.2
65–74	306 (14.3)	631 (14.7)	–1.3
75 and older	193 (9.0)	386 (9.0)	0.0
Resource utilization			
Length of stay (days) during surgical admission, mean (SD)	7.91 (4.9)	7.79 (6.0)	0.0
Hospitalization in the 30 days before surgical admission	320 (14.9)	642 (15.0)	–0.1
Comorbidities			
Gagne comorbidity score	0.85 (1.4)	0.88 (1.4)	0.0
Alcohol or drug abuse/dependence	26 (1.2)	53 (1.2)	–0.3
Asthma	108 (5.0)	224 (5.2)	–0.8
Back pain	352 (16.4)	706 (16.5)	–0.1
Chronic obstructive pulmonary disease	139 (6.5)	302 (7.0)	–2.2
Cancer	1,347 (62.8)	2,718 (63.4)	–1.2
Chronic pain	7 (0.3)	15 (0.4)	–0.3
Fibromyalgia	60 (2.8)	113 (2.6)	1.0
Hemostatic disorder	55 (2.6)	114 (2.7)	–0.6
Liver disease	319 (14.9)	614 (14.3)	1.6
Renal disease	699 (32.6)	1,408 (32.8)	–0.5
Medications used during the baseline period			
β-Blocker	399 (18.6)	834 (19.5)	–2.1
COX-2 inhibitor	39 (1.8)	83 (1.9)	–0.9
Heparin or LMWH	16 (0.8)	33 (0.8)	–0.2
Muscle relaxants	55 (2.6)	111 (2.6)	–0.1
Nonselective NSAIDs	126 (5.9)	246 (5.7)	0.6
Oral Anticoagulants	48 (2.2)	90 (2.1)	1.0

Values are displayed as N (%), unless otherwise stated, other covariates included in the propensity score were year, number of office visits, distinct medications filled, hospitalizations, and days spent in the hospital during the baseline period. Additional comorbidities included were diabetes mellitus, cerebrovascular disease, migraines, mood disorder, obesity, osteoarthritis, oxygen dependence, psychosis, rheumatoid arthritis, congestive heart failure, delirium, dementia, inflammatory bowel disease, seizure disorder, ischemic heart disease, liver disease, renal disease, history of smoking, and cardiac dysrhythmia. Additional medications included were angiotensin-converting enzyme inhibitor, angiotensin-II receptor blockers, antipsychotics, anxiolytics, corticosteroids, digoxin, diuretics, hypoglycemic, insulin, statins, calcium channel blockers, chronic respiratory therapy, antiarrhythmics, anticonvulsants, antidepressants, and antiplatelet agents. The distribution of these covariates in the propensity score–matched cohort is shown in table S4, Supplemental Digital Content 1, http://links.lww.com/ALN/B225.

COX-2 = cyclooxygenase-2; LMWH = low-molecular-weight heparin; NSAID = nonsteroidal antiinflammatory drug.

restrictions on the cohort in order to facilitate the interpretability of the analysis while still retaining a sample size large enough from which to make inferences.

However, when interpreting the results of the study, it is important to consider the limitations of our data. Despite the fact that this study uses a rich and robust data set, unmeasured confounding is a concern. One main source of potential confounding not accounted for is the size of the incision. Although the models are able to adjust for type of surgery, this may not capture the true extent of surgery. Therefore, epidural placement could be a marker for a larger incision, which would be more painful in the postoperative period. This association could potentially mask a protective effect. That said, given the surgical procedures that were selected for the study, we would generally not expect significant variation in the approach or incision size.

This cohort was limited to patients with commercial insurance, and we imposed several exclusion criteria in order to

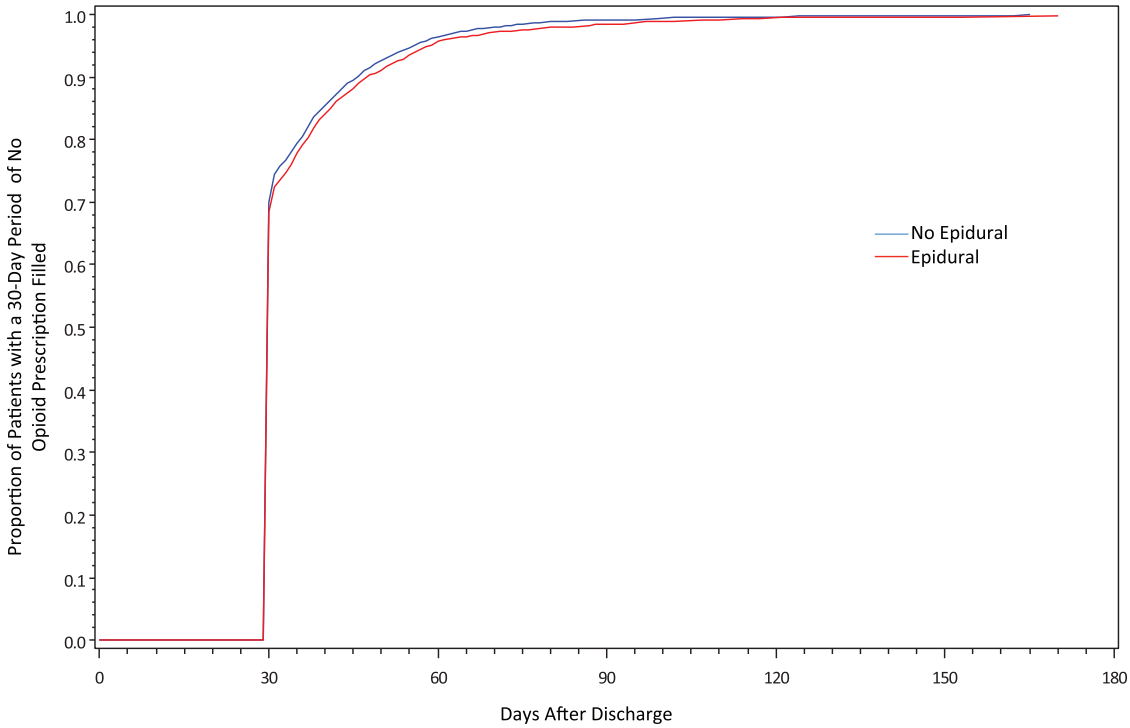

Fig. 2. Time-to-event curves displaying the proportion of patients in each group who had a 30-day period without filling a prescription for an opioid after discharge.

Table 3. Association between Epidural Placement and Persistent Opioid Use

	No Epidural	Epidural*	*P* Value
Time since last opioid prescription filled			
Primary analysis			
30-day gap—crude	Ref	0.99 (0.94–1.04)	0.6295
30-day gap—propensity matched	Ref	0.96 (0.91–1.01)	0.0910

* Results represent hazard ratios with 95% CIs in parentheses.
Ref = reference category.

Table 4. Results from the Sensitivity Analyses

	No Epidural	Epidural*	*P* Value
Time since last opioid prescription filled			
15-day gap	Ref	0.96 (0.91–1.01)	0.1401
30-day gap accounting day supply	Ref	0.97 (0.92–1.02)	0.2095
Colectomy-only cohort—30-day gap	Ref	0.97 (0.92–1.03)	0.3725
Nonsurvival analysis			
Total morphine equivalents dispensed within 90 days of discharge, mean (SD)	606 (5,288)	651 (6,566)	0.7670
Proportion of patients filling two or more opioid prescriptions within 90 days of discharge, n (%)	1,178/4,288 (27.5%)	652/2,144 (30.4%)	0.0138
Proportion of patients filling a single opioid prescription between 90 and 180 days of discharge, n (%)	492/4,288 (11.5%)	248/2,144 (11.6%)	0.9120

* Results represent hazard ratios with 95% CIs in parentheses, except where noted.
Ref = reference category.

create a study population that was opioid naive. This was to ensure that we captured opioid use that was related to surgery rather than due to chronic dependence or use. Therefore, the results might not be generalizable to all patients undergoing surgery and there could be a subgroup of patients in whom epidurals could prevent persistent opioid consumption.

Despite its limitations, our study provides strong evidence that in a large nationwide cohort of opioid-naive patients undergoing abdominal surgery, epidural placement was not protective against prolonged opioid use after surgery. This finding obviously does not detract from the benefits of epidurals including superior perioperative analgesia and a potential reduction of certain perioperative complications.[27] Indeed, we believe that epidurals should continue to be a mainstay in the provision of perioperative analgesia for patients undergoing abdominal surgery. However, more research is needed to better understand the mechanism of persistent opioid use after surgery and its prevention.

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Competing Interests

Dr. Patorno is a consultant for Aetion Inc. (New York, New York). The other authors declare no competing interests.

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