Original Article

Preoperative opiate use leads to increased postoperative opiate use and readmissions after anterior cervical discectomy and fusion

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Background: Determine effects of pre-operative opiate use on anterior cervical discectomy and fusion (ACDF) surgery outcomes.

Methods: The study design was a single center retrospective cohort study. Patient records were reviewed from 2013 and 2018 for elective 1 to 2 level ACDF surgeries. Patients were classified as: opiate naive (ON: no history of opiate) use, acute opiate (AO: <6 months preoperatively) use, and chronic opiate (CO: 6–12 months preoperatively) use based on prescription history before surgery. Opiate use was quantified by milligram morphine equivalents (MME) at 6–12 months preop, 0–6 months preop, 0-6 months postop, and 6–12 months postop. Charts were reviewed for American Society of Anesthesiologists (ASA) physical status classification and smoking history.

Results: Readmission rates were 9.8% for ON, 9.1% for AO, and 30% for CO (P value <0.05). Average opiate use measured in MME 6-12 months post-surgery was 5.76 for ON, 18.44 for AO, and 39.92 for CO (P value <0.05). Readmission rate between nonsmokers, former smokers, and active smokers was 4.4%, 0%, and 10.8% (P value <0.05) at 30–90 days post-surgery, and 1.1%, 14.5%, and 2.5% (P value <0.05) in the 91 days to 1-year post-surgery.

Conclusions: There is statistically significant relationship between CO and higher readmission rates after ACDF. Preoperative opiate use is also associated with increased opiate use 6–12 months after surgery. Smoking history is also associated with increased readmission rates.

Keywords: Anterior cervical discectomy and fusion (ACDF) surgery; spine surgery; opiates; pain

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Introduction

Use of opiate pain medications have become increasingly common in the United States. As pain control was more emphasized as a measurement of quality of care, the prescription of opiates for chronic pain control doubled from 1980 to 2000 (1). Concurrently, this also led to an increase in the prescription of more potent opiates (1). Such a trend has continued into the 2010s, with total prescription

opiate sales in various settings quadrupling between the years 1999 and 2010 (2). With such prevalent opiate use, its negative side effects have become more evident. In 2018, nearly 10 million people abused prescription opiate medications (3). Half a million people died between 2000 and 2015 from opiate overdose, and over 70,000 people died in 2017 alone from opiate overdose (4,5). The increase of opiate related deaths, hospitalizations, and emergency room (ER) visits has triggered a national movement to decrease opiate use. In 2017, President Donald J. Trump initiated the President's Commission on Combating Drug Addiction and the Opioid Crisis in conjunction with securing $1.8 billion dollars in funds for states to work on decreasing opioid overdose (6,7). These policies reflect a nationwide effort in the U.S. that has resulted in a 4.6% decrease in opiate overdose deaths between 2017 and 2018 (4).

The physiological effects of opiates are mediated through various receptors such as mu, delta, and kappa receptors. Of these receptors, interaction with the mu receptor is thought to be key in the opiate related mechanism of action in pain control, increasing the threshold for pain and alteration of pain perception (8). This interaction also causes side effects such as euphoria, respiratory depression, constipation, seizures, and hypothermia in the acute setting (9). Chronic opiate use has also been associated with opiate tolerance due to changes in rate of drug metabolism and adaptations of the nervous system signaling pathway (10). Such opiate tolerance has been associated with depression, immunosuppression, hyperalgesia, sexual dysfunction, and depression (10).

Multiple database studies have shown that pre-operative opiate use is associated with undesired post-operative outcomes such as increased cost, readmission, revision surgery, and ER visits in operations spanning from abdominal surgeries, orthopedic joint replacements, and spine surgeries including anterior cervical discectomy and fusions (ACDFs) (11-14). Database studies have the advantage of high power due to large sample size, but they are unable to determine details such as reason for readmission, amount or type of opiate prescription, or timeline of reoperations or readmissions. Although negative effect of opiates in the perioperative setting is well known, the goal of this study is to perform a detailed investigation into the effects of preoperative opiate use on short segment ACDF surgeries and its outcomes with regards to objective and measurable parameters such as: hospital readmission, ER visits, revision surgeries, length of stay, operative time, intraoperative blood loss, and post-operative opiate use using the electronic medical records of a single academic institution. We present the following article in accordance with the STROBE reporting checklist (available at https://jss.amegroups.com/article/view/10.21037/jss-21-126/rc).

Methods

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The project was approved by LLUH Institutional Review Board Human Research & Compliance (IRB # 5200255), and the need for consent was waived due to the nature of the study as a retrospective chart review. The authors performed retrospective review of the medical records of all patients who underwent short segment ACDF at a single tertiary referral center from 2013 to 2018. A *priori* power analysis was performed with an estimated effect size of 0.5, power threshold of 0.8, and alpha of 0.05, the sample size estimates included 14 patients per opiate use group. Inclusion criteria were patients aged 17 years and above undergoing primary one to two level ACDF as an elective procedure for cervical spondylotic disease (*Figure 1*). Exclusion criteria were: acute cervical trauma (fracture or instability), polytrauma, infection, cervical neoplasm, concurrent procedures such as posterior cervical fusion, history of previous cervical fusion, extension of fusion into occiput or thoracic spine, and fusion of 3 or more levels. The patients were then divided into three categories: opiate naive (ON) for patients with no history of opiate use, acute opiate (AO) use for patients with less than 6 months of pre-operative opiate use, and chronic opiate (CO) use for those who used opiates for more than 6 months before surgery. Patients' prescription records were then reviewed to convert opiate type and dosing into milligram morphine equivalents per day (MME/day) according to the opioid dose conversion table made available by the Centers for Disease Control and Prevention (15). Patient information collected before surgery also included smoking status, American Society of Anesthesiologists (ASA) physical status classification, and demographic information. Data collection also included: rates of reoperation within 2 years of surgery, rates of ED visits in 6 months, rates of readmission in the first 30 days postoperatively, 31–90 days postoperatively, and 90-days to 1 year postoperatively, operative times, length of stay, intraoperative blood loss, need for transfusion, and postoperative opiate use at 0–6 months after surgery and

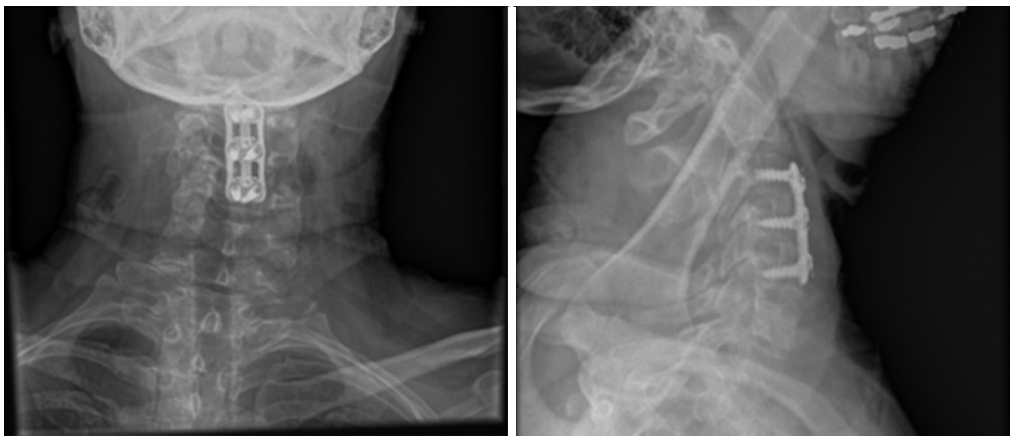

Figure 1 Postoperative radiographs consistent with 2 level anterior cervical decompression and fusion.

6–12 months after surgery.

Patients were also divided based on their smoking history into the following groups: as non smokers, former smokers, and active smokers. Rates of reoperation, ER visits, and readmission was assessed for these respective groups as well.

Statistical analysis

Student's *t*-test or Mann-Whitney U test were used as appropriate for comparison of continuous variables. Chi-squared analysis was used for comparison of categorical variables. Data collection and visualization was performed using Microsoft Excel version 16.45 (Microsoft Corporation, 2017, Redmond, WA, USA). SPSS version 27 (IBM Corporation, 2020, Armonk, NY, USA) was utilized for all subsequent statistical analyses. Alpha was set at 0.05 *a priori*.

Results

Study group characteristics

Initial review of patient data yielded 270 patients who met inclusion criteria by undergoing ACDF between 2013 and 2018. Of the 270 patients, 72 patients were excluded due to posterior fusion, C-spine fracture, acute trauma, neoplasm, fusion spanning more than two levels, fusion extending to thoracic spine or skull. A total of 198 patients were included in the study. Of the 198 patients, 102 patients were opiate naive, 66 patients used opiates for less than 6 months prior to surgery, and 30 patients used opiates for greater than 6 months prior to surgery.

Demographics

The average age at time of surgery for all patients was 55.6 (range: 17–93, SD: 12.17). Overall, 88 patients were male while 110 patients were female. Average BMI for all patient groups was 29.8 (range: 16.33–67.5, SD: 6.61). Out of 198 patients, 5 patients were ASA 1, 110 patients were ASA 2, 77 patients were ASA 3, and 6 patients were ASA 4. There was no statistically significant difference in distribution of patients of ON, AO, and CO groups across different ASA classifications (P value >0.5, *Table 1*). Eighty-six patients underwent one level fusion while 112 patients underwent two level fusion. Ninety-four patients were nonsmokers, 63 patients were former smokers at time of surgery, 41 patients were active smokers at time of surgery. One hundred sixty-two patients identified as white or Caucasian, 22 patients as Hispanic, 8 patients as black, and 6 patients as other (*Table 1*).

Impact of preoperative opioid use on reoperation rates

Overall 2-year reoperation rate (RR) was 5.1% amongst all groups. When separating into first postoperative 30-day, 31- to 90-day, and 91-day to 2-year postoperative time intervals the overall RR was 2.0%, 1.0%, and 2.0% respectively.

Reoperation rate between naive, acute, and chronic opiate users was 2.0%, 1.5%, and 0% in the 30-day time interval, 0%, 1.5%, and 3.0% in the 31- to 90-day time interval, and 2.0%, 1.5%, and 3.0% in the 91-day to 2-year postoperative time interval respectively (P>0.05, *Table 2*).

Causes of reoperation were stenosis (4, 40%),

Table 1 Demographics

Variable	Opiate naive	Acute opiate use	Chronic opiate use	P value
Mean age at surgery (SD)	56.13 (12.44)	55.92 (12.66)	53.73 (10.16)	0.630
Gender, n (%)				
Male	51 (50.0)	28 (42.4)	9 (30.0)	0.141
Female	51 (50.0)	38 (57.6)	21 (70.0)	
BMI, mean (SD)	30.17 (5.73)	29.61 (7.62)	28.89 (7.08)	0.625
ASA classification, n (%)				
1	3 (2.9)	1 (1.5)	1 (3.3)	0.917
2	54 (52.9)	39 (59.1)	17 (56.7)	
3	41 (40.2)	24 (36.4)	12 (40.0)	
4	4 (3.9)	2 (3.0)	0 (0.0)	
Levels, n (%)				
One level	46 (45.1)	31 (47.0)	9 (30.0)	0.265
Two levels	56 (54.9)	35 (53.0)	21 (70.0)	
Smoking history, n (%)				
No smoking history	54 (52.9)	29 (43.9)	11 (36.7)	0.551
Former smokers	29 (28.4)	22 (33.3)	12 (40.0)	
Active smokers	19 (18.6)	15 (22.7)	7 (23.3)	
Ethnicity, n (%)				
White	86 (84.3)	53 (80.3)	23 (76.7)	0.910
Hispanic	11 (10.8)	7 (10.6)	4 (13.3)	
African American	3 (2.9)	3 (4.5)	2 (6.7)	
Other	2 (2.0)	3 (4.5)	1 (3.3)	

BMI, body mass index; SD, standard deviation.

Table 2 Reoperation rates

Reoperation situation	Opiate naive (%)	Acute opiate use (%)	Chronic opiate use (%)	P value
No reoperation	98 (95.9)	62 (95.4)	28 (90.9)	0.811
Reoperation first 30 days	2 (2.0)	2 (1.5)	0 (0.0)	
Reoperation 31–90 days	0 (0.0)	1 (1.5)	1 (3.0)	
Reoperation 91 days to 2 years	2 (2.0)	1 (1.5)	1 (3.0)	

pseudoarthrosis (3, 30%), hardware migration (1, 10%), hematoma evacuation (1, 10%), and combination of both pseudoarthrosis and hardware migration (1, 10%). After adjusting for confounders, there was no association between opioid groups and reoperation rates.

ER visits

Rates of ER visits within 6 months after surgery between opiate naive, acute opiate users, and chronic opiate users were 14.7%, 9.1%, and 20% respectively (P value 0.32). Causes of ER visits included pain (5, 18.5%), dysphagia

Table 3 Opiate usage *vs.* readmission rates

Readmission situation	Opiate naive (%)	Acute opiate use (%)	Chronic opiate use (%)	P value
30 days readmission	4 (3.9)	2 (3.0)	0 (0)	0.497
31 to 90 days readmission	4 (3.9)	2 (3.0)	2 (6.7)	0.763
91 days to 1 year readmission	2 (2.0)	2 (3.0)	7 (23.3)	0.001

Table 4 Causes for readmission

Cause	Opiate naive (%)	Acute opiate use (%)	Chronic opiate use (%)	Total
No readmission	92 (90.2)	60 (90.9)	21 (70.0)	173
Readmission related to ACDF				9
Posterior cervical surgery	2 (2.0)	1 (1.5)	2 (6.7)	
Dysphagia	1 (0.98)	1 (1.5)	0 (0)	
Surgical site infection	1 (0.98)	0 (0)	0 (0)	
Hematoma	1 (0.98)	0 (0)	0 (0)	
Readmission unrelated to ACDF				16
Lumbar surgery	4 (3.9)	1 (1.5)	0 (0)	
Other surgeries	0 (0.0)	2 (3.0)	3 (10)	
Fall	0 (0.0)	0 (0)	2 (6.7)	
Suicide attempt	0 (0.0)	0 (0)	1 (3.3)	
TIA	1 (0.98)	0 (0)	1 (3.3)	
Gastroparesis	0 (0.0)	1 (1.5)	0 (0)	

ACDF, anterior cervical discectomy and fusion; TIA, transient ischemic attack.

(3, 11.1%), infection (3, 11.1%), fall (2, 7.4%), constipation (2, 7.4%), hematoma at surgical site (1, 3.7%), COPD (1, 3.7%), leg edema (1, 3.7%), allergic reaction (1, 3.7%), cellulitis (1, 3.7%), unilateral mydriasis (1, 3.7%), pharyngitis (1, 3.7%), back spasm (1, 3.7%), peripheral neuropathy (1, 3.7%), generalized weakness (1, 3.7%), chest pain(1, 3.7%), and nausea (1, 3.7%).

Rates of readmission

Overall readmission rate (RaR) was 12.6% across all groups at 1-year follow up. Of all readmissions, 36% were directly related to the ACDF and 64% were unrelated. Total readmission rate between naive, acute, and chronic opiate users was 3.9%, 3.0%, and 0% (P>0.05) in the 30-days time interval, 3.9%, 3.0%, and 6.7% (P>0.05) in the 31 to 90-days time interval, and 2.0%, 3.0%, and 23.3% (P<0.05) in the 91-days to 1-year postoperative time interval respectively (*Table 3*). Rate of readmissions with direct relationship to index ADCF surgery between naive, acute, and chronic opiate users was 4.9%, 3%, and 6.7% within the 1 year postoperative period (P>0.05).

Causes of readmission directly related to ACDF were subsequent cervical spine surgery (5, 20%), dysphagia (2, 8%), surgical site infection (1, 4%), surgical site hematoma (1, 4%). Causes of readmission unrelated to ACDF were subsequent lumbar spine surgeries (5, 20%), unrelated non spine surgeries (5, 20%), fall (2, 8%), suspected transient ischemic attack (2, 8%), gastroparesis (1, 4%), and suicidal intent (1, 4%, *Table 4*).

Postoperative opiate use

Average daily postoperative opiate use measured in MME at 0–6 months were 92.67 for opiate naive patients, 89.64 for acute opiate users, and 90.87 for chronic opiate users

Table 5 Opiate usage and post op 6–12 months MME

Variable	Opiate naive	Acute opiate use	Chronic opiate use	P value
MME/day 6–12 months post op	5.76	18.44	39.92	<0.05

MME, milligram morphine equivalents.

Table 6 Opiate usage and postop 6–12 months MME excluding other causes of opiate prescription

Variable	Opiate naive	Acute opiate use	Chronic opiate use	P value
MME/day 6–12 months post op	3.06	16.46	37.96	<0.05

MME, milligram morphine equivalents.

(P value >0.05). Average daily post-operative opiate use in MMEs at 6–12 months were 5.76 for opiate naive patients, 18.44 for acute opiate users, and 39.92 for chronic opiate users (P value <0.05, *Table 5*).

A separate analysis excluded 10 patients out of 198 patients who were prescribed opiate medications for reasons due to unrelated surgeries or admissions. In this subgroup of 188 patients, average daily postoperative opiate use measured in MME at 0–6 months were 92.47 for opiate naive patients, 86.29 for acute opiate users, and 92 for chronic opiate users (P value >0.05). Average daily post-operative opiate use in MMEs at 6–12 months were 3.06 for opiate naive patients, 16.46 for acute opiate users, and 37.96 for chronic opiate users (P value <0.05, *Table 6*).

Operative times

Average operative times were 139.7 minutes (SD: 43.07) for opiate naive patients, 135.9 minutes (SD: 54.30) for acute opiate users, and 130.9 minutes (SD 57.66) for chronic opiate users (P value 0.668).

Length of stay

Average length of stay was 2.1 days (SD: 2.55) for opiate naive group, 1.7 days (SD: 2.96) for acute opiate group, and 1.9 days (SD: 1.27) for chronic opiate group (P value 0.587).

Blood loss and transfusions

Average intraoperative blood loss was 28.28 mL (SD: 36.51) for opiate naive patients, 29.17 mL (55.90) for acute opiate patients, and 71.83 mL (SD: 204.81) for chronic opiate patients (P value =0.053, *Table 7*). However, no patients included in the study required blood transfusion during ACDF surgeries.

Smoking and reoperations

Reoperation rate between nonsmokers, former smokers, and active smokers was 2.1%, 3.2%, and 0% (P>0.529) in the 30-days time interval, 1.1%, 0%, and 2.4% (P>0.476) in the 31- to 90-day time interval, and 1.1%, 3.2%, and 4.9% (P>0.397) in the 91-day to 1-year postoperative time interval respectively.

Smoking and ER visits

Rate of ER visits within 6 months of ACDF surgery was 12.8% for nonsmokers, 15.9% for former smokers, and 12.2% for active smokers (P value =0.819).

Smoking and readmissions

Readmission rate between nonsmokers, former smokers, and active smokers was 2.1%, 5.0%, and 2.5% (P>0.05) in the 30-days time interval, 4.4%, 0%, and 10.8% (P value =0.047) in the 31- to 90-day time interval, and 1.1%, 14.5%, and 4.9% (P value =0.008) in the 91-day to 1-year postoperative time interval respectively (*Table 8*).

Discussion

Recent literature suggests that preoperative opiate use is associated with poor post-surgical outcomes across multiple specialties including spine surgery (11-14,16). Specifically, our study group previously found a direct relationship between preoperative opiate use and increased rates of reoperation and readmission in 93 patients undergoing 1–2 level posterior lumbar fusion from 2013–2017 (16). In this study we set out to assess if there is a similar finding in patients undergoing ACDF, employing the same definition of CO and AO as more or less than 6 months of preoperative opiate use and involving patients of similar demographics, surgeons, and similar study timeline as the previous lumbar fusion study. The secondary objective was to establish a relationship between other preoperative risk factors and other measures of surgical outcome such as smoking and readmissions.

Table 7 Opiate usage and intraoperative blood loss

Variable	Opiate naive	Acute opiate use	Chronic opiate use	P value
Blood loss in mL (std)	28.28 (36.51)	29.17 (55.90)	71.83 (204.81)	0.053

std, standard deviation; mL, milliliters.

Table 8 Smoking *vs.* readmission rates

Variable	Nonsmoker (%)	Former smoker (%)	Active smoker (%)	P value
No readmission	87 (91.5)	52 (79.4)	34 (75.6)	
30 day readmission	2 (2.1)	3 (5.0)	1 (2.5)	0.621
31 to 90 day readmission	4 (4.4)	0 (0.0)	4 (10.8)	0.047
91 day to 1 year	1 (1.1)	8 (14.5)	2 (4.9)	0.008

There was no statistical difference in distribution of patients from ON, AO, and CO groups in different ASA classifications (P value =0.917). Also, ASA score did not appear to directly influence narcotic utilization. This is consistent with the findings of Yoo *et al.* who evaluated inpatient narcotic utilization after ACDF based on ASA score and found that ASA was not an independent risk factor for postoperative narcotic consumption (17). The American Society of Anesthesiologists (ASA) classification was introduced in 1941 as an instrument to help assess the overall health status and comorbidities of patients before surgery (18-20). The initial goal of the classification was to predict postoperative complications, although currently it is also used to evaluate perioperative risk (21). The ASA classification has been found to be a reliable predictor of adverse postoperative events in patients undergoing ACDF and lumbar fusion (22,23). In the current study, ASA score did not have any statistically significant association with readmission or reoperation rates.

After surgery, average daily post-operative opiate use at 0–6 months were 92.67 MME for opiate naive patients, 89.64 MME for acute opiate users, and 90.87 MME for chronic opiate users (P value =0.957). Average daily opiate use at 6–12 months post-surgery were 5.76 MME for opiate naive patients, 18.44 MME for acute opiate users, and 39.92 MME for chronic opiate users (P value =0.00002). These results suggest that while it is typical for all patients to be prescribed similar amounts of opiates in the immediate postoperative setting to control for acute pain, patients with history of preoperative opiate use continue to require significantly more opiates for pain control at 6 months and beyond when surgical pain from ACDF is expected to have decreased. Similar findings have been reported in the literature as patients undergoing cervical spine surgery including ACDF are known to be more likely to require opiates long after surgery if they have a history of preoperative opiate use (24,25). A possible explanation may be that patients who use opiates prior to ACDF have more severe cervical pathology that is difficult to treat. However, research by Rosenthal *et al.*, suggest that preoperative opiate use is linked to increased postoperative opiate use even in surgeries unrelated to spine such as arthroplasty and that trends in postoperative opiate use is more related to nociception altering and addictive properties of opiates itself (26,27). When considering patients with history of opiate use prior to ACDF, spine surgeons should advise patients of possible lack of pain relief with surgery and the subsequent requirement for long term opiate use post-surgery.

Patients in the chronic opioid group had a 23.3% readmission rate in the 91-day to 1-year postoperative time interval (P=0.001). At time of ACDF, patients of differing preoperative opiate use history seemed to be in similar state of health as there was no significant difference in distribution of patients across different ASA classifications. A previously suggested mechanism by which opiate medications affect postoperative recovery include inhibition of angiogenesis and immune response with subsequent suppression of wound healing (28,29). Also, opiate induced hyperalgesia may cause the patient to be less eager to participate in necessary rehabilitation activities and dressing changes (30). However, because statistical significance between chronic opiate use and admissions can be maintained for admissions of all causes but not for admissions directly ACDF, it is difficult to

credit solely surgical complications as explanation for the trends seen in admissions. Rather, the tendency of opiate tolerant patients to continue to use opiates long after ACDF as discussed above may explain how such patients have a more complicated post-surgical course as well. Opiate medications affect more than pain transmission, also affecting gastrointestinal motility, immunity, cognition, and the reward pathway through addiction (10,16,31). As patients who used opiates prior to ACDF continue to use opiates after surgery, the opiate dependent population may go on to develop more medical issues requiring inpatient treatment.

In addition to preoperative opiate use, smoking history was shown to be associated with increased readmissions following ACDF. In the current study, active smokers had a 10.8% readmission rate during the 31- to 90-day postoperative time interval (P=0.047). Active and former smokers had a 2.5% and 14.5% readmission rate during the 91-day to 1 year postoperative interval (P=0.004). While tobacco use has been previously shown to be associated with suboptimal outcomes following spine fusion surgery in the form of pseudoarthrosis or other major complications, such findings are not limited to spinal surgery (32,33). Even in cases of bariatric surgery, smoking is associated with increased readmission rates in 30 days (34). In addition to the effect of smoking on wound healing, smoking is associated with change in pain perception and substance abuse including opiates (35,36). Patients with a history of smoking are therefore at increased risk of readmission following ACDF due to complicated post-operative recovery, comorbidities associated with smoking, and an overlap of deleterious effects seen with opioids.

Average blood loss during ACDF was 28.3 mL for opiate naive patients, 29.2 mL for acute opiate users, and 71.8 mL for chronic opiate users (P value =0.053). Although this relationship technically did not reach statistical significance, it is noteworthy that patients with a history of chronic opiate use tended to have higher intraoperative blood loss during surgery. Although there is literature reporting a negative effect of opioids on blood rheology, there has been no association between opioids and increased bleeding (37,38). Despite the seemingly increased blood loss for chronic opiate patients, no patients in the study required transfusions.

Limitations

The limitations of this study include lack of outcome measures such as: preoperative or postoperative function, VAS or NDI scores as preoperative opiate use may have caused differences in pain relief or function despite similar rates of ED visits or reoperations. However, there is inconsistency in data collected by operating surgeons following surgery to gauge improvement of pain. The goal of this study was to collect objective and measurable outcome measures more than subjective measures. Also, study data relies upon accurate entry of outcomes by numerous clinicians in the medical record. Opiate use was determined based on prescribed dosages and it is difficult to determine the actual amount of opiates consumed by patients in a non hospital setting. This finding is consistent with all studies quantifying opiate consumption. Patients may have received opiates from providers not listed within the study institution, as noted in the pre-CURES era. Patients may have obtained opiates from family members or friends, known as diversion. On the opposite spectrum, patients who were prescribed opiates may not have necessarily filled their prescription if their pain was well controlled on a non-opiate pain regimen.

Conclusions

Preoperative opiate use is associated with increased opiate use 6–12 months after short segment ACDF surgery. Chronic opiate use was associated with higher readmission rates within 1 year after surgery. Smoking history is also associated with increased readmission rates. As ACDF is increasingly considered by surgeons and insurance companies to be a surgery done in the outpatient setting or associated with short hospital stays, there is an increasing push from insurance companies for bundled payments. Therefore, readmission of patients who undergo ACDF has implications on healthcare costs and insurance reimbursements. Spine surgeons considering ACDF surgery, even short segment surgery on patients with a history of chronic opiate or tobacco use should be mindful of increased risk of readmissions and continued postoperative opiate use.

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Footnote

Reporting Checklist: The authors have completed the

STROBE reporting checklist. Available at https://jss.amegroups.com/article/view/10.21037/jss-21-126/rc

Data Sharing Statement: Available at https://jss.amegroups.com/article/view/10.21037/jss-21-126/dss

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://jss.amegroups.com/article/view/10.21037/jss-21-126/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The project was approved by LLUH Institutional Review Board Human Research & Compliance (IRB # 5200255), and the need for consent was waived due to the nature of the study as a retrospective chart review.

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