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Chronic Opioid Usage in Surgical Patients in a Large Academic Center

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Abstract

Objective—The objective of this study is to investigate the prevalence and disparity of chronic opioid usage in surgical patients and the potential risk factors associated with chronic opioid usage.

Background—Chronic opioid usage is common in surgical patients; however, the characteristics of opioid usage in surgical patients is unclear. In this study, we hypothesize that the prevalence of chronic opioid usage in surgical patients is high, and that significant disparities may exist among different surgical populations.

Methods—Data of opioid usage in outpatients among different surgical services were extracted from the electronic medical record database. Patient demographics, clinical characteristics of sex, age, race, body mass index (BMI), specialty visited, duration of opioid use, and opioid type were collected. Chronic opioid users were defined as patients who had been recorded as taking opioids for at least 90 days determined by the first and last visit dates under opioid usage during the investigation.

Results—There were 79,123 patients included in this study. The average prevalence is 9.2%, ranging from 4.4% to 23.8% among various specialties. The prevalence in orthopedics (23.8%), neurosurgery (18.7%), and gastrointestinal surgery (14.4%) ranked in the top three subspecialties. Major factors influencing chronic opioid use include age, Ethnicity, Subspecialty, and multiple

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specialty visits. Approximately 75% of chronic users took opioids that belong to the category II Drug Enforcement Administration classification.

Conclusions—Overall prevalence of chronic opioid usage in surgical patients is high with widespread disparity among different sex, age, ethnicity, BMI, and subspecialty groups. Information obtained from this study provides clues to reduce chronic opioid usage in surgical patients.

Keywords

chronic; opioids; prevalence; risk factor; surgical patients

During the last decade, the use of opioids for pain management has dramatically increased. Sales and distribution of opioids in the United States have increased nearly 4-fold between 1997 and 2010 to 710 mg morphine equivalents per person.¹ Opioid dependence among patients being treated was reported to be as high as 26% in 2006.² In 2008 opioids were implicated in 14,800 deaths in the United States, a 300% increase over 1 decade.³ The total cost of nonmedical use of prescription opioids was estimated to be \$53.4 billion in 2006.⁴ The emerging opioid crisis demands clinician and government action.

Over 100 million surgical procedures are performed annually in the United States. In 2010, 51.4 million inpatient procedures were performed in the United States;⁵ another 53.3 million procedures were performed during ambulatory surgical visits.⁶ Approximately 98.6% of these surgical patients received opioids during hospitalization.⁷ The occurrence of chronic postsurgical pain varied from 10% to 50% depending on the type of operation.⁸ A recent Canadian study demonstrated that 7.7% of opioid-naïve elderly patients were still on opioids a year subsequent to surgery.⁹ The clinical epidemiology of chronic opioid usage in surgical patients is not well characterized. As opioid usage is common in the perioperative period and many patients have surgery because they are suffering with pain, we hypothesized that the prevalence of chronic opioid usage in surgical patients is high, and that associated factors may be identified through existing databases. Thus, the major aims of our study are to determine the prevalence and characteristics of chronic opioid usage in surgical patients over a 2-year period in a large medical center.

Methods

This investigation protocol was approved and the written informed consent was waived by the Institutional Review Board of the University of Pennsylvania.

In this retrospective cross-sectional study, data from surgical patients' electronic medical records were extracted out of Clarity, an Epic analytical reporting database, using an SQL-driven crystal report at the University of Pennsylvania Health system. Data were cleaned using R statistical software. The inclusion criteria consisted of patients being 18 years or older, who had direct outpatient interaction with a surgical practitioner, and who received care at the University of Pennsylvania Medical Center from January 2010 to December 2011 at least twice with a minimum of 90 days between the patient's first and last visit. A chronic opiate user was defined as a subject who had been actively taking at least one medication

with a pharmaceutical subclass of “opioid agonists,” “opioid partial agonists,” and/or “opioid combinations” with a DEA (Drug Enforcement Administration) class code of “category-II high abuse potential” or “category -III moderate dependence” for at least 90 days. The 90-day time period was estimated as the time difference between the last visit date within the reporting period and the first recorded visit where a medical provider (nurse or physician) confirms the usage of opioid(s) for a patient. Patient's characteristics were collected, including sex, age, ethnicity, body mass index (BMI), and surgical specialty, and categorized into individual subgroups accordingly. BMI was categorized as underweight (<18.0), normal (18.0–24.9), overweight (25.0–29.9), or obese (≥30.0). There were 14 specialties included in this study: neurosurgery, dermatology, oncology, ophthalmology, urology, oral/maxillofacial, otorhinolaryngology, orthopedic, cardiac, gastrointestinal, plastic, thoracic, transplant, and vascular surgery. The number of visited specialties was defined as the number of specialties a patient had visited during the investigation period. The exclusion criteria include: (i) patients with age less than 18 years old; (ii) patients with only a single visit during the investigation period; (iii) patients with missing demographic data for age or sex or incomplete electronic records during the investigation period; (iv) patients with multiple visits, but whose visits span less than a 90 day time frame; (v) patients who visited OB/ GYN, Obstetrics, or Gynecology departments. Based on those criteria, 244,617 patients (75.6% of the database) were excluded from the data set before analysis.

Statistical Analysis

Data are presented as percentage or mean $\pm$ standard deviation. Age and BMI are calculated based on their value at a patient's first visit. When a patient visited multiple specialties, the patient is only counted once in the demographic summary. Distributions of chronic opioid user prevalence between specialties are based on patients who visited only one specialty. The distributions of patients in various demographic and clinical groups were summarized in numbers and frequencies. *T*-tests were used for comparing mean age and BMI, whereas Pearson χ^2 goodness-of-fit tests were used for comparing the distributions of categorical variables for chronic opioid users with nonchronic opioid users included in this study. Within each subgroup, the prevalence of chronic use was calculated as a percentage of the total surgical patients who were chronic users in that subgroup. The adjusted odds ratios (OR) with 95% confidence intervals (CI) were determined based on the methodology reported¹⁰ and a multivariate logistic regression with predictors of race, BMI group, age group, sex, and whether or not the patient had visited multiple specialties. *P* value less than 0.05 is considered statistically significant for hypothesis tests; a 95% CI which does not include 0 is considered significant for OR.

Results

There were 79,123 patients included in this study. Detailed demographics of surgical patients in these 2 years are listed in Table 1. The average prevalence of the chronic opioid usage in surgical patients is 9.2%. Females accounted for a slightly smaller proportion of the sample population than males; Caucasians and African Americans accounted for the majority of the total population. The mean age was 59.4 ± 14.9 years. The mean BMI was 29.0 ± 6.9 . Within the pool of patients classified as chronic opioid users, 73.8% were taking

at least one medication in the category of the “Highest abuse potential” Drug Enforcement Administration (DEA) code. The common opioid used chronically belongs to DEA II in surgical patients. Oxycodone was the most common one in DEA II. The characteristics of the chronic opioid users are presented in Table 2.

Significant disparities exist among various subspecialties, ranging from 4.4% to 23.8% among various specialties (Figure 1). The prevalence in orthopedics (23.8%), neurosurgery (18.7%), and gastrointestinal (GI) surgery (14.4%) ranked in the top three subspecialties (Figure 1). The prevalence in female patients (10.3%) is higher than that in male patients (8.3%, $P < 0.01$). Significant disparity also exists between various ethnicities (Figure 2, $P < 0.01$).

The higher prevalence of chronic opioid usage is commonly seen in the middle-aged patient group with the highest rate observed within the age group of 50 to 59 years (11.9%) (Figure 3). The prevalence of chronic opioid usage is higher in patients with abnormal BMI as compared with that in patients with normal BMI (Figure 4).

The adjusted OR was used to determine the importance of the potential factors associated with chronic opioid usage. The results are presented in Table 3. The data provided evidence that females [OR: 1.23 (1.16–1.30)] were more likely to be chronic users than males. Compared with Caucasians, African Americans [OR: 1.59 (1.49– 1.69)] and Hispanic Latinos [OR: 1.38 (1.11–1.70)] were associated with a higher likelihood of becoming chronic opioid users, but Asians [OR: 0.63 (0.48–0.82)] were less likely to be chronic opioid users. Having a BMI other than normal was found to be a factor in chronic opioid usage. The OR differed between age groups but generally indicated that middle-aged patients (patients between 30 and 69 years) were more likely to be chronic opioid users than these in other age groups. Patients who visited multiple specialties [OR: 1.84 (1.74–1.95)] at the hospital were associated with a higher OR than patients who visited only one specialty during the period.

Discussion

This study demonstrates high prevalence of chronic opioid usage in surgical patients with wide disparities across different subgroups. Characteristics of chronic opioid users were determined and some potential factors were identified.

In the current study, the prevalence of chronic opioid usage in surgical patients was 9.2%. A national survey during 1998 to 2006 indicated that opioids were used by 4.9% of the US adult population. The prevalence of regular opioid usage (defined as at least 5 days per week for at least 4 weeks) was around 2%.¹¹ Variance results from differences in subjects, length of opioid usage, and study period. Despite the longer duration for the definition of chronic opioid usage in the current study, the prevalence of chronic opioid usage in unspecified surgical patients was almost 5 times more than that in the general population. It is possible that such high prevalence could be because of the nature of the retrospective data retrieved from the electronic records, preexisting pain that warranted surgical intervention, or postoperative pain. The incidence of persistent postsurgical pain after various common

operations was 10% to 50%⁸ and of these patients, 18.3% reported moderate to severe persistent pain in the area of surgery for more than 3 months after surgery.¹²

A wide disparity in the prevalence of chronic opioid usage was observed between different subgroups. Such discovery could allow physicians to assess high risk factors for proper prevention and intervention.

Sex

The current study suggests female sex as a potential factor for chronic opioid usage in surgical patients, which is consistent with related reports.^{11,13,14} Studies on sex differences have found that females tend to report pain more frequently, possess pain of greater intensity, and exhibit more pain-related disability than males.^{15–17} It is known that estrogen affects pain processing,¹⁸ however, it is unclear whether or not estrogen affects opioid consumption and the behavior of opioid usage.

Age

The prevalence in different age groups is a reverse U-shaped distribution with the highest prevalence in the age range of 50 to 59 years. Across the elderly subgroups, except for the lower limbs, most regional pain declined with age. The overall prevalence of pain, however, did not decline.¹⁷ The distribution, metabolism, and excretion of several drugs are altered with progressing age. The elderly also suffer from more chronic health conditions in general, all of which can confound the prohibition/reduction of opioid usage. Given the higher risk of side effects or overdose, physicians may be reluctant to prescribe opioids to this population. The observation of decreased prevalence in the population over 60 years might result from conflicts between benefits and risks in pain management in the elderly.

Race/Ethnicity

The current study on surgical patients shows that African Americans had higher chance of chronic opioid usage when compared with Caucasians. Many previous studies have revealed ethnic disparities in pain and opioid prescription. While non-Hispanic Whites were associated with more opioid prescription and drug overdose than any other ethnicity, African Americans and Hispanics had higher scores of pain and received less opioid-related therapy.^{19–22} One possible explanation for this discrepancy is that ethnic variances in pain management may fluctuate within different environmental and social settings. The current study was carried out in the Philadelphia area, which has one of the highest densities of African American population in the United States. It is clear, though, that the Asian population has less prevalence of chronic opioid usage.

BMI

Chronic opioid usage is potentially associated with body habitus, especially in the underweight population. Patients with low BMI had higher prevalence of chronic opioid usage than patients with normal BMI. Although the mechanism of this association is unclear, severe surgical disease could be the potential cause. A prospective cohort study indicated that drug abuse was correlated with lower BMI.²³ Large increases in BMI over the

norm could lead to more chronic pain-related conditions, especially musculoskeletal pain.²⁴ Evidently, obese patients were more likely to use opioids chronically.

Subspecialties

The prevalence in different specialties varied from 4.4 % to 23.8%. The top three subspecialties to prescribe opioids were orthopedics, neurosurgery, and GI surgery by prevalence. As opioids are important medications in treating severe chronic pain, their prevalence should parallel the severity of pain related specialties. Musculoskeletal pain, especially of the lower back region, is a common chronic pain condition leading to orthopedics or neurosurgery visits.^{25,26} A retrospective study in an orthopedic clinic found that 66% of patients with a well-defined spinal diagnosis consumed opioids, with 38% of patients depending on opioids for more than 3 months.²⁷ Among the wide range of incidences related to persistent postsurgical pain, amputees experienced a high occurrence of phantom pain. Postsurgical pain was also frequently reported after operations on the back, extremities, and lung. Studies indicated that opioids were overprescribed (given excessive amounts than needed) after surgery in some populations, which may potentially lead to misuses and abuse.^{28,29} An analysis on chronic abdominal pain-related visits in outpatient clinics showed that whereas the prevalence of chronic abdominal pain decreased, opioid prescriptions more than doubled.³⁰ Opioids generally do not work well for gastrointestinal pain or ischemic pain in vascular surgery patients; however, their usage remains high in such populations; 14.4% in GI surgical patients and 9.7% in vascular surgical patients, as this study revealed. Further investigation is needed to reveal the causes and strategies to reduce opioid usage in such patient groups. Patients with end-stage renal disease commonly suffer from moderate or severe chronic pain;^{31–33} chronic use of opioids in this group was 10%, which was similar to the transplantation surgery subgroup (13%) in our study. Number of visits to different specialties seems to be an important factor of potential chronic opioid usage with an OR of 1.84 as indicated in Table 3.

The majority of opioids used chronically belong to DEA class II in surgical patients. Of these, oxycodone was the most common one in this class. It was also the most common opioid drug purchased by pharmacies because of its heavy medical usage during the past decade.³⁴ Consequently, it was reported to be involved in one third of opioid related deaths.³⁵ As a DEA III opioid, hydrocodone is used as a combination formula rather than as a single medication. The United States consumed 99% of the global hydrocodone supply in 2007. The prevalence of abuse and drug-poisoning deaths was just as pronounced as oxycodone.^{3,36} Potent opioid usage was reported to be associated with poor quality of life.³⁷ In contrast, users with less potent opioids had a lower rate of discontinuation.³⁸ It is unclear whether long-term use of opioids for chronic pain unrelated to cancer can improve quality of life or functioning.³⁹

This is the first study on chronic opioid usage that focuses on surgical patients with a sample population of 79,123 covering 13 specialties for 2 consecutive years. The penetrance of the study along with the extensiveness of the data allows us to identify significant disparity of chronic opioid usage among various subgroups of patients and some potentially important factors that may be related to chronic opioid usage. These discoveries are helpful to

clinicians, researchers, and policy makers in finding strategies to reduce chronic opioid usage without compromising proper pain management.

Several limitations should also be heeded: (1) The generalizability of these results may be limited as the study is only focused around a single medical facility. (2) This closed network study may overlook chronic users, who fill prescriptions or seek medical treatment, outside of the network; thus, the overall prevalence may be under-estimated. (3) It is unclear whether this prevalence is a preexisting issue, a postsurgery effect, or how it's modulated upon "successful" surgery. It is critical to reveal whether patients with chronic opioid usage coming for surgery for chronic pain stop or reduce the usage of opioids after a successful surgery. (4) In this retrospective study, data was retrieved from the electronic medical records. The "chronic user" label is granted based on information presented in the medical records. Errors may exist from the data obtained because the data may be affected by the accuracy/reliability of the report of opioid usage from the patient and the accuracy of documentation from the practitioner. However, such potential errors would not affect the subgroup comparison since all subgroups employed the same criteria/definition. (5) Although we have demonstrated the potential factors, no causal relationship is established nor can interventional strategy be depicted because of the nature of a retrospective study. (6) We were unable to address some of the factors, such as risk adjustment of groups.

Conclusions

The prevalence of chronic opioid use in surgical patients is high and data suggests that it differs with gender, age, ethnicity, BMI and subspecialties. While a higher prevalence of opioid usage is expected in orthopedics and neurosurgery, it is alarming that such high prevalence exists in certain subspecialties (i.e. GI and vascular surgery, etc.), since the efficacy of pain control by opioids in these areas is unclear and the majority of opioids have abuse potentials. Major factors potentially related to chronic opioid usage are, but not limited to, age (middle-aged), weight (underweight or obese) and ethnicity (i.e. African American). However, it is important to note that the potential factors may be incidental due to the limitation of the methodology used in this study.

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Figure 1. Prevalence of chronic opioid usage by specialty. Significant disparity on chronic opioid usage is revealed ($P < 0.001$). The top three subspecialties with high chronic opioid usage were orthopedics, neurosurgery, and GI surgery.

Figure 2.

Disparity in the prevalence of chronic opioid usage in various ethnicities. Significant disparity is revealed ($P < 0.001$). African American has the highest prevalence of opioid usage. Asians had the lowest prevalence.

Figure 3.
Prevalence in chronic opioid usage by age group ($P < 0.001$).

Figure 4.

The prevalence of chronic opioid usage is higher in patients with abnormal BMI as compared with that in patients with normal BMI (* $P < 0.001$). BMI was categorized as underweight (<18.0), normal (18.0 – 24.9), overweight (25.0 – 29.9), or obese (≥ 30.0). BMI indicates body mass index.

Table 1
Demographics of the Surgical Patients in 2010 and 2011

	Number	Percentage
Sex		
Male	41409	52.3
Female	37714	47.7
Race/Ethnicity		
White	50215	63.5
AfricanAmerican	20482	25.9
Hispanic/Latino	1098	1.4
Asian	1627	2.1
Others	3622	4.6
Age (yrs)		
Under 30	2798	3.5
30–39	4787	6.1
40–49	11765	14.9
50–59	19069	24.1
60–69	20521	25.9
70–79	13381	16.9
Over 80	6802	8.6
BMI		
Underweight	399	0.5
Normal	18871	23.9
Overweight	26152	33.1
Obese	7485	9.5
Unknown	26056	33.0
Specialty		
Single	49580	62.7
Multiple	29543	37.3
COU		
Yes	7303	9.2
No	71820	90.8

Others in race include American Indian, Pacific Island, and other unlisted minorities. BMI, body mass index, COU, chronic opioid user.

Table 2

Characteristics of COU and Non-COUs 2010–2011 (N = 7303)

	COU		Non-COU		χ^2 or <i>t</i> test for Comparing COU and Non-COU Groups
	Number	Percentage	Number	Percentage	
Age (yrs)					<i>P</i> < 0.0001
Mean ± SD	57.3 ± 13.1		59.6 ± 15.0		
18–29	144	2.0	2654	3.7	
30–39	475	6.5	4312	6.0	
40–49	1360	18.6	10405	14.5	
50–59	2268	31.1	16801	23.4	
60–69	1738	23.8	18783	26.2	
70–79	935	12.8	12446	17.3	
>80	383	5.2	6419	8.9	
BMI					<i>P</i> < 0.0001
Mean ± SD	23.1 ± 8.6		28.9 ± 8.8		
Normal	1744	23.9	17127	23.8	
Underweight	61	0.8	338	0.5	
Overweight	2941	40.3	23211	32.3	
Obese	1279	17.5	6206	8.6	
Unknown	1278	17.5	24938	34.7	
Sex					<i>P</i> < 0.0001
Male	3423	46.9	37985	52.9	
Female	3880	53.1	33833	47.1	
Race/Ethnicity					<i>P</i> < 0.0001
White	3937	53.9	46278	64.4	
African American	2867	39.3	17615	24.5	
Hispanic/Latino	133	1.8	965	1.3	
Asian	71	1.0	1556	2.2	
Other	214	2.9	3408	4.7	
Unknown	81	1.1	1998	2.8	
Number of specialties					<i>P</i> = 0.384

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	COU		Non-COU		χ^2 or <i>t</i> test for Comparing COU and Non-COU Groups
	Number	Percentage	Number	Percentage	
Single	4543	62.2	45037	62.7	
Multiple	2760	37.8	26783	37.3	
Duration of usage					
3–6 months	1727	23.6			
6 months–1 year	2105	28.8			
>1 year	3471	47.5			
DEA class code					
High abuse potential	5389	73.8			
Moderate dependence	1914	26.2			

BMI indicates body mass index; COU, chronic opioid user; DEA, drug enforcement agency.

Table 3**OR of Potential Factors**

	OR	95% CI (Lower Limit, Upper Limit)	P
Sex, vs. Male, reference			
Female	1.23	(1.16, 1.30)	<0.0001
Race/ethnicity, vs. White, reference			
African American	1.59	(1.49, 1.69)	<0.0001
Hispanic/Latino	1.38	(1.11, 1.70)	0.0026
Asian	0.63	(0.48, 0.82)	0.0008
Age, vs. 18–29, reference			
30–39	1.61	(1.29, 2.03)	<0.0001
40–49	2.01	(1.64, 2.48)	<0.0001
50–59	2.06	(1.69, 2.54)	<0.0001
60–69	1.42	(1.16, 2.03)	0.0007
70–79	1.14	(0.93, 1.42)	0.2147
>80	0.95	(0.75, 1.20)	0.6411
BMI, vs. Normal, reference			
Underweight	2.08	(1.57, 2.71)	<.0001
Overweight	1.12	(1.05, 1.20)	0.0006
Obese	1.38	(1.27, 1.50)	<0.0001
Specialty Visited, vs. Single, reference			
Multiple	1.84	(1.74, 1.95)	<0.0001

BMI indicates body mass index; CI, confidence interval; OR, odds ratio.