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The opioid epidemic in acute care surgery—characteristics of overprescribing following laparoscopic cholecystectomy

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Abstract

Background

Postoperative prescribing following acute care surgery must be optimized to limit excess opioids in circulation as misuse and diversion are frequently preceded by a prescription for acute pain. This study aimed to identify patient characteristics associated with higher opioid prescribing following laparoscopic cholecystectomy (LC).

Methods

Among patients age ≥18 years who underwent LC at a single institution 2014-2016, opioids prescribed at discharge were converted to oral morphine equivalents (OME) and compared to developing state guidelines (max 200 OME). Preoperative opioid use was defined as any opioid prescription 1-3 months before LC or a prescription unrelated to gallbladder disease <1 month before LC. Univariate and multivariable methods determined characteristics associated with top quartile opioid prescriptions among opioid-naïve patients.

Results

Of 1,606 LC patients, 34% had emergent procedures, and 14% were preoperative opioid users. Non-emergent LC patients were more likely to use opioids preoperatively (16% vs 11%, p=0.006), but median OME did not differ by preoperative opioid use (225 vs 219, p=0.40). Among 1,376 opioid-naïve patients, 96% received opioids at discharge. Median OME was 225 (IQR 150-300), and 52% were prescribed >200 OME. Top quartile prescriptions (≥300 OME) were associated with gallstone pancreatitis diagnosis, younger age, higher pain scores, and longer length of stay (all p<0.05). While median OME did not differ by emergent status (225, IQR 150-300 for both, p=0.15), emergent had more top quartile prescriptions (32% vs 25%, p=0.005). After adjusting for diagnosis, age, and sex, emergent status showed evidence of being associated with top quartile prescription (OR 1.3, 95% CI 1.0-1.8). Thirty-day refill rate was 5%.

Conclusions

Over half of opioid-naïve patients undergoing LC were prescribed opioids exceeding draft state guidelines. Variation in prescribing patterns was not fully explained by patient factors. Acute care surgeons have an opportunity to optimize prescribing practices with the ultimate goal of reducing opioid misuse.

Level of Evidence: Level 3 retrospective cohort study

Keywords: cholecystectomy; opioids; narcotics; emergent; pain

Background

The opioid epidemic continues to be a public health crisis in the United States. With dramatically increased opioid prescribing over the last two decades, it is essential to examine opioid prescribing following acute care surgical procedures. Opioids prescribed postoperatively can be a source for abuse and/or diversion,[1–4] and prolonged use of opioids increases the risk of an individual developing opioid dependence following an acute pain episode.[5] Recent studies have estimated that between 1% and13% of surgical patients who were opioid-naïve prior to a surgical encounter developed opioid dependence following the encounter.[6–10] Given the high risk of misuse and diversion associated with overprescribing, responsibility is increasingly falling to surgeons to prescribe judiciously in order to control pain but limit the number of unnecessary opioids provided to the patient.

Treatment from an acute care surgeon may be a patient's first exposure to opioids, and laparoscopic cholecystectomy (LC) is one of the most common procedures performed by acute care and general surgeons.[11] Over-prescribing following LC has been reported both by evaluating the amount of opioids prescribed[12] and the amount that went unused.[13] Prescriptions were compared to recent state guidelines and legislation limiting initial opioid prescriptions for acute pain to a maximum of 7 days or 200 oral morphine equivalents (OME).[12,14–16]

Two groups recently developed guidelines specific to LC for opioid-naïve patients[17,18]; however, no studies to date have taken into consideration the varying patient populations undergoing LC. LC is performed in both the emergent and non-emergent settings, and patients present for LC with indications ranging from functional to obstructive disorders and acute to chronic inflammatory states. Variation in prescribing by emergent status and indication for LC as well as additional patient and operative factors, including age, sex, patient-reported pain scores, length of stay (LOS), and Transverse Abdominis Plane (TAP) block use, is unknown. If patient and operative factors associated with opioid utilization are identified, guidelines could be tailored not only to specific procedures, but also to specific factors that affect postoperative pain management needs following a given procedure.

In this study we aimed to characterize opioid prescribing practices following emergent versus non-emergent LC and identify factors associated with high opioid prescribing that may inform opioid prescribing guidelines following LC.

Methods

Patients aged ≥18 years who underwent LC between January 1, 2014 and December 31, 2016 at a single institution were identified via retrospective review using Current Procedural Terminology, 4^{th} Edition (CPT-4) codes 47562 and 47563. Patients who had an intra-hospital transfer (n=17), underwent LC converted to open or another major surgical procedure during the same hospitalization (n=349), died in hospital (n=1), underwent partial/aborted cholecystectomy (n=4), or declined Minnesota research authorization (n=121) were excluded.

Emergent patients were identified as those who were admitted through the emergency department (ED), while those who were not admitted through the ED were identified as non-emergent. Administrative data were reviewed for patient demographics, diagnosis, regional anesthetic use (TAP block, identified by CPT-4 codes 64486 and 64488), maximum and last pain scores during the hospitalization, LOS, non-surgical readmissions within 30 days following discharge, and perioperative opioid prescriptions. Diagnoses associated with the cholecystectomy were recorded using the International Classification of Diseases, Ninth

Revision (ICD-9) and Tenth Revision (ICD-10), and patients were grouped as (1) gallstone pancreatitis, (2) common bile duct stone or obstruction (including cholangitis and patients with a CPT-4 code for Endoscopic Retrograde Cholangio-Pancreatography [ERCP]), (3) acute cholecystitis, (4) biliary colic (including functional gallbladder disease), and (5) other, including malignant neoplasm of gallbladder, polyps, or other gallbladder disease. Patients with any diagnosis during the cholecystectomy encounter that fell into one of the first four diagnosis categories were assigned to that diagnosis group hierarchically; all other patients were chart reviewed and assigned to a diagnosis group based on the combination of all diagnoses for their encounter. Functional gallbladder disease was included in the biliary colic group as this diagnosis is difficult to isolate based solely on the combination of ICD diagnosis and CPT procedure codes. Billing data at our institution do not enable us to differentiate between LOS of 0 days versus 1 day, so hospitalizations <1 day were represented as 1 day. LOS was assessed both as a continuous measure and as a dichotomous measure (>1 vs ≤1 day). Preoperative opioid use was defined as any opioid prescription 90-31 days before LC; patients with a prescription 30-1 days before LC but not an opioid prescription 90-31 days before LC were reviewed, and patients with an opioid prescription only for acute pain relating to their gallbladder pathology were not considered preoperative opioid users while patients with an opioid prescription for any other indication were considered to be preoperative opioid users.

The primary outcome was amount of opioids prescribed at discharge. Outpatient opioid prescriptions between the date of surgery and discharge date were considered as discharge opioid prescriptions and converted to OME. To compare to recent CDC and developing state guidelines for opioid prescribing for acute pain,[16,19] discharge prescriptions were dichotomized as >200 vs ≤200 OME. To further explore variation in high OMEs prescribed, discharge prescriptions were dichotomized as top quartile versus lower three quartiles among patients who were opioid-naïve. Refills were assessed as a secondary outcome and classified as prescriptions for opioids within 30 days following discharge; patients with a surgical procedure within 30 days following discharge were excluded from analysis of refills. Tramadol was included as a discharge opioid prescription.

Chi-square tests, Fisher's exact tests, t-tests, and Wilcoxon rank sum tests identified patient and operative factors associated with preoperative opioid use, emergent surgery, diagnosis, any discharge opioid prescription, top quartile prescriptions, and refills. Analysis including preoperative opioid users was limited to comparing opioid prescribing between preoperative users and opioid-naïve patients. Factors associated with emergent versus non-emergent surgery, diagnosis, top quartile prescriptions, and refills were evaluated among all opioid-naïve patients and separately within emergent and non-emergent opioid-naïve patients.

This work was approved by the Institutional Review Board. Analysis was completed using SAS version 9.4 (SAS Institute Inc., Cary NC), and p-values <0.05 were considered significant.

Results

From 2014 through 2016, 1,606 adults underwent LC at our institution and were eligible for inclusion. Mean age was 53.4 years (Standard Deviation [SD] 18.0), and 36.6% (n=588) were male. Approximately one third (34.4%, n=553) of procedures were emergent. The median LOS was 1 day (interquartile range [IQR] 1-1), and LOS was >1 day for 20.5% of patients (n=330). The most common indication was biliary colic, representing 51.1% of patients (n=821), followed by acute cholecystitis (n=509, 31.7%), common bile duct stone or obstruction (n=166, 10.3%), gallstone pancreatitis (n=83, 5.2%), and other indications (n=27, 1.7%).

Opioid-naïve patients vs preoperative opioid users

Among all patients, 94.3% (n=1,515) were prescribed opioids postoperatively, with a median OME of 225 (IQR 150-300) prescribed. Approximately one in seven patients (14.3%, n=230) was a preoperative opioid user. Non-emergent LC patients were more likely to use opioids preoperatively compared to emergent patients (16.0% vs 11.0%, p=0.006); however, sex, age, and diagnosis group did not differ among preoperative opioid users and opioid-naïve patients (all p>0.05).

Opioid-naïve patients were significantly more likely to be prescribed opioids than preoperative opioid users (95.8% vs 85.7%, p<0.001), but the median OME did not differ between opioid-naïve patients and preoperative opioid users (225 [IQR 150-300] vs 219 [IQR 125-300], p=0.40). The overall 30-day refill rate was 6.3%, with refills significantly more likely among preoperative opioid users (11.7% vs 5.4%, p<0.001).

Opioid-naïve patients

Among the 1,376 patients who were opioid-naïve (85.7%), distributions of age, sex, and diagnosis were similar to those observed in the full cohort. The median highest pain score recorded was 5 (IQR 3-7), while the median last pain score recorded before dismissal was 2 (IQR 1-4).

Almost all opioid-naïve patients (n=1,318, 95.8%) were prescribed opioids at discharge. Median OME was 225 (IQR 150-300), and 52.2% (n=718) were prescribed >200 OME. The top quartile of OMEs prescribed was ≥300 OME. The thirty-day refill rate was 5.4% (n=72).

Comparison of emergent vs non-emergent among opioid-naïve patients

Over one third of patients (n=492, 35.8%) underwent emergent LC. Diagnosis varied significantly between emergent versus non-emergent patients, where the most common indication among emergent patients was acute cholecystitis (n=301, 61.2%) while the most common indication among non-emergent patients was biliary colic (n=618, 69.9%), p<0.001. Emergent LC patients were younger (mean age 52.2 [SD 18.6] vs 54.3 [SD 17.4], p=0.04), more likely to have LOS >1 day (37.0% vs 12.0%, p<0.001), more likely to have a perioperative TAP block (26.4% vs 9.4%, p<0.001), and had higher maximum pain scores (median 6 [IQR 5-8] vs 4 [3-6], p<0.001). Last pain scores before discharge did not vary between emergent and non-emergent LC patients (median 2 [IQR 1-4] for both, p=0.40).

Patients who underwent emergent LC were less likely to have a discharge opioid prescription compared to non-emergent LC (93.7% vs 96.9%, p=0.004). While median OME did not differ between emergent and non-emergent LC patients (225 [IQR 150-300] for both, p=0.15), the former were more likely to have a top quartile prescription (32.3% vs 25.2%, p=0.005). (**Figure 1**) Refill rates were similar for emergent and non-emergent LC patients (5.4% vs 5.3%, p=0.94).

Variation by diagnosis among opioid-naïve patients

Among opioid-naïve patients likelihood of a top quartile prescription also varied by diagnosis group; patients with gallstone pancreatitis were most likely to receive a top quartile prescription (40.3%), followed by patients with "other" gallbladder-related diseases (36.4%), acute cholecystitis (30.9%), biliary colic (25.0%), and common bile duct stone or obstruction (24.2%), p=0.02. While patients with gallstone pancreatitis were most likely to receive a top quartile prescription, they were also most likely to receive no prescription for opioids at all (15.3% vs 0.0%-9.2% among other diagnosis groups, p<0.001). Maximum pain scores were highest among patients with gallstone pancreatitis, common bile duct stone or obstruction, and acute cholecystitis (p<0.001), but last pain score did not differ by diagnosis (p=0.42).

Variation by other factors among opioid-naïve patients

Other factors associated with a top quartile prescription included LOS >1 day, lack of perioperative TAP block, and age. Top quartile prescriptions were also associated with higher maximum pain score and higher last pain score prior to discharge. Refills did not significantly vary by top quartile prescriptions (5.1% among patients with top quartile prescriptions vs 5.4%, p=0.82).

Patients who were not prescribed opioids at discharge had a longer LOS (median 2 [IQR 1-4] vs 1 [1-1], p<0.001) and lower last pain score (median 2 [IQR1-3] vs 2 [1-4], p=0.004) compared to those with a discharge opioid prescription.

Multivariable analysis among opioid-naïve patients

After adjusting for age, sex, and diagnosis in a multivariable logistic regression model, emergent LC patients trended towards being more likely to receive a top quartile prescription (Odds Ratio [OR] 1.35, 95% Confidence Interval [CI] 1.00-1.82, p=0.050). A top quartile prescription was also more likely among younger patients (OR 1.29 age 18-49 vs ≥50 years, 95%

CI 1.01-1.66, p=0.04) and among patients with gallstone pancreatitis compared to acute cholecystitis (OR 1.69, 95% CI 1.00-2.86, p=0.049).

Stratified by emergent status for opioid-naïve patients

Upon analyzing patients who underwent emergent LC separately from non-emergent patients in order to assess factors associated with top quartile prescriptions isolated from differences in emergent versus non-emergent procedures, diagnosis group was not statistically significantly associated with a top quartile prescription in either group of patients. However, there is evidence of variation by diagnosis group, where patients with gallstone pancreatitis received the highest percentage of top quartile prescriptions among both ED patients (44.8%) and non-ED patients (37.2%). Last pain score and length of stay were not associated with top quartile prescriptions among either emergent patients or non-emergent patients (p>0.05); increasing highest pain score was associated with top quartile prescriptions among emergent patients (p=0.02) but not among non-emergent patients (p=0.50).

Refills among opioid-naïve patients

Among all opioid-naïve patients, higher pain scores during index hospitalization were significantly associated with refills within 30 days following discharge, where patients with a refill within 30 days following cholecystectomy had higher maximum pain scores (median 6.5 [IQR 5-8] vs 5 [3-7], p<0.001) and higher last pain scores (median 3 [IQR 2-5] vs 2 [1-4], p<0.001) during the index hospitalization compared to patients without a refill within 30 days following cholecystectomy. Likelihood of a refill was also significantly associated with diagnosis, where patients with gallstone pancreatitis were the most likely to have a refill (10.1%), followed by "other" gallbladder diseases (9.5%), acute cholecystitis (7.0%), biliary colic (4.6%), and common bile duct stone or obstruction (1.3%), p=0.02. While patients with a surgical procedure within 30 days following discharge were excluded from analysis of refills, refills were significantly associated with 30-day non-surgical readmission, where 34.1% of patients who were readmitted had a refill compared to only 4.4% of those without a readmission, p<0.001. Likelihood of a refill was not significantly associated with a perioperative TAP block compared to no TAP block (7.3% vs 5.0%, p=0.18) and did not significantly vary by length of stay (7.5% among those with LOS >1 day vs 4.8% for LOS of ≤1 day, p=0.08).

Discussion

This study characterizes opioid prescribing following LC by emergent status, diagnosis, and other patient and operative factors. Among opioid-naïve patients, higher opioid prescriptions were associated with emergent cases, gallstone pancreatitis, higher maximum and last pain scores, longer length of stay, and lack of perioperative TAP block use. However, this study also found variation in opioid prescribing that remains unexplained by patient and operative factors, pointing to continued opportunity for standardization in prescribing practices.

The majority of opioid-naïve patients (>95%) in our study were prescribed opioids following LC, and over half of patients were prescribed 225 or more OME, exceeding published guidelines and legislation. These findings are consistent with those of Hill and colleagues, which found an opioid prescription rate of 98.6% and a median prescription the equivalent of 30 5mg oxycodone pills (equivalent to 225 OME) prior to efforts to implement procedure-specific prescribing guidelines at their institution.[13,17] After developing and implementing guidelines for prescribing specific to LC (maximum prescription 112.5 OME), the authors observed a significant reduction in opioid prescribing following LC without an associated increase in refills, suggesting that there is opportunity for standardization and reduction in opioid prescribing following laparoscopic cholecystectomy at our institution. However, while these guidelines successfully reduced opioid prescribing following LC,[17] they did not address potential differences in postoperative analgesia needs by factors including emergent status, diagnosis, and pain scores. The present study provides an examination of variation in prescribing by these factors, which should inform tailoring of prescribing guidelines to ensure that individuals are not prescribed more opioids than required.

This study found that while the median OME did not differ between emergent and non-emergent LC patients, there was significant variation in prescribing among patients who received a high number of opioids. Among patients with prescriptions higher than the median, emergent LC patients had larger prescriptions compared to non-emergent patients. These results demonstrate an opportunity to standardize prescribing following emergent and non-emergent procedures and indicate the need to understand whether actual post-discharge opioid utilization differed between patients who underwent LC emergently versus not emergently.

The differences between opioid prescriptions following emergent and non-emergent LC may be explained partially by variation in underlying pathology. Patients with gallstone pancreatitis had the lowest rate of discharge opioid prescriptions but the highest rate of top quartile prescriptions and highest rate of refills overall. If actual utilization varies by diagnosis, existing procedure-specific guidelines should be tailored by indication, whereas if actual opioid utilization does not vary by diagnosis, surgeons should adhere to procedure-specific guidelines regardless of indication. While existing guidelines provide a starting point for standardizing and reducing opioid prescribing, further work needs to be done to understand variation in utilization of opioids and to provide prescribers with more guidance on appropriate prescribing practices.

Pain scores were also associated with top quartile prescribing. Among all opioid-naïve patients, higher maximum and last pain scores were associated with a top quartile prescription. However, among emergent patients alone, only the maximum pain score was associated with a higher likelihood of a top quartile prescription, while the last pain score during the hospitalization was not associated with a top quartile prescription among either emergent or non-emergent patients alone. This provides evidence that patients who had more pain in the hospital at any time are prescribed more opioids, irrespective of discharge pain levels. In an effort to reduce overprescribing, surgeons should tailor discharge prescriptions to the pain control needs of the patient at discharge rather than their pain over the whole course of their hospitalization.

Perioperative TAP blocks were more prevalent among emergent LC patients and were associated with lower discharge opioid prescriptions. This is consistent with recent research reporting a significant reduction in perioperative opioid consumption among patients with a TAP block during LC.[20] Furthermore, TAP blocks were not associated with increased refill rates in our study, which provides evidence that TAP blocks may provide a means to reduce opioid requirement after discharge. These findings are consistent with recent recommendations that emphasize the use of multimodal analgesia as a strategy for reducing opioid prescriptions.[21–24] The efficacy of TAP blocks in reducing the need for opioids upon discharge should be confirmed by prospective study.

Interestingly, this study found that opioid naïve patients were significantly more likely to receive a discharge opioid prescription compared to preoperative opioid users. We hypothesize that when writing the discharge prescription providers may account for opioids already available to the patient, and opioids were not prescribed for patients who already had a sufficient supply to manage their postoperative pain. Among opioid naïve patients, longer LOS and lower last pain scores were observed among those who did not receive a discharge opioid prescription, indicating that these patients may have had their pain more under control and did not necessitate an opioid prescription. Furthermore, while we were unable to assess the reason that patients were not prescribed opioids at discharge, anecdotally the most likely reason is that the patient declined opioids. Identifying patient populations who may not need any opioids at discharge is an important area for future work. A recent randomized clinical trial found that among patients admitted to the emergency department with acute extremity pain, a combination of ibuprofen and acetaminophen was as effective in short-term pain reduction as three other opioid and acetaminophen combination analgesics.[25] Similar research into the use of non-opioids to effectively treat pain in the surgical patient population is warranted.

The refill rate among opioid-naïve patients in our study (5.4%) was similar to the recently reported rate following LC (4.3%)[13] but less than half of the recently reported rate following open and laparoscopic cholecystectomy (11.3%).[26] We found that a lower initial prescription was not associated with a higher risk of a refill. This is consistent with another study of opioid-naïve postoperative patients which reported that refills after surgery were not associated with the initial amount prescribed but rather with patient factors including tobacco use, anxiety, mood disorders, and substance abuse disorders.[27] In contrast, Thiels and colleagues found that patients with a top quartile initial prescription was associated with a higher, not lower, risk of a refill in a study of 25 common surgical procedures at our institution.[12] Importantly, these findings provide evidence that lowering the initial prescription may not increase the risk of a refill.

The variation in opioid prescribing following LC points to the need for standardization in prescribing practices. Goals to standardize and reduce unnecessary prescribing must be balanced with the need to manage patients' pain. In order to satisfy both requirements, it is vital that surgeons engage in discussions with the patient prior to surgery both to set appropriate patient expectations for pain management and to understand patient preferences for postoperative analgesics.[14,21,22,24,28] Such discussions should include information on treatment options including non-opioid analgesics, potential risks of opioid use, pain management goals, and an assessment of factors that could increase the risk of opioid misuse or addiction, including medical and psychiatric comorbidities and current or past substance abuse.[11,21,22,24] Surgeons should engage with patients and caregivers postoperatively to ensure that they are educated on safe use of opioids, appropriate methods of disposal of unused narcotics, and a plan for safely tapering use of prescribed medications.[21,22] Education and training for surgeons is necessary for giving them the best tools to be able to fight the opioid epidemic at the point of administration of opioids to populations of opioid-naïve patients.

This study has several limitations. We were unable to determine the amount of opioids that were actually used after discharge or assess refills obtained outside of our institution, so this work focuses only on prescribing. Future work is required to assess the actual amount of opioids patients use following LC at our institution. Post-surgical opioid prescriptions are typically written by a resident, fellow, nurse practitioner, or physician assistant at our institution, but we were unable to account for who provided the prescription in our analysis. This study does not account for postoperative complications that may have affected discharge opioid prescribing or refills. Further, our institution serves as a referral center for a large geographic area and does not currently have electronic opioid prescribing. Notably this analysis does not account for distance traveled, which may influence prescribing practices due to concerns for patients being unable to return for a refill. Finally, while prescribing patterns found in our institution may not directly reflect other institutions' prescribing, this work highlights the importance of assessing prescribing patterns and developing guidelines and practices to standardize and optimize opioid prescribing using evidence based parameters. It may serve as a template for other institutions with acute care surgery practices to similarly evaluate their opioid prescribing.

Conclusion

In characterizing opioid prescribing following LC at a single institution, we found significant variation in discharge opioid prescriptions by emergent status, diagnosis, pain scores, length of stay, and use of perioperative TAP block. These results identify need for further assessment and refinement of procedure-specific guidelines for opioid prescribing following this common acute care surgical procedure in order to ensure optimal prescribing.

Author Contribution

Kristine T. Hanson – literature search, study design, data analysis, data interpretation, writing

Cornelius A. Thiels – literature search, study design, data interpretation, critical revision

Stephanie F. Polites – study design, data interpretation, critical revision

Halena M. Gazelka – critical revision

Mohamed D. Ray-Zack – data collection, critical revision

Martin D. Zielinski – study design, critical revision

Elizabeth B. Habermann – literature search, study design, critical revision

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Figure 1. Opioid oral morphine equivalents (OME) prescribed at discharge following emergent vs non-emergent laparoscopic cholecystectomy among opioid-naïve patients

Figure 2. Top quartile opioids by maximum and last pain scores

Figure 3. Multivariable logistic regression model of top quartile prescriptions among opioid-naïve patients. Abbreviations: odds ratio (OR), confidence interval (CI)

Figure 1

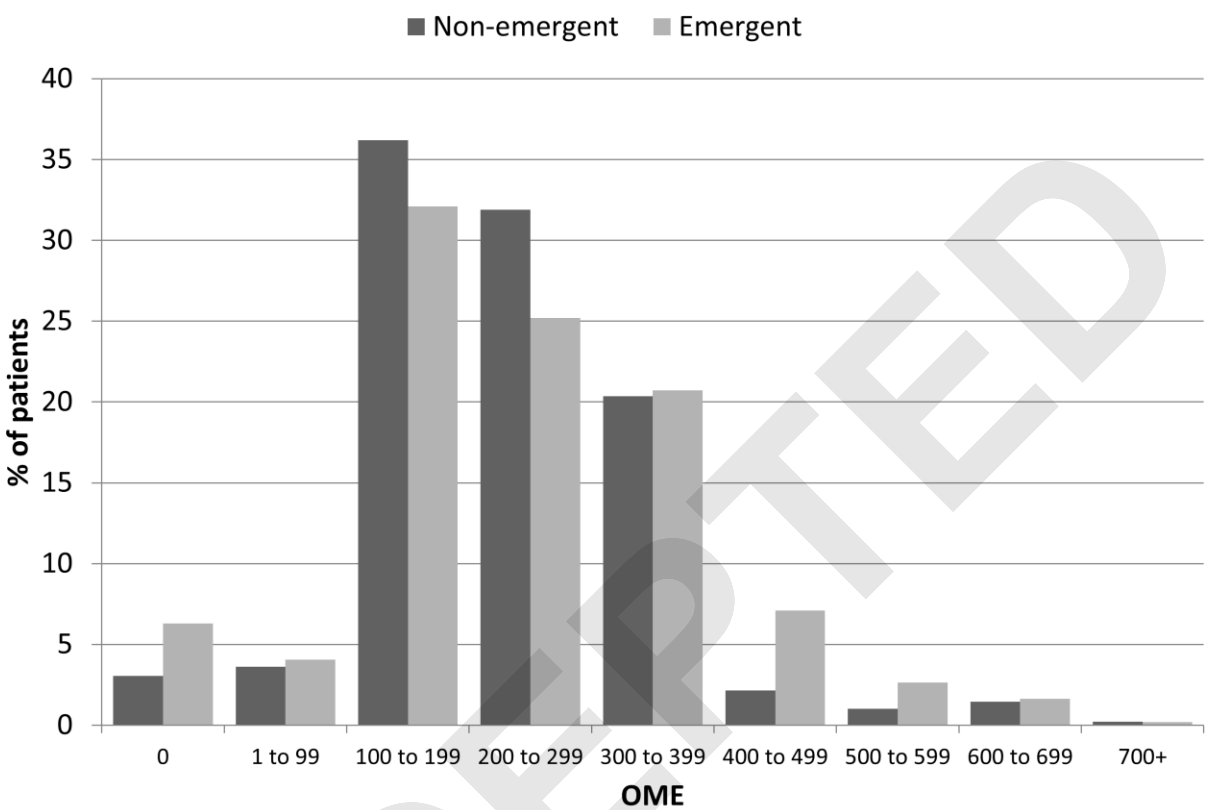

Non-emergent
Emergent
40
35
30
25
20
15
10
5
0
% of patients
0
1 to 99
100 to 199
200 to 299
300 to 399
400 to 499
500 to 599
600 to 699
700+
OME

Figure 2

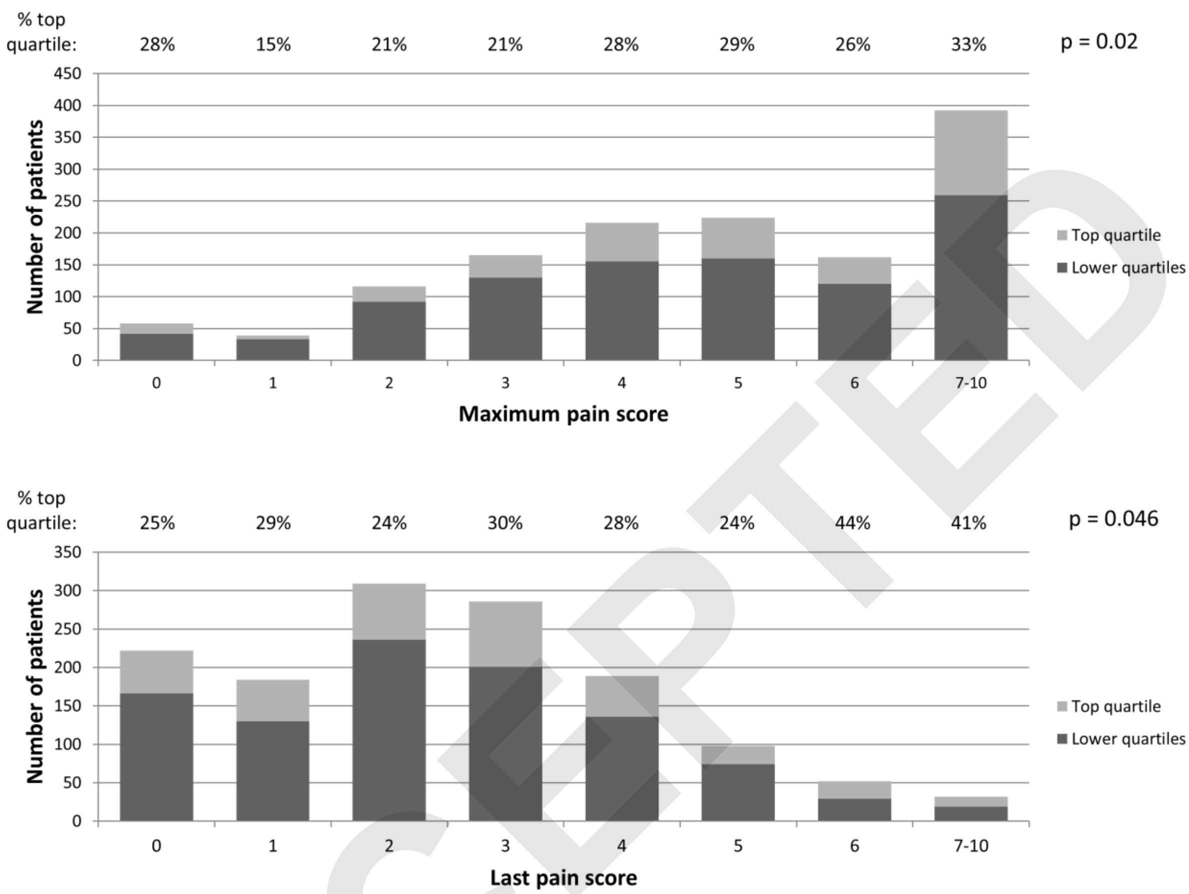
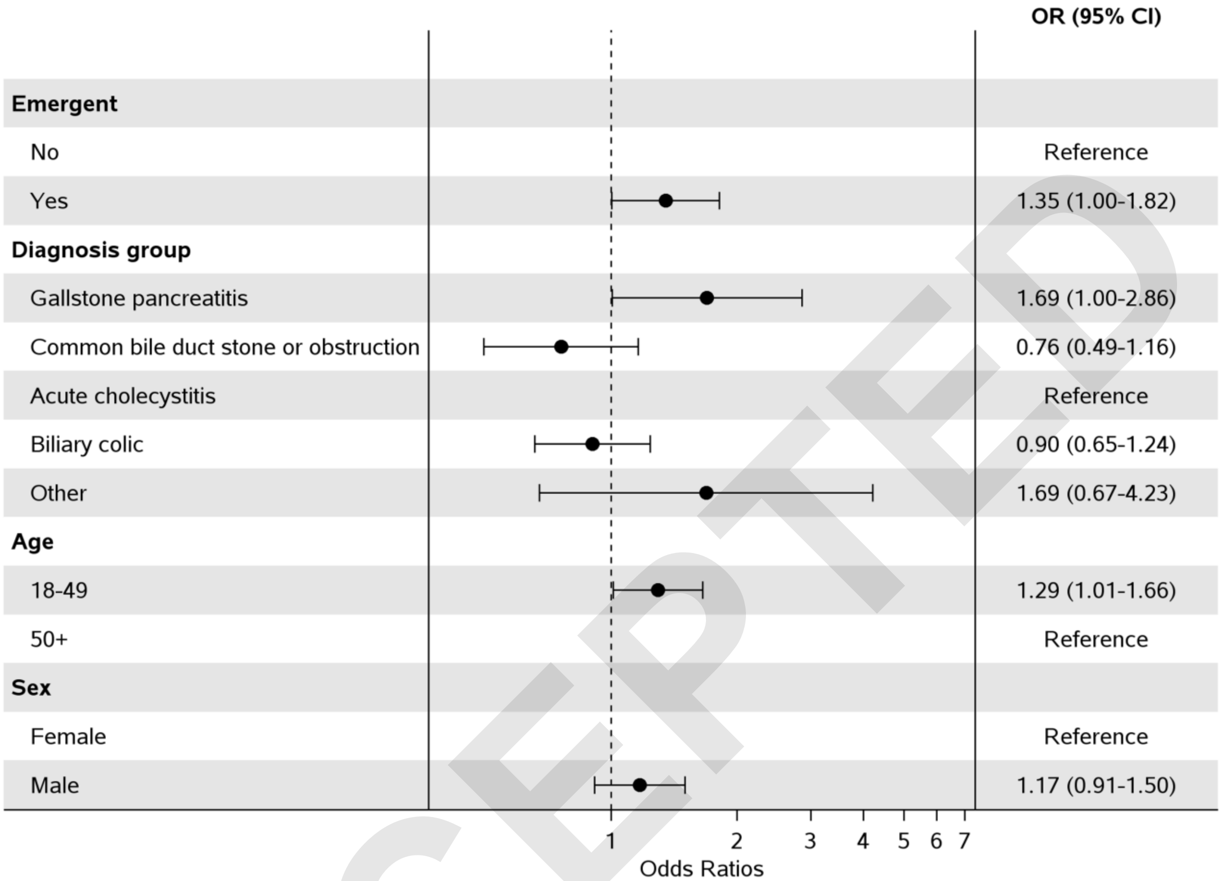

% top quartile:
28%
15%
21%
21%
28%
29%
26%
33%
p = 0.02
Number of patients
Top quartile
Lower quartiles
Maximum pain score
0
1
2
3
4
5
6
7-10
% top quartile:
25%
29%
24%
30%
28%
24%
44%
41%
p = 0.046
Number of patients
Top quartile
Lower quartiles
Last pain score

Figure 3



OR (95% CI)
Emergent
No
Reference
Yes
1.35 (1.00-1.82)
Diagnosis group
Gallstone pancreatitis
1.69 (1.00-2.86)
Common bile duct stone or obstruction
0.76 (0.49-1.16)
Acute cholecystitis
Reference
Biliary colic
0.90 (0.65-1.24)
Other
1.69 (0.67-4.23)
Age
18-49
1.29 (1.01-1.66)
50+
Reference
Sex
Female
Reference
Male
1.17 (0.91-1.50)
1
2
3
4
5
6
7
Odds Ratios

Table 1. Patient factors and opioid prescribing for emergent vs non-emergent opioid-naïve laparoscopic cholecystectomy patients. Values displayed are N (column %) unless otherwise specified.

	All (n=1376)	Non-emergent (n=884)	Emergent (n=492)	P-value
Patient factors				
Diagnosis group				<0.001
Gallstone pancreatitis	72 (5.2%)	43 (4.9%)	29 (5.9%)	
Common bile duct stone / obstruction	153 (11.1%)	68 (7.7%)	85 (17.3%)	
Acute cholecystitis	434 (31.5%)	133 (15.0%)	301 (61.2%)	
Biliary colic	695 (50.5%)	618 (69.9%)	77 (15.7%)	
Other	22 (1.6%)	22 (2.5%)	0 (0.0%)	
Female sex	872 (63.4%)	572 (64.7%)	300 (61.0%)	0.17
Age, mean (SD)	53.5 (17.9)	54.3 (17.4)	52.2 (18.6)	0.04
TAP block	213 (15.5%)	83 (9.4%)	130 (26.4%)	<0.001
Postoperative course				
LOS, median (IQR)	1 (1,1)	1 (1,1)	1 (1,2)	<0.001
LOS >1 day	288 (20.9%)	106 (12.0%)	182 (37.0%)	<0.001

	All (n=1376)	Non-emergent (n=884)	Emergent (n=492)	P-value
Maximum pain score, median (IQR)	5 (3,7)	4 (3,6)	6 (5,8)	<0.001
Last pain score before discharge, median (IQR)	2 (1,4)	2 (1,4)	2 (1,4)	0.40
30-day readmission	55 (4.0%)	28 (3.2%)	27 (5.5%)	0.04
Opioid prescribing				
Opioids prescribed at discharge	1318 (95.8%)	857 (96.9%)	461 (93.7%)	0.004
OME, median (IQR)	225 (150,300)	225 (150,300)	225 (150,300)	0.15
OME >200	718 (52.2%)	456 (51.6%)	262 (53.3%)	0.55
OME ≥300	382 (27.8%)	223 (25.2%)	159 (32.3%)	0.005
Opioid refill within 30 days following discharge*	72 (5.4%)	46 (5.3%)	26 (5.4%)	0.94

*not assessed for N=31 patients with a surgical procedure within 30 days following discharge

Abbreviations: standard deviation (SD), interquartile range (IQR), length of stay (LOS), transverse abdominis plane (TAP), oral morphine equivalents (OME)

Table 2. Patient factors and opioid prescribing by diagnosis group among opioid-naïve patients. Values displayed are N (column %) unless otherwise specified.

	Gallstone pancreatitis (n=72)	Common bile duct stone / obstruction (n=153)	Acute cholecystitis (n=434)	Biliary colic (n=695)	Other (n=22)	P-value
Patient factors						
Emergent	29 (40.3%)	85 (55.6%)	301 (69.4%)	77 (11.1%)	0 (0.0%)	<0.001
Female sex	37 (51.4%)	81 (52.9%)	264 (60.8%)	475 (68.3%)	15 (68.2%)	<0.001
Age, mean (SD)	59.8 (17.9)	58.9 (19.0)	52.8 (17.8)	51.9 (17.4)	58.9 (12.4)	<0.001
TAP block	6 (8.3%)	32 (20.9%)	118 (27.2%)	56 (8.1%)	1 (4.5%)	<0.001
Postoperative course						
LOS, median (IQR)	3 (1,4)	2 (1,4)	1 (1,1)	1 (1,1)	1 (1,1)	<0.001
LOS >1 day	50 (69.4%)	105 (68.6%)	92 (21.2%)	40 (5.8%)	1 (4.5%)	<0.001

Maximum pain score, median (IQR)	6 (5,8)	6 (4,8)	6 (4,7)	4 (3,6)	3 (2,5)	<0.001
Last pain score before discharge, median (IQR)	2 (1,3.5)	2 (1,4)	2 (1,4)	3 (1,4)	2 (1,3)	0.42
30-day readmission	9 (12.5%)	5 (3.3%)	24 (5.5%)	16 (2.3%)	1 (4.5%)	<0.001
Opioid prescribing						
Opioids prescribed at discharge	61 (84.7%)	139 (90.8%)	411 (94.7%)	685 (98.6%)	22 (100.0%)	<0.001
OME, median (IQR)	225 (118.75,300)	180 (150,275)	225 (150,300)	225 (150,300)	225 (150,300)	0.22
OME>200	39 (54.2%)	72 (47.1%)	237 (54.6%)	357 (51.4%)	13 (59.1%)	0.50
OME ≥300	29 (40.3%)	37 (24.2%)	134 (30.9%)	174 (25.0%)	8 (36.4%)	0.02

Opioid refill within 30 days following discharge*	7 (10.1%)	2 (1.3%)	30 (7.0%)	31 (4.6%)	2 (9.5%)	0.02

*not assessed for N=31 patients with a surgical procedure within 30 days following discharge

Abbreviations: standard deviation (SD), interquartile range (IQR), length of stay (LOS), transverse abdominis plane (TAP), oral morphine equivalents (OME)

Table 3. Patient factors associated with a top quartile prescription among opioid-naïve patients. Values displayed are N (row %) unless otherwise specified.

	Overall (N=1376)		Non-emergent (N=884)		Emergent (N=492)	
	% top quartile	P-value	% top quartile	P-value	% top quartile	P-value
Emergent		0.005		--		--
No	25.2%		--		--	
Yes	32.3%		--		--	
Sex		0.31		0.24		0.99
Female	26.8%		24.0%		32.3%	
Male	29.4%		27.6%		32.3%	
Age, mean (SD)		0.03		0.16		0.15
Top quartile OME	51.8 (17.1)		52.9 (16.9)		50.4 (17.5)	
Non top quartile OME	54.2 (18.1)		54.7 (17.6)		53.0 (19.1)	
TAP block		0.004		0.61		<0.001
No	29.2%		25.5%		37.6%	
Yes	19.7%		22.9%		17.7%	
LOS, median (IQR)		0.08		0.49		0.57
Top quartile OME	1 (1,1)		1 (1,1)		1 (1,2)	

	Overall (N=1376)		Non-emergent (N=884)		Emergent (N=492)	
	% top quartile	**P-value**	**% top quartile**	**P-value**	**% top quartile**	**P-value**
Non top quartile OME	1 (1,1)		1 (1,1)		1 (1,2)	
LOS >1 day		0.04		0.44		0.30
≤1 day	26.5%		24.8%		30.6%	
>1 day	32.6%		28.3%		35.2%	
Maximum pain score		0.02		0.50		0.02
0	27.6%		32.0%		0.0%	
1	15.4%		15.6%		14.3%	
2	20.7%		23.7%		8.7%	
3	21.2%		20.1%		26.9%	
4	28.2%		25.8%		35.1%	
5	28.6%		29.1%		27.6%	
6	25.9%		23.6%		28.8%	
7-10	33.9%		26.9%		39.4%	
Last pain score before discharge		0.046		0.30		0.30
0	25.2%		24.4%		26.4%	

	Overall (N=1376)		Non-emergent (N=884)		Emergent (N=492)	
	% top quartile	P-value	% top quartile	P-value	% top quartile	P-value
1	29.3%		25.8%		35.9%	
2	23.6%		20.9%		29.1%	
3	29.7%		27.9%		33.7%	
4	28.0%		23.2%		37.5%	
5	24.5%		26.6%		20.6%	
6	44.2%		45.5%		43.3%	
7-10	40.6%		33.3%		45.0%	
30-day readmission		0.02		0.08		0.17
No	27.2%		24.8%		31.6%	
Yes	41.8%		39.3%		44.4%	
Diagnosis group		0.02		0.07		0.10
Gallstone pancreatitis	40.3%		37.2%		44.8%	
Common bile duct stone / obstruction	24.2%		22.1%		25.9%	
Acute cholecystitis	30.9%		30.8%		30.9%	

	Overall (N=1376)		Non-emergent (N=884)		Emergent (N=492)	
	% top quartile	P-value	% top quartile	P-value	% top quartile	P-value
Biliary colic	25.0%		23.1%		40.3%	
Other	36.4%		36.4%		0.0%	

Abbreviations: standard deviation (SD), interquartile range (IQR), length of stay (LOS), transverse abdominis plane (TAP), oral morphine equivalents (OME)

Appendix 1. Oral morphine equivalent conversion factors

Name	**Conversion factor**	**Conversion**
Tramadol	0.1	50 mg tablet = 5 OME
Hydrocodone	1	5 mg tablet = 5 OME
Oxycodone	1.5	5 mg tablet = 7.5 OME
Hydromorphone	4	2 mg tablet = 8 OME
Codeine	0.15	30 mg tablet = 4.5 OME