Opioid prescribing practices and patient-requested refill patterns following laparoscopic inguinal hernia repair

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Abstract
Purpose Excessive post-operative opioid prescribing has led to efforts to match prescriptions with patient need after surgery. We investigated opioid prescribing practices, rate of patient-requested opioid refills, and associated factors after laparoscopic inguinal hernia repair (LIHR).

Methods LIHRs at a single institution from 3/2019 to 3/2021 were queried from the Abdominal Core Health Quality Collaborative for demographics, perioperative details, and patient-reported opioid usage. Opioid prescriptions at discharge and opioid refills were extracted from the medical record. Univariate and multivariable regression were used to identify factors associated with opioid refills within 30-days of surgery.

Results Four hundred and ninety LIHR patients were analyzed. The median number of opioid tablets prescribed was 12 [interquartile range (IQR) 10–15], and 4% requested a refill. On univariate analysis, patients who requested refills were younger [55 years (IQR 37–61) vs. 62 years (IQR 36.8–61), \( p = 0.012 \)], more likely to have undergone transabdominal preperitoneal repair (75% vs. 26.4%, \( p < 0.001 \)), have a scrotal component (30% vs. 11%, \( p = 0.022 \)), and have permanent tacks used (80% vs. 49.4%, \( p = 0.014 \)). There was a 12% increase in the odds of opioid refill for every 1 tablet of oxycodone prescribed at discharge (95% CI for OR 1.04–1.21, \( p = 0.003 \)) after controlling for age and surgery type. Patient-reported opioid use was available for 289 (59%) patients. Post-operatively, 67% of patients used \( \leq 4 \) opioid tablets, and 87% used no more than 10 opioid tablets.

Conclusion Most patients use fewer opioid tablets than prescribed. Requests for opioid refills are rare following LIHR (4%) and associated with higher opioid prescribing.

Keywords Post-operative pain · Opioids · Laparoscopic inguinal hernia repair · Opioid refills · Patient-reported outcomes

Introduction
The epidemic of opioid addiction in the United States is more important now than ever. Even as the COVID-19 pandemic has swept the globe, overdose deaths from Dec 2019 to Dec 2020 rose almost 30% from the prior year, with more than 93,000 Americans dying from drug overdoses [1]. Physicians realize there is a link between prescription opioids leading to addiction [2, 3], and significant work has been done to decrease over prescribing of opioids after surgery [1, 4–6]. Still, post-operative opioid prescribing remains high in the United States [7], especially when compared to prescribing practices in other countries [8, 9].

It is common practice in the United States to routinely prescribe opioids for outpatient surgical procedures [10] and for many general surgeons, laparoscopic inguinal hernia repair (LIHR) is one of the highest volume outpatient operations [11]. Recent evidence suggests that patients often receive more opioids than needed to treat acute pain after this common procedure [12]. This is problematic as excess unused opioid tablets which are not properly disposed could lead to diversion for non-medical use [13]. However, there is also concern that patient harm could result from the ineffective management of acute pain [4] and that undertreating surgical pain could result in more opioid refill requests.
As a high-volume hernia practice, we are working to better match our opioid prescription to patient need upon hospital discharge [14] and are committed to continued quality improvement efforts. In this study, we aim to describe our routine opioid prescription after laparoscopic hernia repair and to determine the incidence of refill requests, potential predictors of those requests, and the relationship between refill requests and the initial opioid prescription to help inform future practice.

**Methods**

Following approval by the Institutional Review Board and waiver of informed consent, a post-hoc analysis of patients enrolled in a randomized controlled trial (RCT) [15] was conducted (authors who enrolled patients in the original RCT included ASP, DMK, SR, MJR, ELM, CGM, SS, DA, and CCP). The original trial included all elective laparoscopic inguinal hernia repairs performed on patients ≥ 18 years at Cleveland Clinic Foundation sites during the 2-year study period from March 2019 to March 2021. Patients were retrospectively identified in the Abdominal Core Health Quality Collaborative (ACHQC) registry, which is a hernia-specific, prospective national registry with the objective of continuous quality improvement and is unique from most large registries in which data are collected and entered in real time by the surgeons themselves [16]. Participating surgeons input patient demographic information, hernia-specific variables, operative details, patient-reported outcomes (PROs), and post-operative follow-up information at standardized time points.

Patient demographic data, comorbidities, operative details including type of repair, and post-operative data including patient-reported pain and opioid use after surgery were queried from the ACHQC registry. Patient-reported opioid use was recorded at 30-days follow-up, where patients indicate what range of opioid tablets they used after surgery (options included 0, 1–2, 3–4, 5–10, 11–15, 16–30, 30 or more, and prefer not to answer). Laparoscopic hernia repair types included either transabdominal preperitoneal (TAPP) or totally extraperitoneal (TEP). Patient-reported outcomes were gathered using the EuraHS Quality of Life (QoL) Score as part of standard pre- and post-operative care, which asks patients to rate their pain at the site of the hernia or hernia repair (total 30 points, 3 individual questions), restriction of activities (total 40 points, 4 individual questions), and cosmesis (total 20 points, 2 individual questions) [17]. Medical records were manually reviewed to capture opioid prescriptions at the time of discharge including opioid type, dose, and number of tablets to calculate morphine milligram equivalents (MME) for each prescription. The same data was collected for any opioid refill requests from patients. All opioid prescriptions were written at the discretion of the operative team and no standardized prescribing policy existed. The primary outcome was opioid refills within 30 days of the index operation.

Data were described using median and interquartile ranges (IQR) for continuous variables and counts with percentages for categorical variables. For analysis, patients were divided into two groups based on whether an opioid refill was given within 30 days of the index operation. Univariate analysis of variables was performed between these two groups. Statistical significance was achieved by examining two-sided p values generated by appropriate statistical testing (Wilcoxon rank sum test, Fisher’s exact, Chi-square test). Multivariable logistic regression was performed to assess whether the total MME of the discharge opioid prescription was independently related to subsequent refill requests. In this model, the unit increment of discharge prescription MME was set at 7.5 mg, equal to one 5 mg tablet of oxycodone. p value < 0.05 was considered significant. R software (version 4.0.0, 2020-04-24, Vienna, Austria) was used for all analyses.

**Results**

A total of 490 laparoscopic inguinal hernia repairs (LIHR) were included in the study. Median age was 61 years (IQR 51–68 years), 95% were male, and a majority were Caucasian (84%) (Table 1). Most patients underwent TEP repair (72%) for primary inguinal hernias (10% recurrent) with 39% of patients undergoing bilateral repair, went home the same day, and had low post-operative complication rates (Tables 2 and 3).

Most patients were discharged with oxycodone (44%) or Percocet (38%), the median number of tablets of any opioid prescribed at discharge was 12 (IQR 10–15), and the median MME of the total post-operative opioid prescription was 75 mg (IQR 67.5–112 mg). At discharge, 12% of patients were prescribed ≤ 5 opioid pills, 31% from 6 to 10 pills, 40% from 11 to 15 pills, and 17% > 15 pills. Post-operative patient-reported opioid use was available for 349 (71%) patients. Of these, 46% of patients reported using zero opioid tablets after discharge, 70% reported using four or fewer opioid tablets, and 84% reported using no more than ten opioid tablets. There were no statistical differences in number of opioid tablets, MME, or type of opioid in the discharge prescription between those who requested an opioid refill and those who did not (Table 4).

The 30-day patient-requested opioid refill rate was 4% (20/490 patients). On univariate analysis, younger patients [55 years (IQR 37–61) vs. 62 years (IQR 52–69); p = 0.012] tended to request refills more frequently, but there were no differences in gender, baseline opioid use, comorbidities, or
American Society of Anesthesiology score between the two groups (Table 1). EuraHS-QoL scores were available for 320 patients (65%). Patients who requested an opioid refill had higher pre-operative EuraHS-QoL restriction of activities score [13 (IQR 2.5–23) vs. 20 (IQR 8–32), \( p = 0.047 \)] but not a statistically different baseline EuraHS-QoL pain score at the hernia site.

From an operative standpoint, patients who requested a refill were more likely to have undergone a TAPP repair (75% vs. 25%, \( p < 0.001 \)) compared to TEP and were more likely to have a scrotal component to their hernia (30% vs. 11%; \( p = 0.02 \)). Those who requested opioid refills were also more likely to have permanent tacks used (80% vs. 49%, \( p = 0.01 \)) compared to patients who did not request a refill (Table 2). Post-operatively, all patients had a median length of stay of 0 days (IQR 0–0). Complications from the surgery were rare and not different between the patients who requested an opioid refill and those who did not (Table 3). Patients who requested opioid refills had higher scores for...
After controlling for age and surgery type, there was a 12% increase in the odds of opioid refill for every one tablet of oxycodone prescribed at discharge (95% confidence interval for odds ratio 1.04–1.21, $p = 0.003$). For opioid refills, median MME of total refill prescription was 112.5 mg (IQR 90–150), median number of tablets prescribed was 15 (IQR 12–21), and refill prescription was written a median of 5 days after surgery (IQR 3–8).
Discussion

In our study of 490 patients who underwent laparoscopic inguinal hernia repair, only 4% of patients requested an opioid prescription refill after surgery. There were pre-operative and intra-operative factors which appear to correlate with refill requests, and higher amounts of opioids prescribed at discharge was independently associated with increased odds of opioid refill request. We also showed that despite efforts to curb opioid prescribing after surgery due to their addictive properties, most patients still receive more opioid tablets than they report needing to control their pain.

A principal concern among surgeons is that lowering the post-operative opioid prescription too much will lead to inadequate pain control and increased patient requests for opioid refills. These concerns may be well founded in other surgical specialties such as orthopedic surgery, where rates of opioid refill requests can be as high as 62% [18]. However, refill requests after general surgical procedures are much lower, closer to 2–7% [19–22]. The advent of electronic prescribing of opioids has also made it easier to prescribe and retrieve opioid refill prescriptions, which lowers concerns about undertreating surgical pain. Additionally, multiple studies have shown that even after interventions which reduce post-operative opioid prescribing, the rate of opioid refill requests does not change [22–26]. One such study instituted an educational intervention with a decrease in the average opioid prescription for short-stay general surgeries from 207 to 105 MME, while the refill rate remained at 3% pre- and post-intervention [22]. While opioid refills after surgery do not necessarily correlate with continued chronic use, studies have found that a higher number of pills prescribed after surgery is associated with a greater risk of chronic opioid use [27–29]. All of these findings are consistent with our own, showing a low rate of refill requests that are associated with greater opioid prescribing at discharge.

Still, patients who did not request a refill were likely prescribed more than was necessary. There exist a variety of recommendations regarding how many opioid tablets to prescribe after inguinal hernia repair surgery, ranging from 6 to 15 tablets [19, 23, 30–33]. Some of these recommendations are based on expert consensus, while others are based on patient-reported opioid use after surgery. In our study population, nearly half (46%) of the patients reported using zero opioid tablets after discharge, 70% reported using four or fewer tablets, and 84% using no more than ten tablets. Several studies confirm our findings and show similarly low opioid use after other outpatient general surgical procedures [19, 30, 34]. Despite this, the median number of opioids prescribed to our patients was 12 tablets. This leaves a significant number of opioids unused after a patient recovers from surgery. If not properly disposed, these could be diverted for non-medical purposes [35] and suggests that 15 opioid tablets is too high for most patients after LIHR.

Another important topic in the discussion of opioid prescriptions after surgery is the addition of non-opioid pain control adjuncts. The use of local anesthesia is surgeon dependent at our institution and has occurred in 37% of procedures in this study. Interestingly, there was a trend towards greater local anesthetic use in those who requested an opioid refill, which is counterintuitive as randomized studies show improvement in post-operative pain control with the use of local anesthesia for LIHR [36, 37]. Prescription of other non-opioid oral pain medications at discharge is not standardized at our institution and is surgeon and resident dependent. This presents a clear opportunity for improvement, as even an educational intervention for only residents showed an increase in non-opioid medications prescribed at discharge, a decrease in the MME of the discharge opioid prescription, and a decrease in patient-requested opioid refills [38].

We found several patient and hernia-specific variables which could be associated with opioid refills. One interesting finding was that no patients in our study who requested

| Table 4 Post-operative opioid prescribing patterns and usage | Full cohort $N=490$ | No refill $N=470$ | Requested refill $N=20$ | p value |
|------------------------------------------------------------|---------------------|-----------------|------------------------|---------|
| Number of tablets, median [IQR]                            | 12 [10–15]          | 12 [10–15]      | 15 [9.8–16.2]          | 0.42    |
| MME, median [IQR]                                         | 75 [67.5–112]       | 75 [67.5–112]   | 112 [73.1–122]         | 0.14    |
| Discharge opioid type, N (%)                               |                     |                 |                        |         |
| None                                                       | 7 (1.4)             | 7 (1.5)         | 0                      | 0.18    |
| Hydromorphone                                              | 1 (0.2)             | 1 (0.2)         | 0                      |         |
| Hydrocodone–acetaminophen                                  | 75 (15.3)           | 74 (16)         | 1 (5)                  |         |
| Oxycodone                                                  | 215 (44)            | 200 (43)        | 15 (75)                |         |
| Oxycodone–acetaminophen                                    | 183 (37)            | 179 (38)        | 4 (20)                 |         |
| Tramadol                                                   | 8 (1.6)             | 8 (1.7)         | 0                      |         |
| Tramadol–acetaminophen                                     | 1 (0.2)             | 1 (0.2)         | 0                      |         |

IQR interquartile range, MME morphine milligram equivalents
an opioid refill reported pre-operative chronic opioid use, which has previously been shown to be a predictor of opioid refills [20, 29, 39]. We also found that a greater proportion of patients who requested a refill underwent TAPP repair compared to those who did not (75% vs. 26%, \( p < 0.001 \)). Literature regarding acute pain after LIHR is mixed, with some studies finding no difference between the two surgical approaches, but one showing increased pain for up to 3 months in those who underwent TAPP compared to TEP repair [40–42]. We also found a greater proportion of patients who requested a refill had a scrotal component to their hernia (30% vs. 11%, \( p = 0.02 \)) which has not been confirmed by other studies but could indicate a larger hernia with more dissection to reduce the hernia sac. Regarding tack use in LIHR, an increasing number of tacks used is thought to increase post-operative pain [43]. However, while patients who requested refills in our study had a higher proportion of permanent tack use, there was a slightly lower number of mesh tacks used. The absolute difference was small [median of 5 (IQR 3–8) vs. 4 (IQR 3–4)] and the actual tack number was relatively low compared to studies which show that > 10 tacks used is a predictor of acute post-operative pain [43]. However, the increase in refills after TAPP repair compared to TEP could be due to overall higher tack number, as TAPP repair in our study had a median of six additional tacks to close the peritoneum. It should be noted that all these comparisons were made on univariate analysis, and thus interpreted with caution as their association with opioid refill request could be influenced by other variables. Ultimately, a larger data set will allow more variables to be included in a multivariable analysis to address confounding factors for what is a relatively rare event.

Although opioid refills were uncommon, our study also shed light on the opioid prescribing practices at the time of refill. With a refill request at a median of 5 days after surgery, most patients will not have seen their surgeon for post-operative follow-up. Yet despite an appointment scheduled in the near future, the refill prescription had a median MME and number of tablets which was higher than the original opioid prescription. No prior studies exploring this topic have collected data regarding the prescribing practices at the time of refill; thus, there is no guidance in the literature for surgeons when they receive a refill request. Based on our data, we recommend prescribing fewer opioid tablets in the refill prescription, given that post-operative pain and recovery can be further assessed at the follow-up appointment.

This study does have limitations. First, when searching for opioid refill requests, only the medical record of the original hospital system where the surgery was performed was searched. There is a possibility that a patient requested and received an opioid refill from a provider outside of the original hospital system which would have been missed in our analysis. However, given that most providers will refer a patient to their surgeon for control of acute post-operative pain and that electronic health records provide a way for patients to contact their surgical team after discharge, we expect this issue to be minimal. Intra-operative opioid administration was not available and its effect on post-operative opioid use is thus unknown. Unfortunately, with only 20 opioid refill requests captured in this large cohort of post LIHR patients, multivariable logistic regression was limited to only 3 variables. Although we were able to show that the amount of opioids prescribed at discharge was an independent predictor of refills, a larger data set with more refill events could help identify additional predictors of refills. The ACHQC recently added a 30-day outcome variable for whether an opioid refill was requested, which will allow future studies to harness the power of this national registry to study opioid refills. We would also like to acknowledge a source of unconscious bias in the part of our data set that originates from the ACHQC, which is observer bias. Surgeons only enter what they know about the patient at the time and any outcomes which were reported to them. Surgeons are encouraged to be thorough in their reporting and specific definitions for each variable are readily available to minimize variation between observers.

This study clearly shows that despite our prescribing practices falling within the range of published guidelines for the number of opioid tablets which should be given after LIHR, most of our patients reported using far fewer opioids than they were prescribed. Furthermore, a higher number of opioids prescribed at the time of discharge was an independent predictor of refill requests within 30 days of surgery. We intend to use these results to design interventions which will optimize our post-operative pain control strategy and recommend frequent assessment of patient-reported opioid use after surgery to minimize post-operative opioid prescriptions without compromising pain control.

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**Declarations**

**Conflict of interest** Ajita Prabhu reported receiving honoraria for speaking and a research grant paid to her institution from Intuitive Surgical and serving on an advisory board and receiving honoraria from Medtronic and Becton, Dickinson, and Company. Michael Rosen reported receiving salary support for his role as Medical Director of the Abdominal Core Health Quality Collaborative and grant support paid to his institution from Pacira. No other disclosures were reported.

**Ethical approval** This study was reviewed by our Institutional Review Board and deemed ethically acceptable to proceed.

**Human and animal rights** This article does not contain any studies actively involving human participants, as it is a retrospective review of data already collected in the medical record and a national hernia database.
We were given a waiver of informed consent.
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