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Post-operative pain control and opioid usage patterns among patients undergoing thyroidectomy and parathyroidectomy

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Abstract

Objectives: To examine opioid prescribing patterns after endocrine surgeries. To evaluate factors associated with postoperative pain and opioid use.

Study Design: Cross-sectional

Setting: Academic university health system

Subjects and methods: Two hundred nine patients who underwent total thyroidectomy (TT), hemithyroidectomy (hT), or parathyroidectomy (P) by 4 surgeons between August 2015 and November 2017. Eighty-nine patients completed a phone survey about postoperative pain and opioid use. Prescription, demographic, and comorbidity data were collected retrospectively. Patient characteristics associated with opioid use, use of 10 opioid pills, and pain score were identified using chi-square, t-test, ANOVA, or Pearson correlation. Identified factors were further assessed using multivariable logistic and linear regression modeling.

Results: The median numbers of opioid pills prescribed were TT 20, hT 25, P 20. The median numbers of pills used were TT 1.5, hT 2, and P 0. Of 1947 total prescribed pills, 19.7% were reported to be taken. The number of pills meeting the opioid needs of 80% of these patients was 10. In multivariable analyses, older age was associated with lower odds of opioid use (OR 0.97, 95% CI 0.94–0.999, $p=0.04$) and lower pain scores (Pearson correlation coefficient -0.05 , 95% CI -0.10 – -0.001 , $p=0.04$). Charlson Comorbidity Index score >5 was associated with use of 10 pills (OR 6.62, 95% CI 1.60 – 27.50, $p=0.01$).

Conclusion: Excess opioids are often prescribed for endocrine surgeries. By using an ideal pill number and understanding predictors of postoperative pain, surgeons can more adequately treat pain and limit excess opioid prescriptions.

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Keywords

opioid; thyroidectomy; parathyroidectomy; endocrine surgery; postoperative pain

Introduction:

Opioid analgesics are used to treat post-operative pain and enhance recovery. Appropriate management of postoperative pain reduces perioperative morbidity, complications, hospital stay, and costs.¹ However, in light of the recent opioid epidemic, narcotic prescribing patterns by physicians are an area of increasing concern.² The over-prescription of pain medications has been implicated as a major contributor to the burgeoning opioid epidemic and the associated increases in overdose deaths in the United States.³ The over-supply of opioids by prescribers following surgery contributes to a large reservoir of unused prescription opioids, which run the risk of diversion for non-medical use.^{4,5}

There is an overall lack of data-driven approaches to optimal opioid prescribing after surgery, especially after endocrine surgeries. Approximately 93,000 thyroidectomies and 12,000 parathyroidectomies are performed in the United States each year.^{6,7} These surgeries are increasingly done in the ambulatory setting with postoperative pain managed on an outpatient basis at the discretion of the surgical team.⁸ Our study investigates the potential over-prescription of opioids at our institution and opioid use patterns for routine endocrine procedures with the goal of creating a standardized approach to postoperative pain management for patients undergoing thyroid or parathyroid surgery.

The aims of this study were: (i) to examine opioid prescribing patterns after thyroid and parathyroid surgeries, (ii) to evaluate predictive factors associated with greater postoperative pain and opioid use, and (iii) to guide best practices for the prescription of post-operative opioids. We performed a cross sectional study to qualify patient characteristics associated with greater post-operative pain and to quantify an “ideal” number of opioid pills that would meet the pain needs of patients undergoing thyroid and parathyroid surgeries.

Methods:

The Albert Einstein College of Medicine Institutional Review Board approved this project, which included a medical record chart review and a phone survey of patients who had undergone thyroid or parathyroid surgery.

Patient cohort.

Based on billing records, we identified patients who underwent total thyroidectomy (TT), hemithyroidectomy (hT), or parathyroidectomy (P) by one of 4 surgeons in the Montefiore Medical Center/Albert Einstein College of Medicine Department of Otorhinolaryngology-Head and Neck Surgery between August 2015 and November 2017. Criteria for inclusion were subject age >18 years and English as preferred language. We excluded patients who did not speak English, and those who underwent lateral neck dissections (Current Procedural Terminology code ‘60254’). Patients who underwent surgery less than 6 weeks prior to the survey collection period were excluded due to the possibility of acute pain bias. Patients

with central neck dissection were not excluded. For analysis, patients who underwent completion thyroidectomy were categorized as hT and patients undergoing both thyroid and parathyroid surgeries were categorized as TT or hT as applicable.

Data collection.

Clinical Looking Glass (CLG) is a datamining software application developed at Montefiore Medical Center that integrates demographic, clinical and administrative datasets from the Electronic Medical Record (EMR) and allows them to be reproduced in a programmable format for statistical access. We utilized CLG to screen the study population defined above for information regarding age, race, ethnicity, preferred language, date and type of surgery, insurance status, and Charlson Comorbidity Index at the time of surgery.⁹

Additional data collected by chart review of the EMR at the time of survey administration included postoperative opioid and non-opioid analgesia prescriptions, length of admission, diagnosis of primary or secondary hyperparathyroidism, perioperative or postoperative complications, body mass index (BMI), history of chronic pain disorders, psychiatric disorders, and substance use. To harmonize the number of pills prescribed across different opioid medications, we defined one pill as a dose equivalent to 5mg of oxycodone and used an online clinical calculator to estimate dose conversions.¹⁰

Telephone survey.

We attempted a telephone survey on patients between 6 weeks and 2 years after surgery. All subjects surveyed provided oral consent to participate in the study. Patients reported their pain after surgery on a scale from 0 to 10, how many opioid pills were taken, refill requirements, and what they did with any leftover medication (Supplemental Figure 1). When possible, patients were asked to examine their leftover medication bottles to determine how many opioid pills they took.

Statistical analysis.

We identified an “ideal number” of pills to prescribe for each operation based on the number of pills that would satisfy 80% of patients’ postoperative opioid needs. This ideal number is the 80th percentile for number of pills taken by patients undergoing a procedure, as described by Hill et al.¹¹ Primary outcomes were numeric pain score out of 10, reported use of any opioid medication versus none, and use of 10 opioid pills versus <10 pills. Patient characteristics associated with opioid use were tested using chi-square analysis for categorical variables and student t-test or Wilcoxon rank-sum for continuous variables. Patient characteristics associated with reported pain score were tested using t-test or ANOVA for categorical variables or Pearson correlation coefficient for continuous variables.

Multivariable regression analysis.

Multivariable logistic regression models for opioid use and use of 10 pills and a multivariable linear regression model for pain score were built using forward selection methodology. The variables age and gender were fixed in each model. Predictor variables tested for inclusion were: Body mass index (BMI), type of surgery, insurance status, length of admission, diagnosis of secondary hyperparathyroidism, history of chronic pain disorder,

history of substance use, history of tobacco use, psychiatric illness or medication, prescription of a non-opioid analgesic, history of opioid use prior to surgery, Charlson score, and elapsed weeks between surgery and survey administration. Candidate variables with an association of $p < 0.25$ in univariate testing were entered into the models consecutively by increasing p values, and dropped if $p > 0.1$ upon entry. Because the dataset could not accommodate large complex logistic regression models, variables included in the final logistic regression models were limited to age, gender, and the 1 or 2 most significant other predictors. Predictor variables met the assumption of non-collinearity tested by a value of variance inflation factor (VIF) < 10 . For logistic regression, assumption of a linear relationship between independent variables and log odds of outcomes was tested using the fractional polynomial test. For linear regression, variables met the assumptions of normality of residuals, homoscedasticity of residuals, and linear relationship between independent variables and outcome. Each model was evaluated for observations with high leverage, defined as standardized Pearson residual > 3 for logistic regression and Cooks distance $> 4/(89)$ for linear regression. Survey data was stored using Microsoft Excel. All statistics were performed in STATA 14.0 (Stata Corp, College Station, TX). Criterion for significance in all analyses was $p = 0.05$.

Results:

Of 209 patients meeting the inclusion criteria (Figure 1), 89 patients (43%) completed the phone survey (TT 48, hT 20, P 21). All subsequent analyses refer to those that completed the survey. Of 89 patients, 82% were female and median age was 55 years (IQR 40 – 64). The hT group consisted of 13 primary hemithyroidectomies and 7 completion hemithyroidectomies. In the P group, indications for surgery were primary hyperparathyroidism ($n=11$) and secondary hyperparathyroidism ($n=10$). Median time of survey response was 46 weeks (IQR 30 – 77 weeks) after surgery. Seventy-five patients (84%) were given an outpatient post-operative prescription for an opioid medication through the EMR. Of these prescriptions, 73 (97.3%) were oxycodone 5mg, 1 (1.3%) was hydromorphone 5mg, and 1 (1.3%) was acetaminophen-codeine 300–30mg. The median number of oxycodone 5mg equivalents (“pills”) prescribed for each type of surgery were TT 20 (IQR 20–30), hT 25 (IQR 10–30), P 20 (IQR 0–30; Figure 2). There was no significant association between number of pills prescribed and type of surgery ($p=0.60$), surgeon ($p=0.55$), race-ethnicity ($p=0.65$), or gender ($p=0.64$). There was no significant correlation between number of pills prescribed and age (Pearson correlation coefficient = -0.03 , $p=0.79$). Patients reported a median pain score of 5 (IQR 3 – 7) ascribed to the surgery overall, and reported a median of 5 (IQR 3 – 10) days for the pain to go away completely.

Fifty-one (57%) patients reported taking any opioid pills after surgery, while 36 patients reported that they did not use opioids at all. Two patients did not recall whether they used opioids or not and deferred all questions relating to opioid use. Table 1 shows the characteristics of patients who took and did not take opioids. Because 2 patients who were not prescribed opioids at discharge reported taking opioids for postoperative pain, all patients regardless of initial opioid prescription were included in all analyses. Prescription data were unavailable for 3 patients. One patient reported obtaining an opioid refill outside of our EMR system. The median numbers of pills taken were TT 1.5 (IQR 0–7), hT 2 (IQR

0–5), and P 0 (IQR 0–5) (Figure 2). Of 1947 total prescribed pills, 383 (19.7%) were reported as taken. Forty-five patients (52%) reported having leftover pills, of which 25 (56%) still had them in their possession, 19 (42%) had thrown them away, and 1 (2%) had returned to the pharmacy. Only sixteen patients (18%) were aware that opioid medications could be returned to the pharmacy for safe disposal. Non-narcotic analgesics were prescribed for 18 patients (21.7%) and included acetaminophen, ibuprofen, aspirin, gabapentin, and tramadol.

Table 2 shows factors predictive of opioid use in multivariable logistic regression analysis.

The ideal number of opioid pills to prescribe overall was 10: 80% of patients who received opioid prescriptions used 10 or fewer equivalents of oxycodone 5mg for pain management. The ideal number for each type of surgery was TT 11 (80% used 11 or fewer pills), hT 10 (80% used 10 or fewer pills), P 8 (80% used 8 or fewer pills). If the ideal number were prescribed, the total number of opioid pills initially prescribed would be 756, or 39% of the 1947 actually prescribed.

Patients who took 10 pills (n=15) had a significantly higher Charlson score than patients who took less than 10 pills (5 [IQR 0–9] vs 2 [IQR 0–3], $p=0.01$) by Wilcoxon rank-sum test. All other variables were not significantly different between patients who used 10 pills and those who used <10 pills in univariate analysis (data not shown). Table 3 shows a multivariable logistic regression of variables associated with using 10 pills.

As expected, higher pain score was associated with taking opioids (Figure 3). Higher pain score correlated with younger age using Pearson correlation coefficient ($p=0.02$). Table 4 shows a multivariable linear regression model for pain score.

In univariate analysis, elapsed weeks from surgery to survey was not significantly associated with pain score (Pearson correlation coefficient -0.07 , $p=0.54$), using opioids (median 54 weeks in used vs. 39 weeks in unused, Wilcoxon rank-sum $p=0.17$), or using 10 pills (median 50 weeks in 10 pills vs. 43 weeks in <10 pills, $p=0.84$). These factors remained not significant when tested in the multivariable models (Table 2–4).

Discussion:

Head and neck surgeons performing thyroidectomy and parathyroidectomy prescribed a wide range of opioid pills for postoperative analgesia.^{11–13} At our institution, we observed via direct survey that excess pills were frequently prescribed. A standardized prescribing practice, such as an ideal pill number which is sufficient for a majority of patients, can minimize opioid waste and prevent diversion to non-medical use.¹¹ In a prospective analysis of thyroidectomy and parathyroidectomy patients, Lou et al. found that 20 oral morphine equivalents (OMEQ), or the equivalent of 13.3 oxycodone 5mg pills, met the opioid needs of 93% of patients, similar to our ideal pill number of 10.¹⁴ Furthermore, almost half of our patients did not use their outpatient opioid prescriptions at all, which supports new recommendations that patients undergoing otolaryngology surgeries that cause “moderate” levels of pain, including endocrine surgery, can be managed with non-opioid analgesia.²

Some studies have explored the effects of preoperative and perioperative anesthesia interventions within the first 24–36 hours after thyroidectomy.^{15–18} However, there is limited data on opioid requirements after discharge.¹⁴ In our study sample, a median of 5 days for pain to completely resolve was reported, highlighting the need for outpatient postoperative pain management guidelines. Studies of pain control after other otolaryngologic procedures similarly focus on pain postoperative day 0–1, with few studies reporting on pain postoperative day 5 or beyond.^{19–23} Alternative postoperative medications studied to decrease opioid use in otolaryngology include NSAIDs, scheduled acetaminophen, gabapentin, and tramadol.^{2,22,24} Additional trials of alternatives to opioids after otolaryngology surgery will contribute to practice guidelines for opioid stewardship.

As expected, being prescribed opioids at discharge was associated with higher pain score. Younger age was associated with a higher pain score and use of opioids, in line with some studies linking younger age and greater opioid use and pain, although this relationship is inconsistent in the literature.^{14,19,20,25,26} Unlike some studies, we did not find any effects of gender or extent of endocrine surgery on pain and opioid use.^{14,20} Notably, we did not separate primary and completion hemithyroidectomies due to an insufficient number of patients. However, patients undergoing completion thyroidectomies may have different expectations of pain than those undergoing the surgery for the first time, which may affect subsequent pain scores and opioid use.

We found that BMI was not significantly associated with using opioids postoperatively ($p=0.06$), but our study may be underpowered to observe an association. Studies of other types of surgery have demonstrated a positive correlation or no correlation between obesity and postoperative opioid use.^{27–34}

Being in the highest quartile (5–11 points) of Charlson score compared to the bottom quartile was significantly associated with using 10 opioid pills. This is consistent with data demonstrating that higher Charlson index is associated with higher maximal pain after septorhinoplasty and new persistent opioid use 90 days after minor and major surgical procedures, including thyroidectomy and parathyroidectomy.^{5,26} However, our data did not show a significant association between Charlson score and pain in multivariable linear regression. Of note, common comorbidities associated with opioid use that are not included in the Charlson index, such as psychiatric history or chronic pain conditions, were not associated with any outcomes. However, other studies have shown that chronic pain conditions were associated with greater pain and increased opioid use after otolaryngology surgeries.^{20,21}

There are several limitations to this study. This includes those inherent to studies with survey-based methodology, including non-response bias and recall bias given our 57.4% non-response rate and long intervals between surgery and survey administration. However, we did not find that elapsed time between surgery and survey was a significant predictor of any of our outcomes in multivariable analyses. It is also possible that non-responders have different pain experiences or patterns of opioid use after surgery not captured in our dataset, which may limit the generalizability of our results. Our study was also subject to selection bias because we interviewed English-speaking patients only.

In the future, survey-based analysis of pain control and opioid use may focus on specific reasons for beginning or discontinuing opioids in order to provide insight into how to decrease opioid needs. It is important to ask patients about their use of safe storage and disposal techniques, which may help prevent medication diversion to non-prescription use.³⁵ It would be valuable to collect data about non-prescribed analgesia that patients may use postoperatively, because non-narcotic medications play an essential role in reducing outpatient opioid needs.²² Future prospective studies may also include measures of preoperative pain, anticipated pain, pain catastrophization, or pain counseling, which have been found to affect postoperative pain after otolaryngology surgeries.^{25, 36}

Conclusions:

Our findings add to a growing body of literature suggesting a pattern of overprescription of opioid medication to patients undergoing endocrine surgery. Surprisingly, we found that almost half of our patients used no opioid pills at all. Younger age was predictive of higher pain scores and greater odds of using opioids. High Charlson score predicted greater odds of using ≥ 10 opioid pills. Future investigations should focus on the effects of prospectively implementing standardized guidelines such as an ideal pill number of 10 for opioid prescription after endocrine surgeries, as well as identifying factors associated with increased outpatient opioid use and pain after other otolaryngology surgeries. Our data, along with these additional studies, could help to appropriately manage postoperative pain and minimize excess opioid prescribing.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1:
Subject selection

Figure 2:
Total Number of Pills Prescribed (A) and Taken (B)

Figure 3:

Box plot illustrating pain and use of opioids. The horizontal line within the box indicates the median, box boundaries indicate 25th–75th percentile, whiskers indicate the highest and lowest scores.

Table 1:

Characteristics of patients who used vs. did not use opioids after surgery.

Variable	Did Not Use Opioids, N (%)	Used Opioids, N (%)	p-value
Continuous variables			
N = 87	36 (41%)	51 (59%)	
Age in years, mean (SD)	56.7 ($\pm$ 14.2)	50.3 ($\pm$ 16.2)	0.06
Length of admission (days), median (IQR)	1(1,1.5)	1(1,1)	0.93
Body Mass Index, mean (SD)	34.7 ($\pm$ 7.3)	31.8 ($\pm$ 6.1)	0.051
Categorical variables			
Gender			0.49
F	31 (86%)	41 (80%)	
M	5 (14%)	10 (20%)	
Race/Ethnicity			0.30
Non-Hispanic White	4 (11%)	4 (8%)	
Hispanic	6 (17%)	15 (29%)	
Non-Hispanic Black	21 (58%)	21 (41%)	
Others/Not Recorded	5 (14%)	11 (22%)	
Extent of Surgery			0.24
Total Thyroidectomy	17 (47%)	29 (57%)	
Partial Thyroidectomy	7 (19%)	13 (25%)	
Parathyroidectomy	12 (33%)	9 (18%)	
Central Neck Dissection			0.66
No	33 (92%)	48 (94%)	
Yes	3 (8%)	3 (6%)	
Parathyroid Diagnosis			0.80
Hyperparathyroidism, primary	6 (50%)	5 (56%)	
Hyperparathyroidism, secondary	6 (50%)	4 (44%)	
Has Insurance			0.80
No	1 (3%)	1 (2%)	
Yes	35 (97%)	50 (98%)	
Charlson Score			0.17
1 st quartile (0 points)	10 (37%)	17 (63%)	
2 nd quartile (1–2 points)	14 (52%)	13 (48%)	
3 rd quartile (3–4 points)	8 (53%)	7 (47%)	
4 th quartile (5–11 points)	4 (22%)	14 (78%)	
History of Psychiatric Disorder			0.98
No	29 (81%)	41 (80%)	
Yes	7 (19%)	10 (20%)	
History of Chronic Pain Condition			0.35
No	28 (78%)	35 (69%)	
Yes	8 (22%)	16 (31%)	

Variable	Did Not Use Opioids, N (%)	Used Opioids, N (%)	p-value
Substance Use Disorder			0.69
None	32 (89%)	44 (86%)	
Tobacco	4 (11%)	6 (12%)	
Multiple	0 (0%)	1 (2%)	
Non-opioid analgesia prescribed			0.56
No	28 (82%)	37 (77%)	
Yes	6 (18%)	11 (23%)	
Taking opioid pain medication at time of survey			0.22
No	34 (94%)	44 (86%)	
Yes	2 (6%)	7 (14%)	
Took opioids prior to surgery			0.09
No	36 (100%)	47 (92%)	
Yes	0 (0%)	4 (8%)	

SD=standard deviation, IQR=interquartile range

P-values from t-test (normally distributed continuous variables), Wilcoxon rank-sum test (non-normally distributed continuous variables) and chi-square test (categorical variables).

Table 2:

Multivariable logistic model for using opioids vs. not using opioids (n=87)

Characteristic	Odds Ratio (95% CI)	P-value
Age (years)	0.97 (0.94 – 0.999)	0.04 *
Male Gender (vs Female)	1.30 (0.37 – 4.62)	0.68
Charlson Score		
1 st quartile (0 points)	Ref	
2 nd quartile (1–2 points)	0.55 (0.18 – 1.74)	0.31
3 rd quartile (3–4 points)	0.82 (0.21 – 3.24)	0.78
4 th quartile (5–11 points)	1.99 (0.47 – 8.34)	0.35
Body Mass Index	0.93 (0.87 – 1.00)	0.06

* Significant at p<0.05

Model p=0.05; Pseudo-R² = 0.11

Variables tested in the model but not included to limit variables or because not significant: Race-ethnicity, elapsed time between surgery and survey, type of surgery, length of admission, prior use of opioids.

Variables with p>0.25 in univariate analysis and therefore not tested in the model: central neck dissection, diagnosis of secondary hyperparathyroidism, history of chronic pain disorder, substance use, psychiatric illness or medication, prescription of a non-opioid analgesic, insurance status.

Table 3:

Multivariable logistic model for using ≥ 10 opioid pills vs. 0-10 pills (n=87)

Characteristic	Odds Ratio (95% CI)	P-value
Age (years)	0.98 (0.94 – 1.01)	0.21
Male Gender (vs Female)	0.91 (0.19 – 4.32)	0.91
Charlson Score		
1 st quartile (0 points)	Ref	Ref
2 nd quartile (1–2 points)	0.17 (0.02 – 1.62)	0.13
3 rd quartile (3–4 points)	0.40 (0.04 – 3.97)	0.43
4 th quartile (5–11 points)	6.62 (1.60 – 27.50)	0.01 *

* Significant at p<0.05

Model p<0.001; Pseudo-R² = 0.24

Variables tested in the model but not included to limit variables or because not significant: Race-ethnicity, received opioid prescription at discharge, elapsed time between surgery and survey, type of surgery, length of admission, prior use of opioids.

Variables with p>0.25 in univariate analysis and therefore not tested in the model: body mass index, central neck dissection, diagnosis of secondary hyperparathyroidism, history of chronic pain disorder, substance use, psychiatric illness or medication, prescription of a non-opioid analgesic, insurance status.

Table 4:

Multivariable linear regression model for pain score (n=89)

Characteristic	Coefficient	95% CI	P-value
Age (years)	-0.05	(-0.10 - -0.001)	0.04 *
Male gender (vs female)	-0.32	(-2.03 - 1.38)	0.71
Race-Ethnicity (vs Non-Hispanic White)			
Hispanic	-0.23	(-2.91 -2.45)	0.87
Non-Hispanic Black	-0.04	(-2.38 - 2.29)	0.97
Other	-0.62	(-3.27 - 2.04)	0.64
Received opioid prescription at discharge (vs did not)	2.06	(0.09 - 4.02)	0.04 *
Charlson Score (points)			
1 st quartile (0 points)	Ref	Ref	Ref
2 nd quartile (1-2 points)	0.43	(-1.26 - 2.13)	0.61
3 rd quartile (3-4 points)	0.24	(-1.83 - 2.31)	0.82
4 th quartile (5-11 points)	2.27	0.19 - 4.36	0.03 *
Length of admission (days)	0.16	(-0.11 - 4.37)	0.24
Body Mass Index	0.09	(-0.01 - 0.19)	0.07

 $R^2 = 0.21$; Adjusted $R^2 = 0.10$ * Significant at $p < 0.05$

Variables tested in the model but not significant and therefore excluded: Insurance status.

Variables not significant at $p < 0.25$ in univariate analysis and therefore not tested in the model: type of surgery, diagnosis of secondary hyperparathyroidism, history of chronic pain disorder, substance use, tobacco use, psychiatric illness or medication, prescription of a non-opioid analgesic, elapsed time between surgery and survey, insurance status