Healthcare utilization by patients with primary hyperparathyroidism

What is the effect of kidney stone formation?

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ABSTRACT

INTRODUCTION: Urolithiasis is a common complication of primary hyperparathyroidism (PHPT). Parathyroidectomy has been shown to decrease the rate of stone formation. The purpose of this study was to evaluate healthcare resource utilization before and after parathyroidectomy and identify predictors of increased healthcare utilization.

METHODS: A retrospective analysis of patients who had a parathyroidectomy for PHPT in Nova Scotia from 2013–2018 was performed. Data from five years before parathyroidectomy to three years after were included. Outcomes included emergency department (ED) visits and the number of urologic interventions. Random-effects Poisson regression models were used to calculate the primary outcomes, ED visits, and the number of urologic interventions while adjusting for prespecified characteristics.

RESULTS: Fifty patients (62% female) with a mean age of 60±11 years were identified. ED visits were 0.42 per year before parathyroidectomy and 0.20 per year after in a multivariate analysis (incidence rate ratio [IRR] 0.48, confidence interval [CI] 0.25–0.91, p=0.024). There was no statistical difference between male and female ED visits (p=0.6719). There was no difference in the rate of ED visits for non-urologic reasons after parathyroidectomy (p=0.0749). The incidence of urologic intervention for stones was 1.24 per year before parathyroidectomy and 0.53 per year after (IRR 0.42, CI 0.26–0.68, p=0.0005).

CONCLUSIONS: Healthcare resource utilization, in terms of ED visits and urologic intervention, significantly decreased after parathyroidectomy. Sex showed no statistical difference in predicting healthcare utilization, while non-urologic ED visits remained the same after surgery. Expedited parathyroidectomy for PHPT patients may decrease urologic interventions and ED visits, resulting in less healthcare utilization.

INTRODUCTION

Primary hyperparathyroidism (PHPT) is an endocrine disorder characterized by high levels of serum calcium due to dysregulation of parathyroid hormone production, usually due to parathyroid adenoma formation.[1] PHPT is a known risk factor for nephrolithiasis, and an underlying diagnosis of PHPT is established in approximately 5–7% of stone formers.[2-4] Excessive secretion of parathyroid hormone disrupts calcium homeostasis, leading to hypercalcemia and increased urinary calcium excretion, predisposing individuals to nephrolithiasis.[5] Although not fully elucidated, the resorptive hypercalciuria associated with PHPT is considered to be the major contributor to the pathophysiology of kidney stones in this patient population.

While many patients with PHPT are asymptomatic, nephrolithiasis is an indication for parathyroidectomy.[6,7] Studies confirm that successful parathyroidectomy reduces kidney stone recurrence in patients with primary hyperparathyroidism.[8-11] In a retrospective study of 674 patients, a 250% reduction in hospital contact was observed for patients who received parathyroidectomy, with longer time to stone recurrences.[9] Although stone formation may not be completely resolved after parathyroidectomy, decreased urologic interventions and hospital contact benefit both the patient and, subsequently, the healthcare costs associated with their episodes.

KEY MESSAGES

- Healthcare resource utilization, in terms of ED visits and urologic intervention, were greater in patients with primary hyperparathyroidism (PHPT), and significantly decreased after parathyroidectomy.
- ED visits were reduced by 52% after parathyroidectomy, while urologic interventions decreased by 58%.
- Sex showed no statistical difference in predicting healthcare utilization, while non-urologic ED visits remained the same after surgery.
- Expedited parathyroidectomy for patients with PHPT may decrease urologic interventions and ED visits, resulting in a decrease in healthcare utilization.

Despite the growing body of evidence supporting the efficacy of parathyroidectomy in the management of urolithiasis secondary to hyperparathyroidism, there remains a scarcity of research examining its impact on healthcare resource utilization. It is estimated that over 3 million workdays are lost each year due to treatment for nephrolithiasis in the U.S.[12,13] Stone-forming patients often require multiple urologic interventions, investigations, and emergency department (ED) visits, which come with considerable healthcare costs. By evaluating healthcare utilization in this population, we hypothesized that healthcare utilization would decrease after definitive treatment for patients with PHPT, who may benefit from expedited care.

METHODS

A retrospective analysis was performed to evaluate stone-forming patients who had a parathyroidectomy for PHPT in Nova Scotia from 2013–2018 by otolaryngology-head and neck surgery (ORL-HNS) at our tertiary hospital. Parathyroidectomy for PHPT was also captured by an affiliated high-volume community ORL-HNS surgeon. Chart review from five years before parathyroidectomy and three years after were included, as followup concluded three years postoperatively. Study size was determined after including any patient with accessible records diagnosed with PHPT, known nephrolithiasis, who underwent a parathyroidectomy, which also limited selection bias in our cohort. Data collection captured all events from 2008–2021 on inclusion criteria based on province-wide electronic databases.

Patient demographics were captured, including potential confounding variables such as significant comorbidities (diabetes, hypertension, malignancies, age, and sex), which may influence hospital utilization. All ED visits within the province were reviewed and categorized as urologic (stent-related or evidence of symptomatic stone) or non-urologic, independent of their ED diagnosis. Urologic intervention was defined as extracorporeal shockwave lithotripsy (SWL), ureteroscopy (URS), percutaneous nephrolithotomy (PCNL), or cystoscopy for stent removal. Non-parametric signed-rank test was used for the difference between pre- and post-hospitalization outcomes.

Statistical analysis

Descriptive statistics are reported as counts and percentages for categorical variables, means and standard deviation for normally distributed continuous variables, and medians and interquartile ranges for non-normally distributed continuous variables.

Primary outcomes include the number of ED visits for urologic causes and the composite endpoint of the total number of SWL, URS, PCNL, and cystoscopy with stent removal procedures. Secondary outcomes included ED visits for non-urologic causes and follow-up visits with urology, ORL-HNS, and endocrinology. The primary and secondary outcomes are expressed as rates of visits per year of followup pre- and post-parathyroidectomy surgery.

Incidence rate ratios (IRR) for all outcomes were estimated using a Poisson regression model for count data. Rates of events were compared before and after parathyroidectomy surgery. Random effects models were used to account for the correlation of counts pre and post on the same patient. An offset variable was used to account for varying lengths of followup. Multivariable Poisson regression models were used to model the primary outcomes, the number of ED visits for urologic causes, and the composite endpoint of the total number of SWL, URS, PCNL, and cystoscopy with stent removal procedures, adjusting for prespecified baseline characteristics given population size (sex, diabetes). Statistical analyses were performed using SAS STAT 14.3 version 9.4 (SAS Institute, Cary, NC. U.S.). A two-sided p-value of <0.05 was the threshold for statistical significance unless otherwise specified.

RESULTS

A total of 50 patients (62% female) with a mean age of 60±11 years were identified (Table 1). Hypertension and diabetes were the most common comorbidities (54% and 22%, respectively). Each patient underwent parathyroidectomy, while 12 patients had a history of orthopedic surgery. All patients were assessed by ORL-HNS, 74% had urologic consultation, and 68% were seen by endocrinology prior to parathyroidectomy.

Urologic ED visits

Mean urologic visits to ED for patients prior to parathyroidectomy was 2.1 times per year compared to 0.6 after surgery. ED visits were significantly higher in a multivariable analysis adjusting for sex and diabetes (0.42 vs. 0.20/year) prior to parathyroidectomy when adjusted for the difference in the number of days used to observe events (IRR 0.48, confidence interval [CI] 0.25–0.91, p=0.024) (Figure 1). There was no statistical difference between male and female ED visits (p=0.6719). ED visits decreased after parathyroidectomy for patients with diabetes compared to those without, and was statistically significant (IRR 0.083, CI 0.030–0.23, p<0.0001).

Non-urologic ED visits

Mean visits to ED for non-urologic causes prior to surgery was 3.5/year compared to 2.9/year after parathyroidectomy. There was no statistical difference between ED visits (0.7/year vs. 1.0/year) for non-urologic causes (IRR 1.36, CI 0.97–1.90, p=0.0749).

Table 1. Patient baseline characteristics

Age	
Mean (SD)	60.0 (10.75)
Median (IQR)	61.5 (61.6, 67.0)
Sex n [%]	
Male	19 [38]
Female	31 [62]
Hypertension	27 [54]
Diabetes	11 [22]
Malignancy	10[20]
COPD	4 [8]
Cholecystectomy	14 [29]
Orthopedic surgery	12 [4]

COPD: chronic obstructive pulmonary disorder; IQR: interquartile range; SD: standard deviation.

Urologic followup

Urologic visits prior to parathyroidectomy were 4.5/year compared to 2.4/year after definitive treatment. There was no statistical difference between urologic visits (0.9/year prior to surgery compared to 0.8/year, p=0.5316).

Urologic intervention

Intervention was significantly higher (1.24 vs. 0.53/year) prior to parathyroidectomy in a multivariable analysis adjusting for sex and diabetes (IRR 0.42, CI 0.26–0.68, p=0.0005) (Figure 2). There was no statistical difference observed between male and female procedure rates (p=0.9262). Additionally, rates of intervention for patients with diabetes were not statistically significant (p=0.5116) compared to patients without diabetes.

DISCUSSION

This study highlights healthcare resource utilization patterns among patients undergoing parathyroidectomy for urolithiasis with underlying diagnosis of PHPT. The demographic characteristics of our cohort, comprising largely female patients with a mean age of 60 years, is consistent with the previously described at-risk population for PHPT.[14] The known association of diabetes in the setting of PHPT remained a focus of our analysis as a potential cofounder, especially when considering rates of ED visits.[15] Interestingly, compared to non-diabetics, diabetic patients were less likely to visit the ED for urologic causes after surgery. Although it remains uncertain, improved glucose control after parathyroidectomy has been described, which may contribute to our decrease in ED visits.[16,17]

While comorbidities can be associated with more ED visits disproportionately among male and female patients, we observed no difference in ED visits or urologic intervention in our cohort, reinforcing that gender may not be a significant factor in predicting healthcare resource utilization in this setting.[18]

Prior to parathyroidectomy, patients experienced a substantial burden of urologic-related ED visits, with an average of 2.1 visits per year. Multivariate analysis further underscored the significance of this finding, revealing a 52% reduction in ED visits after definitive treatment. The costs of these visits cannot be undervalued and involve many direct and indirect expenses with each encounter related to their stone burden. An American study evaluating the cost-effectiveness of 3600 stone-formers

found that if 75% of cases could be prevented via medical intervention, a savings of over $440 000 USD a year for employers insuring these medical expenses would be expected.[12] The exact dollar value for each ED visit in the Canadian healthcare system was not a measured outcome of this study; however, decreasing healthcare utilization has shown to offer monetary savings, less time off work, and mitigation of the overcrowding in EDs.

The rate of non-urologic ED visits remained unchanged after surgery, which may further strengthen the potential cost reduction from the urologic impact of stones. Our analysis also examined specific healthcare utilization metrics, including overall urologic visits and interventions, before and after parathyroidectomy. While there was a significant reduction in surgical interventions post-surgery, indicating a decrease in invasive procedures related to urolithiasis, the frequency of scheduled urologic visits did not differ significantly between pre- and postoperative periods. This may suggest a benefit in acute care visits and invasive urologic intervention, but no reduction in ongoing urologic care in our short followup period.

It is quite possible, however, that patients may have ongoing renal stones that require followup post-parathyroidectomy to assess for kidney stone disease progression. Renal stones that formed during the pre-parathyroidectomy years may continue to be a driver of post-parathyroidectomy ED and urologic surgery in future years. Assessment of this was beyond the scope of this study and is a question that may deserve future investigation.

Historically, surgical correction for PHPT has been shown to decrease recurrence and even reduce yearly stone formation by 18 times compared to those not undergoing parathyroidectomy.[10,11] More recently, Huang et al reviewed 1252 patients with stone disease and PHPT, finding a delay to first stone recurrence and decrease of re-recurrence (40.6% vs. 21.9%, respectively) for those undergoing surgery vs. observation over a five-year period.[9] These findings were also supported by Mollerup et al, and demonstrated the durability of treatment for stone prevention up to 10–15 years after surgery.[8,9]

Surgical intervention for PHPT has also been shown to decrease risk with urinary calcium on 24-hour urine collections, as described by Seib et al, who demonstrated a 105 mg postoperative decrease compared to an increase for non-operative patients in a large cohort.[19] In our study, we highlight the decreased stone recurrence in the surgical cohort by observing a 58% reduction in urologic interventions, which come at high financial and labor costs to the healthcare system. While stone recurrence is not always eliminated with parathyroidectomy in this population, the study authors believe a larger emphasis on healthcare utilization, savings, and avoiding urologic intervention warrants a recommendation for prompt consideration of surgical correction.

Although this study was limited by its retrospective nature, small sample size, and single-center analysis, these findings underscore the benefit of parathyroid-

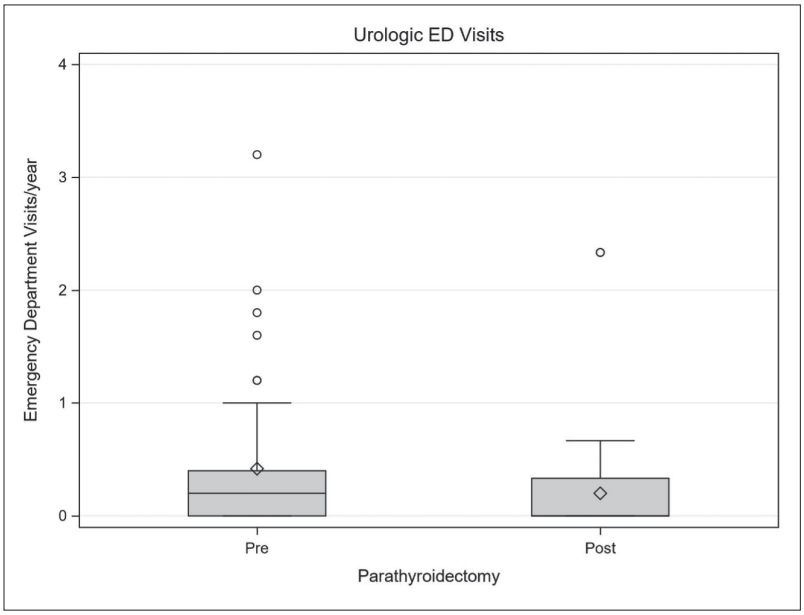

Figure 1. Emergency department (ED) visits were 0.42 per year prior to parathyroidectomy compared to 0.20 per year after surgery in multivariable analysis, adjusting for sex and diabetes.

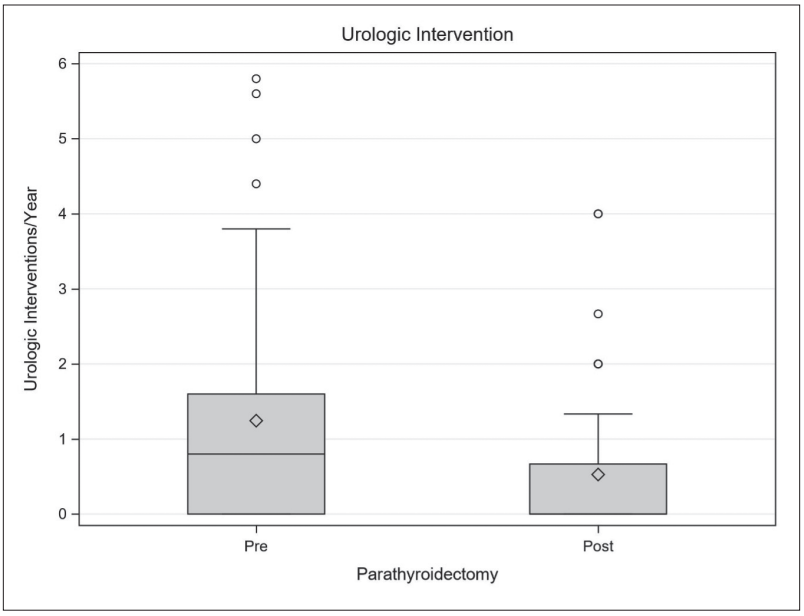

Figure 2. The incidence of urologic intervention was 1.24 per year prior to parathyroidectomy and 0.53 per year after parathyroidectomy.

ectomy on reducing ED visits and urologic-related interventions among patients with PHPT and urolithiasis. Further research to elucidate long-term outcomes and healthcare utilization patterns in larger, multicenter, Canadian cohorts will allow for a more robust generalization of findings and help inform evidence-based clinical practice guidelines.

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