PACU PTH Facilitates Safe Outpatient Total Thyroidectomy
Jeffrey J. Houlton, William Pechter and David L. Steward
Otolaryngology -- Head and Neck Surgery 2011 144: 43
DOI: 10.1177/0194599810390453

The online version of this article can be found at:
http://oto.sagepub.com/content/144/1/43

Published by:
SAGE
http://www.sagepublications.com

On behalf of:
AMERICAN ACADEMY OF
OTOLARYNGOLOGY--
HEAD AND NECK SURGERY

American Academy of Otolaryngology- Head and Neck Surgery

Additional services and information for Otolaryngology -- Head and Neck Surgery can be found at:

Email Alerts: http://oto.sagepub.com/cgi/alerts
Subscriptions: http://oto.sagepub.com/subscriptions
Reprints: http://www.sagepub.com/journalsReprints.nav
Permissions: http://www.sagepub.com/journalsPermissions.nav
PACU PTH Facilitates Safe Outpatient Total Thyroidectomy

Jeffrey J. Houlton, MD1, William Pechter, MD2, and David L. Steward, MD1

Sponsorships or competing interests that may be relevant to content are disclosed at the end of this article.

Abstract

Objective. To determine if a serum parathyroid hormone (PTH)–based discharge algorithm can be used to safely facilitate outpatient total thyroidectomy.

Study Design. Case series with chart review of consecutive total and completion thyroidectomies performed by the senior author from March 2008 to November 2009.

Setting. An academic tertiary care center.

Subjects and Methods. At the authors’ institution, patients undergoing total or completion thyroidectomy are subject to a same-day discharge algorithm that incorporates postanesthesia care unit rapid PTH as the major discharge criterion. Patients with PTH >30 pg/mL are eligible for same-day discharge without supplementation, patients with PTH between 20 and 30 pg/mL are eligible for discharge but receive calcium supplementation, and patients with PTH <20 pg/mL are observed overnight (23 hours) with calcium and vitamin D supplementation.

Results. One hundred eighty patients (mean age, 48.9 years; 83.3% female) underwent total (77.2%) or completion (22.7%) thyroidectomy with or without node dissection. Forty-two percent were performed with minimally invasive video-assisted (MIVA) technique. Seventy-six percent (137/180) of patients had a PTH >20 pg/mL, meeting the PTH discharge criterion. Sixty-nine percent (95/137) of eligible patients were discharged on the same day (53.1% of total). Ten percent of discharge-eligible patients were admitted due to drain placement. Of the 95 patients undergoing outpatient surgery, none were admitted, seen, or called for symptoms of hypocalcemia in the postoperative period. All 180 patients were eucalcemic at postoperative day (POD) 7 and POD 30 office visits. No patients were hypoparathyroid at POD 30. No significant difference in postoperative hypoparathyroidism existed between completion versus total thyroidectomy (11.1% vs 22.2%, P = .28) or MIVA versus standard technique (P = .37).

Conclusion. A PTH-based discharge algorithm can safely facilitate outpatient total or completion thyroidectomy, with minimal risk of clinically significant outpatient hypocalcemia.

Keywords
ambulatory surgery, hypocalcemia, thyroidectomy, parathyroid hormone

Received July 21, 2010; revised October 5, 2010; accepted October 18, 2010.

For more than 2 decades, a growing proportion of studies have advocated the safety, efficacy, and cost savings of an outpatient approach to thyroid surgery.1-5 Yet most total thyroidectomies continue to result in inpatient observation or admission. One of the persistent apprehensions to an outpatient approach is concern for postoperative hypocalcemia and its sequelae. The risk of hypocalcemia following total thyroidectomy has been reported to be as high as 40%.6 Multiple supplementation strategies have been developed for the treatment, and prevention, of postoperative hypocalcemia, but most approaches can be generalized into 1 of 3 strategies: watchful waiting, early/routine supplementation, and parathyroid hormone (PTH)–driven selective supplementation.

Early, routine calcium and vitamin D supplementation following total or completion thyroidectomy reduces the rate of postoperative hypocalcemia when compared with a watchful waiting approach (ie, waiting for patients to become hypocalcemic before supplementation is initiated). More recently, PTH-driven selective supplementation strategies have been developed that use postoperative PTH to predict, and supplement, those patients most at risk for hypocalcemia.7-9 Multiple studies report the predictive relationship between postthyroidectomy hypoparathyroidism (defined variably as serum PTH

1Department of Otolaryngology–Head and Neck Surgery, University of Cincinnati, Cincinnati, Ohio, USA
2University of South Florida College of Medicine, Tampa, Florida, USA

This article was presented at the 2010 AAO-HNSF Annual Meeting & OTO EXPO, Boston, Massachusetts, September 26-29, 2010

Corresponding Author:
Jeffrey J. Houlton, MD, Department of Otolaryngology–Head and Neck Surgery, University of Cincinnati, Academic Health Center, 231 Albert Sabin Way, Room 6407 MSB, PO Box 670528, Cincinnati, OH 45267-0528
Email: houltojy@ucmail.uc.edu
level less than 8-15 pg/mL) and the development of postoperative hypocalcemia. A study by our group concluded that the selective supplementation of calcium and vitamin D to patients with a postanesthesia care unit (PACU)–drawn PTH level less than 15 pg/mL reduced the rate of postoperative hypocalcemia when compared with a watchful waiting approach and avoided supplementation in the large majority of patients not requiring treatment compared with an early, routine approach.

Based on these data, we have developed a PTH-based discharge algorithm that grants those patients at low risk of hypocalcemia eligibility for same-day discharge following total or completion thyroidectomy. This constitutes a large majority of our postoperative patients. Using very conservative definitions for euparathyroidism, those patients with rapid PTH >30 pg/mL are eligible for same-day discharge from PACU without supplementation and those with PTH between 20 and 30 pg/mL are eligible for discharge but receive oral calcium supplementation. Those with PTH <20 pg/mL are observed overnight (23-hour admission) and receive both calcium and vitamin D supplementation. Calcium assays are checked the night of and morning after surgery, and supplementation is increased if appropriate. All patients have a calcium level checked at a 1-week postoperative visit.

The aim of our study is to determine if the developed PTH-based discharge algorithm safely facilitates outpatient total and completion thyroidectomy, with low rates of clinically significant hypocalcemia and readmission.

**Methods**

Approval was granted by the Institutional Review Board of the University of Cincinnati Academic Health Center, and a retrospective case series review was performed. Data were collected on consecutive patients undergoing total or completion thyroidectomy, with or without node dissection, from March 2008 to November 2009 by a single endocrine-specialized otolaryngologist, with significant resident involvement. All eligible patients were included in the study group. Patients were identified based on a current procedural terminology (CPT) code search using codes 60252, 60254, 60260, and 60271. Patients undergoing combined parathyroid surgery or first-time hemithyroidectomy were excluded. Primary outcomes recorded included rate of postoperative hypocalcemia, rate of readmission, and number of emergency department or unplanned office visits for hypocalcemia.

Starting in March 2008, all patients undergoing total or completion thyroidectomy by the senior author were subject to a discharge algorithm whose main determinant was rapid PTH drawn in the PACU. Patients with PTH >30 pg/mL were eligible for discharge without supplementation. Those with PTH between 20 and 30 pg/mL were also eligible for discharge but were supplemented with oral calcium carbonate (500 mg orally twice daily). Those patients with PTH ≤20 pg/mL were admitted for observation and initially supplemented with calcitriol (loading dose of 3 µg once, then 0.5 µg once a day) and calcium carbonate (1 g orally 4 times a day). Calcium levels were checked the night of and morning after surgery, and almost all patients were discharged on postoperative day (POD) 1. Patients requiring calcitriol and calcium supplementation had doses tapered slowly over the course of 4 weeks. Patients with suction drains placed at the time of surgery were admitted for observation regardless of PTH, as was the surgeons’ preference. This allowed for drains to be cared for by nursing staff and for in-hospital monitoring of the conditions that necessitated drain placement. Drains were used in the case of large substernal goiters, large vascular Grave’s glands, lateral neck dissections, and with underlying coagulopathy or anticoagulative therapy. Patients with significant comorbidities and those who desired admission were also observed overnight. Although these patients (including those admitted for drain placement) were ineligible for discharge, they were supplemented based on the established PTH-based protocol. This provided the benefit of early, selective supplementation to all patients and maintained consistency in supplementation for the entire cohort. All patients were given verbal and preprinted instructions advising them to call for symptoms of neck swelling, difficulty breathing, or symptomatic hypocalcemia (ie, perioral paresthesias or muscle spasms).

General data regarding age, gender, indication for thyroidectomy, operation performed, and major complications were collected. Outcomes recorded included discharge eligibility, incidence of outpatient symptomatic hypocalcemia, admission or readmission to the hospital, and number of emergency department or unscheduled office visits. Laboratory data collected included preoperative PTH, preoperative vitamin D, preoperative calcium, PACU calcium, PACU PTH, PACU albumin, POD 1 calcium (for admitted patients), POD 7 calcium (for all patients), and POD 30 calcium (patients requiring early supplementation). The incidence of drain placement, admissions related to drain placement, and rate of hematoma was also recorded.

Standard descriptive statistical methods were used to determine the mean and standard deviation for continuous variables and proportions for categorical data. Chi-square tests were used to compare differences in proportions, and the analysis of variance (ANOVA) or Student’s t test was used for the comparison of means between subgroups of patients, such as completion versus total thyroidectomy or minimally invasive versus standard technique. A P value <.05 was used to indicate statistical significance. Hypoparathyroidism was defined as PTH <15 pg/mL and hypocalcemia was defined as albumin-adjusted calcium <8.0 mg/dL.

**Results**

One hundred eighty patients of mean age 48.9 ± 16.0 years and of 83.3% female gender underwent 139 total (77.2%) and 41 completion (22.7%) thyroidectomies during the study period. Of the 139 total thyroidectomies performed, 15.8% (22/139) included central or lateral neck dissection, whereas 31.7% (13/41) of completion thyroidectomies included neck dissection. Of all surgeries, 42.2% (76/180) were performed with minimally invasive video-assisted technique. Final diagnoses included 48.8% (86/180) multinodular goiter, 28.9 percent (52/180) thyroid carcinoma, 18.3% (33/180) Grave’s...
disease, 3.3% (6/180) multinodular goiter with microscopic foci of thyroid carcinoma, 1.1% (2/180) multiple endocrine neoplasia type 2A, and 0.06% (1/180) Grave’s disease with microscopic foci of thyroid carcinoma.

Neither final diagnoses (P = .29) nor whether a completion or total thyroidectomy (including neck dissections) was performed (P = .34) resulted in a statistically significant difference in the rate of postoperative hypoparathyroidism, defined as PACU PTH <15 pg/mL (Table 1). Excluding neck dissection data, completion thyroidectomy did result in a lower rate of postoperative hypoparathyroidism when compared with total thyroidectomy, but this was not statistically significant either (11.1% vs 22.2%, P = .28, Table 2). Whether the operation was performed with or without a minimally invasive video-assisted technique also did not yield a significant difference in the development of hypoparathyroidism (25.0% vs 19.2%, P = .37).

A summary of preoperative and postoperative laboratory data is displayed in Table 3. Mean PACU-drawn PTH was not significantly different from preoperative PTH (43.4 vs 38.7, P = .10). Overall, 11.1% of patients admitted overnight had an adjusted serum calcium level in the hypocalcemic range (adjusted Ca <8.0 mg/dL) on POD 1. This included 15% (6/39) of patients observed because of PTH <20 pg/mL and 7% (3/42) of patients who were observed overnight despite PTH <20 pg/mL. All 180 patients were euclidean at a 1-week postoperative visit. No patients were hypocalcemic at POD 30, and no patients required calcium or vitamin D supplementation at POD 30. No patients had permanent hypoparathyroidism.

Seventy-six percent (137/180) of patients had a PACU PTH greater than 20 pg/mL and were therefore eligible for same-day discharge by our algorithm (Table 4). This included 109 patients with PTH >30 pg/mL and 28 patients with PTH between 20 and 30 pg/mL. Twenty-four percent (43/180) of patients had a PTH level <20 pg/mL, and 21.7% (39/180) had a PTH level <15 pg/mL. No patients had an undetectable PTH (PTH < 2.5 pg/mL in our lab).

Sixty-nine percent (95/137) of those eligible (PTH >20 pg/mL) were discharged the same day, representing 53.1% (95/180) of the total cohort. Of the 95 patients undergoing outpatient surgery, no patients were readmitted to the hospital and no patients were seen in the emergency department, seen in the office, or called for symptoms of hypocalcemia. One patient (1/85) who was initially admitted postoperatively (PACU PTH 4 pg/mL) was readmitted 36 hours after discharge for symptomatic hypocalcemia. This patient had been noncompliant with home supplementation.

All patients who had a drain placed at the time of surgery were admitted for observation. Overall, 11.7% (21/180) of patients had a drain placed at the time of surgery due to either a large substernal goiter, large vascular Grave’s gland, need for lateral neck dissection, or associated coagulopathy anticoagulation. Thus, 88.3% (159/180) did not have a drain placed. One early hematoma (0.6%) occurred in a patient who had a suction drain placed intraoperatively. No other hematomas or postoperative hemorrhages occurred. Of those potentially eligible for same-day discharge by PACU PTH >20 pg/mL, 10.2% (14/137) were observed overnight because of drain placement. The remainder were either discharged from same-day surgery (69.3%, 95/137) or were admitted for overnight observation because of comorbidities, distant travel, or patient/family preference (20.5%, 28/137).

### Discussion

Using PACU PTH >20 pg/mL as a discharge criterion, 76% of patients undergoing total or completion thyroidectomy were eligible for same-day discharge. Sixty-nine percent of those eligible, and 53% of the total cohort, were discharged the same day. Of those discharged same day, no patients were readmitted, called, or were seen for symptoms related to hypocalcemia. These results compare favorably to three of the most recently published reports on outpatient thyroid surgery. Snyder recently presented 1064 outpatient hemithyroidectomies and total thyroidectomies, all of whom received postoperative supplementation routinely (500 mg of oral calcium and vitamin D, three times a day). Snyder et al reported a 14% incidence of asymptomatic outpatient hypocalcemia and a 5.2% incidence of symptomatic outpatient hypocalcemia in a cohort who underwent 58% total, 12% other bilateral, and 30% unilateral thyroidectomy. In a 2009 study, Trotter et al presented 233 patients undergoing outpatient thyroid surgery. Patients at risk for hypocalcemia were treated with oral calcium routinely (500 mg four times a day). Of the 136 patients undergoing total, subtotal, or completion thyroidectomy (43, 75, and 18, respectively), 4.4% were treated or admitted for symptomatic hypocalcemia. Lastly, Seybt Terris reported on

### Table 1. Diagnoses and Postoperative Hypoparathyroidism (Parathyroid Hormone <15 pg/mL)

<table>
<thead>
<tr>
<th>Final Diagnosis</th>
<th>Percentage of Total</th>
<th>Postoperative Hypoparathyroidism, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multinodular goiter</td>
<td>48.8</td>
<td>17.4</td>
</tr>
<tr>
<td>Thyroid carcinoma</td>
<td>28.9</td>
<td>23.1</td>
</tr>
<tr>
<td>Grave’s disease</td>
<td>18.3</td>
<td>27.3</td>
</tr>
<tr>
<td>Multinodular goiter with microscopic foci of carcinoma</td>
<td>3.3</td>
<td>33.3</td>
</tr>
<tr>
<td>MEN 2A</td>
<td>1.1</td>
<td>0</td>
</tr>
<tr>
<td>Grave’s with microscopic foci of carcinoma</td>
<td>0.06</td>
<td>100</td>
</tr>
</tbody>
</table>

Abbreviation: MEN 2A, multiple endocrine neoplasia type 2A

### Table 2. Operation Performed and Postoperative Hypoparathyroidism (Parathyroid Hormone <15 pg/mL)

<table>
<thead>
<tr>
<th>Operation</th>
<th>Number Performed</th>
<th>Postoperative Hypoparathyroidism, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completion thyroidectomy</td>
<td>27</td>
<td>11.1</td>
</tr>
<tr>
<td>Total thyroidectomy</td>
<td>117</td>
<td>22.2</td>
</tr>
<tr>
<td>Minimally invasive</td>
<td>76</td>
<td>25.0</td>
</tr>
<tr>
<td>Non–minimally invasive</td>
<td>104</td>
<td>19.2</td>
</tr>
</tbody>
</table>

*Excluding cases with neck dissection.*
Table 3. Perioperative Laboratory Results

<table>
<thead>
<tr>
<th>Laboratory Results</th>
<th>Adjusted Total Calcium, Mean ± SD</th>
<th>Parathyroid Hormone, Mean ± SD</th>
<th>Vitamin D (25-OH), Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative</td>
<td>9.5 ± 0.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>38.7 ± 17.6</td>
<td>30.2 ± 13.5</td>
</tr>
<tr>
<td>Postanesthesia care unit</td>
<td>8.7 ± 0.5</td>
<td>43.4 ± 37.1</td>
<td>—</td>
</tr>
<tr>
<td>Postoperative day 1</td>
<td>8.7 ± 0.6</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Postoperative day 7</td>
<td>9.6 ± 0.7</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

<sup>a</sup>Unadjusted total calcium.

Table 4. Parathyroid Hormone–Based Discharge Algorithm and Results

<table>
<thead>
<tr>
<th>PACU PTH, pg/mL</th>
<th>Percentage of Total</th>
<th>Supplementation</th>
<th>Eligible for Discharge</th>
<th>Actual Same-Day Discharge</th>
<th>Patients Readmitted for Hypocalcemia</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;30</td>
<td>60.5</td>
<td>None</td>
<td>Yes</td>
<td>69.3</td>
<td>0</td>
</tr>
<tr>
<td>20-30</td>
<td>15.6</td>
<td>Oral calcium (500 mg twice daily)</td>
<td>No</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>&lt;20</td>
<td>23.9</td>
<td>Oral calcium (1 g 4 times a day) and calcitriol (3 µg loading, 0.5 µg every day)</td>
<td>No</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

418 patients in their most recent experience with outpatient thyroidectomy.<sup>5</sup> Of the 219 patients undergoing total or completion thyroidectomy, 79 patients were discharged same day and treated with a 3-week calcium/vitamin D taper, routinely. Of these 79 outpatients, 5.1% (4/79) were readmitted with symptomatic hypocalcemia.

Thus, although routine supplementation appears to be a favorable replacement strategy, resulting in acceptably low rates of outpatient hypocalcemia, a PTH-based protocol may result in lower rates of outpatient hypocalcemia. Although this conclusion is not supported by our study design, it is conceivable that a PTH-based protocol ensures admission for those most profoundly hypoparathyroid patients who may be discharged using other outpatient protocols. Further prospective study is encouraged in this regard.

Another advantage of a PTH-based supplementation strategy is that it is presumably a surgeon- or technique-independent method of evaluation. Whereas 76% of our population met the discharge criterion, others, being more or less adept at preserving the parathyroid glands, may have varying results. However, personalized results should be reflected in a patient’s PACU PTH, and a surgeon can make an individualized judgment as to the safety of same-day discharge. We have found this attribute to be particularly valuable in the training atmosphere, allowing residents instant feedback as to their technique in preserving the parathyroids.

Although a comprehensive review of outpatient thyroidectomy is beyond the scope of this discussion, our results are consistent with myriad studies that advocate outpatient total thyroidectomy as both safe and efficient.<sup>1</sup>,<sup>5</sup>,<sup>14</sup>,<sup>16</sup> Major apprehensions to outpatient total thyroidectomy are generally related to the routine use of suction drains for the prevention of postoperative hematoma and potential airway compromise and concern for postoperative hypocalcemia and potential tetany. The results of the current study and our experience in general are consistent with the growing consensus that the routine use of suction drains offers no discernible benefit and does not prevent postoperative hematomas.<sup>17</sup>,<sup>18</sup> Of the 88.3% (159/180) of patients in our cohort who did not receive a surgical drain, none developed a postoperative hematoma. Of the 21 patients who did receive a drain, one (0.6% of the total cohort) developed a hematoma in the early postoperative period and required operative evacuation. This patient had a drain placed because of a large substernal goiter. This example emphasizes that the surgeon’s judgment continues to be a critical component in the decision for drain placement and need for inpatient admission.

With regard to concerns for postoperative hypocalcemia, we have presented a seemingly dependable guideline for same-day discharge: patients with PACU PTH >20 pg/mL are at minimal risk for the development of symptomatic hypocalcemia when supplemented appropriately. Furthermore, our data may question whether a cutoff of PTH <20 pg/mL is perhaps too conservative a threshold for discharge (none of the 95 patients with PTH >20 pg/mL developed clinically significant hypocalcemia), but we have found PTH <20 pg/mL to be a safe, comfortable guideline for discharge eligibility and prefer to err on the side of safety.

One other result worth noting is that the indication for operation did not result in statistically significant differences in rates of postoperative hypoparathyroidism (Table 1). This is in contrast to previous studies, including McHenry et al, who found hypothyroidism and thyroid cancer to be independent risk factors for the development of hypocalcemia.<sup>19</sup>,<sup>20</sup> In addition, total thyroidectomy did not result in statistically significant differences in the rate of postoperative hypoparathyroidism when compared with completion thyroidectomy. This is consistent with results of a previous study by our group and reinforces the conclusion that postoperative calcium management is warranted for patients undergoing completion thyroidectomy.<sup>21</sup> However, it may be of particular interest to those surgeons who routinely perform outpatient surgery for first-time hemithyroidectomies but not for completion thyroidectomies that only 11% of completion thyroidectomies were hypoparathyroid postoperatively, and none had symptomatic outpatient hypocalcemia per our protocol.
On a final note, 2 disadvantages of a PTH-based discharge algorithm are its lack of availability at some institutions and the increased cost of running the rapid PTH assay. At our institution, the hospital charge for a rapid PTH assay is just under $100, whereas the actual cost is closer to $10. Although a formal cost analysis was beyond the scope of this study, we believe a PTH-based algorithm to be a cost-effective practice if it can facilitate outpatient surgery. This is in light of a 2007 study by Terris reporting a $2474 reduction in hospital charges with ambulatory surgery. In the present study, 53% of patients undergoing total or completion thyroidectomy underwent same-day discharge. In addition, the current PTH protocol was able to spare the use of calcitriol (recommended because PTH is needed for the hydroxylation of standard, over-the-counter vitamin D) in 76% of our cohort. This is somewhat significant in that an outpatient course of calcitriol at our institution costs between $50 and $70. In terms of the assay itself, we use a rapid PTH assay that is processed by our central laboratory. This is essentially an intact PTH assay that is run with turnover times less than 30 minutes, although commercially available standalone kits are also available. While a review of its availability is beyond the scope of this discussion, the rapid PTH assay is becoming increasingly more available as its use in parathyroid surgery has become more standard.

Conclusion
A PTH-based discharge algorithm safely facilitates outpatient total and completion thyroidectomy. Patients with PACU PTH >30 pg/mL and those with PACU PTH between 20 and 30 pg/mL when supplemented with oral calcium are at minimal risk of significant outpatient hypocalcemia. Preprinted discharge instructions advising patients to call for symptoms of hypocalcemia (including perioral paresthesias and muscle spasms) should be provided to patients undergoing total or completion thyroidectomy.

Author Contributions
Jeffrey J. Houlton, study design, data acquisition and analysis, drafting of article, final approval of article; William Pechter, data acquisition, revision of article, final approval of article; David L. Steward, study design, data analysis, revision of article, final approval of article.

Disclosures
Competing Interests: David L. Steward: Veracyte-Participating in a Clinic Trial with.
Sponsorships: None.
Funding source: None.

References