A Single Parathyroid Hormone Level Obtained 4 Hours after Total Thyroidectomy Predicts the Need for Postoperative Calcium Supplementation

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BACKGROUND: Parathyroid hormone (PTH) levels after total thyroidectomy have been shown to predict the development of symptomatic hypocalcemia and the need for calcium supplementation. This study aimed to determine whether a PTH level drawn 4 hours postoperatively is as effective as a level drawn on postoperative day 1 (POD1) in predicting this need.

STUDY DESIGN: This is a single-institution retrospective review of 4-hour and POD1 PTH levels in patients who underwent total thyroidectomy from January 2012 to September 2012. If POD1 PTH was ≥10 pg/mL, patients did not routinely receive supplementation; if PTH was <10 pg/mL, patients received oral calcium with or without calcitriol.

RESULTS: Of 77 patients, 20 (26%) had a 4-hour PTH <10 pg/mL; 18 (90%) of these patients had a POD1 PTH <10 pg/mL. No patient with a 4-hour PTH ≥10 pg/mL had a POD1 PTH <10 pg/mL. All 18 patients with POD1 PTH <10 pg/mL received calcium supplementation. Three additional patients received supplementation due to reported symptoms or surgeon preference. A 4-hour PTH ≥10 pg/mL compared with a POD1 PTH had a similar ability to predict which patients would not need calcium supplementation; sensitivity was 98% vs 98%, specificity was 90% vs 86%, and and negative predictive value was 95% vs 95%. Of 21 patients who received supplementation, 13 (62%) also received calcitriol, including 9 patients (69%) with a 4-hour PTH <6 pg/mL.

CONCLUSIONS: A single PTH level obtained 4 hours after total thyroidectomy that is ≥10 pg/mL accurately identifies patients who do not need calcium supplementation or additional monitoring of serum calcium levels. Same-day discharge, if deemed safe, can be accomplished with or without calcium supplementation based on the 4-hour PTH level. Greater consideration should be given to calcitriol supplementation in patients with a 4-hour PTH <6 pg/mL. (J Am Coll Surg 2014;219:757–764. © 2014 by the American College of Surgeons)

Hypocalcemia due to inadvertent devascularization or removal of parathyroid glands is the most frequent complication after total thyroidectomy, and occurs in 2% to 47% of patients.13 The majority of cases of iatrogenic hypoparathyroidism are transient (defined as <6 months), but rates of permanent hypoparathyroidism have been reported to be as high as 14%.27 The optimal approach to identify individuals at risk for clinically significant hypocalcemia after total thyroidectomy remains poorly defined. Various protocols have been published for postoperative patient management, and many patients receive repeated unnecessary laboratory testing. Some authors suggest routine calcium supplementation of all patients with calcium and/or calcitriol and others recommend selective supplementation based on serum calcium and/or parathyroid hormone (PTH) levels.23-21

Using early postoperative PTH levels as a guide for calcium and vitamin D management is well established.10,12,15,18,19 The 2007 Australian Endocrine Surgeons guidelines12 reported that a normal postoperative PTH level drawn 4 hours after total thyroidectomy is highly predictive of normocalcemia. In a recent prospective randomized

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study of patients who underwent completion/total thyroidectomy, we demonstrated that a single PTH level on postoperative day 1 (POD1) was highly specific for predicting those patients at risk for clinically significant hypocalcemia.18 Only 10% of patients with a POD1 PTH level \( \geq 10 \text{ pg/mL} \) reported transient symptoms suggesting possible hypocalcemia and none of these patients required calcium supplementation at hospital discharge.

Previous studies have not demonstrated a difference between postoperative PTH levels obtained at 4 hours vs 23 hours.10,14 The hypothesis of this study is that a 4-hour PTH level accurately identifies those patients who do not need calcium and/or vitamin D supplementation (PTH level \( \geq 10 \text{ pg/mL} \)) and, importantly, allows for early identification and supplementation of patients at risk for postoperative hypocalcemia (PTH \( < 10 \text{ pg/mL} \)), which potentially reduces the frequency and severity of hypocalcemic symptoms in this patient subset.

**METHODS**

This is a single-institution, retrospective review of all patients who underwent total or completion thyroidectomy by one of three endocrine surgeons between January and September 2012. Patients who underwent simultaneous parathyroidectomy (for hyperparathyroidism) and those younger than 18 years of age were excluded. This study was approved by our institutional IRB.

Before surgery, serum calcium, PTH, and 25-OH vitamin D levels were obtained, and vitamin D supplementation (ergocalciferol 50,000 U weekly) was recommended for patients with a preoperative 25-OH vitamin D \( < 32 \text{ ng/mL} \). Operative management for patients with differentiated thyroid cancer and for parathyroid autotransplantation at our institution has been described previously.18 Although we routinely autograft all devascularized parathyroid glands, an autograft would not be expected to function in the early postoperative period. A serum PTH level was obtained at 4 hours after surgery and on the morning of POD1 (Fig. 1). Calcium supplementation (2,500 mg calcium carbonate [1 g elemental calcium], 3 times daily) was initiated for patients with a PTH \( < 10 \text{ pg/mL} \), either at 4 hours or on POD1; vitamin D supplementation (calcitriol, 0.5 \( \mu \text{g} \) twice daily) was added for a PTH \( < 2.5 \text{ pg/mL} \) and/or at the attending surgeon’s discretion. Asymptomatic patients with a 4-hour PTH \( < 10 \text{ pg/mL} \) and a POD1 PTH \( \geq 10 \text{ pg/mL} \) were not discharged on calcium supplementation. Symptomatic patients were evaluated on a case by case basis; symptomatic hypocalcemia was defined as any patient who reported symptoms of perioral or digital numbness/tingling, or muscle cramps in the upper or lower extremities. Patients were contacted 24 to 72 hours after discharge and symptoms of hypocalcemia were documented and treated as necessary.

At the first postoperative clinic visit, patients were evaluated for symptoms of hypocalcemia. Patients who were not discharged on supplementation and who remained asymptomatic did not routinely have laboratory tests done. Serum calcium and PTH levels were obtained only for those patients started on calcium supplementation and/or calcitriol supplementation, or if persistent symptoms of hypocalcemia were reported after discharge; laboratory tests were not routinely obtained for patients who were started on ergocalciferol preoperatively. Our institution uses a standard protocol for management of hypocalcemic symptoms and weaning of calcium and calcitriol: patients taking both calcitriol and calcium are first weaned from calcitriol by decreasing the dosage by 0.25 \( \mu \text{g} \) every 3 days, and once weaned from calcitriol, the dose of calcium carbonate is decreased by 1 g elemental calcium every 3 days. Serum calcium and PTH levels were not routinely obtained after the first postoperative visit.

Data collected included age; sex; preoperative and postoperative calcium, PTH, and 25-OH vitamin D levels; extent of surgery (simultaneous central and/or lateral neck dissection, parathyroid autotransplantation); and final pathology (including benign disease vs cancer and parathyroid tissue removed). Postoperative calcium and calcitriol supplementation and presence of hypocalcemic symptoms when in hospital and after discharge were recorded. The primary outcomes measured included need for routine calcium supplementation based on either 4-hour PTH \( < 10 \text{ pg/mL} \) and/or development of symptomatic hypocalcemia (as defined here). Statistical analysis was performed using STATA IC 12 software (Stata Corp). A p value \(< 0.05\) was considered statistically significant.
RESULTS

Demographics
A total of 77 patients underwent completion/total thyroidectomy. Median age was 50 years (range 20 to 82 years) and 66 (86%) were female. Preoperative laboratory results included median serum calcium level of 9.3 mg/dL (range 7.8 to 10.3 mg/dL); median PTH level of 41.8 pg/mL (range 15.7 to 137 pg/mL), and median 25-OH vitamin D level of 30.3 ng/mL (range 6.2 to 87.2 ng/mL). Of the 41 (53%) patients with preoperative 25-OH vitamin D levels <32 ng/mL, 11 (27%) patients actually initiated supplementation with ergocalciferol before surgery.

Of the 77 operations, 73 (95%) were total thyroidectomies and 4 (5%) were completion thyroidectomies. The indication for surgery was biopsy-proven thyroid cancer in 26 (34%) patients. Of the remaining 51 patients, 44 (57%) had benign disease and 7 (9%) had incidental thyroid cancer on final pathology. Central neck dissection was performed in 25 (32%) patients; 15 were bilateral and 10 were unilateral. Parathyroid autotransplantation was performed in 27 (35%) of the 77 patients. Parathyroid tissue was identified in the final specimen in 15 (19%) patients; including 8 (10%) patients who also underwent parathyroid autotransplantation. Of the 15 patients with parathyroid tissue identified in the final specimen, 7 (47%) underwent central neck dissection.

Predicting need for calcium supplementation based on timing of parathyroid hormone levels
At 4 hours after surgery, 20 (26%) of the 77 patients had PTH <10 pg/mL (median 5.4 pg/mL; range 2.3 to 9.8 pg/mL). Of these 20 patients, 2 had a POD1 PTH >10 pg/mL and were not discharged on calcium supplementation. One of these two patients (4-hour PTH 7.5 pg/mL, POD1 PTH 10.2 pg/mL) subsequently reported symptoms of hypocalcemia after discharge and was started on oral calcium supplementation. Based on a 4-hour and POD1 PTH <10 pg/mL, 18 (23%) patients were discharged on oral calcium supplementation; 7 (9%) patients were also started on calcitriol, including the 2 patients with PTH levels <2.5 pg/mL. Of the 18 patients with 4-hour and POD1 PTH <10 pg/mL that were discharged on oral calcium supplementation, the median calcium level on POD1 was 7.9 mg/dL (range 6.2 to 9.2 mg/dL) (Table 1).

The remaining 57 (74%) patients had PTH ≥10 pg/mL at 4 hours (median 27.7 pg/mL; range 10.2 to 97.1 pg/mL) and on POD1 (median 27.7 pg/mL; range 11.2 to 61.3 pg/mL); no patient with a 4-hour PTH ≥10 pg/mL had a POD1 PTH <10 pg/mL. Of these 57 patients, 2 received oral calcium supplementation in the postoperative period. One patient (4-hour PTH 14.9 pg/mL; POD1 PTH 16.7 pg/mL; calcium 7.3 mg/dL) was asymptomatic for hypocalcemia but was started on calcium supplementation before discharge at the discretion of the attending surgeon. The remaining patient (4-hour PTH 16.9 pg/mL; POD1 PTH 14.1 pg/mL; calcium 7.4 mg/dL) reported symptoms on POD2 and calcium and calcitriol supplementation was initiated. Of the 57 patients who had 4-hour and POD1 PTH ≥10 pg/mL, the median calcium level on POD1 was 8.3 mg/dL (range 7.3 to 9.4 mg/dL). The difference in median calcium levels trended toward, but did not reach, statistical significance (p = 0.051).

Overall, 19 (25%) of the 77 patients were discharged on oral calcium supplementation and 2 (2.6%) patients required the addition of calcium supplementation as an outpatient. Using a serum PTH ≥10 pg/mL as the threshold, a 4-hour PTH had a specificity of 90% and POD1 PTH had a specificity of 86% in predicting which patients did not need calcium supplementation after total thyroidectomy (Table 2; p > 0.05). The sensitivity and negative predictive value of 4-hour PTH and POD1 PTH were equivalent.

Parathyroid tissue was autotransplanted and/or identified in the final specimen in 34 (44%) patients. There was no difference in 4-hour (14.7 vs 17.7 pg/mL; p = 0.07) or POD1 PTH (26.5 vs 26.4 pg/mL; p = 0.08) levels between patients who underwent parathyroid autotransplantation and/or had inadvertent parathyroid excised and those who did not. Two patients who did not undergo autotransplantation had two sites of parathyroid tissue identified in final specimen, including one patient with previous gastric bypass who ultimately required oral calcium and calcitriol supplementation and was readmitted for IV calcium (4-hour PTH 8.7 pg/mL; POD1 PTH 7.6 pg/mL). The second patient did not require any supplementation (4-hour PTH 11.5 pg/mL; POD1 PTH 13.4 pg/mL).
From the cohort of 77 patients, 54 (70%) had calcium levels below the normal range at our institution (≤8.5 mg/dL). Of these, 17 (31%) patients had a 4-hour PTH <10 pg/mL, of which 7 (41%) reported symptoms of hypocalcemia. All of these patients received calcium supplementation based on the 4-hour PTH. Of the 23 patients with normal calcium levels, 3 (13%) had a 4-hour PTH <10 pg/mL. All 3 of these patients also reported symptoms of hypocalcemia and received supplementation based on the 4-hour PTH. Two patients with 4-hour PTH levels ≥10 pg/mL and calcium levels ≤8.5 mg/dL received supplementation for reported symptoms in one patient and at the discretion of the surgeon in the other.

Management of 13 patients with symptoms consistent with hypocalcemia

Symptoms of hypocalcemia were reported in 13 (17%) patients postoperatively (Fig. 2). All patients reported symptoms within the first 72 hours after surgery and only one patient reported symptoms before discharge. Of these, 9 (69%) were patients with 4-hour and POD1 PTH <10 pg/mL; 6 (46%) were discharged on oral calcium supplementation and 3 (23%) were discharged on oral calcium supplementation and calcitriol. Calcitriol was added after discharge in 5 of these 9 patients due to persistent symptoms being reported. Of the remaining 4 patients who reported symptoms of hypocalcemia, 1 patient had a 4-hour PTH <10 pg/mL, but a POD1

Table 2. Predictive Value of 4-Hour Parathyroid Hormone vs Postoperative Day 1 Parathyroid Hormone for Patients Not Requiring Supplementation

<table>
<thead>
<tr>
<th>Patients with PTH &lt;10 pg/mL</th>
<th>Patients with PTH &gt;10 pg/mL</th>
<th>PTH, pg/mL, median (range)</th>
<th>Sensitivity, %</th>
<th>Specificity, %</th>
<th>Positive predictive value, %</th>
<th>Negative predictive value, %</th>
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</thead>
<tbody>
<tr>
<td>4-Hour PTH</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>20.1 (2.3–97.1)</td>
<td>98</td>
</tr>
<tr>
<td>POD1 PTH</td>
<td>18</td>
<td>23</td>
<td>59</td>
<td>77</td>
<td>23.2 (2.4–61.3)</td>
<td>98</td>
</tr>
</tbody>
</table>

POD, postoperative day; PTH, parathyroid hormone.

Figure 2. Breakdown of patients with reported symptoms of hypocalcemia within first 72 hours. *Four patients who received IV calcium. POD, postoperative day; PTH, parathyroid hormone.
PTH ≥10 pg/mL, and 1 patient had both a 4-hour and a POD1 PTH ≥10 pg/mL; both patients reported symptoms consistent with hypocalcemia and have been detailed in the previous section. The other two patients had both 4-hour and POD1 PTH ≥10 pg/mL and reported transient, self-limited symptoms consistent with hypocalcemia that did not require calcium supplementation and did not have additional laboratory testing performed, either at the time of reported symptoms or at their postoperative clinic visit.

Overall, 21 patients received oral supplementation (19 at the time of discharge); 8 patients received supplementation with just calcium carbonate and 13 received supplementation with both calcium and calcitriol (7 at the time of discharge). For the 21 patients who received oral calcium supplementation, median 4-hour PTH was 5.4 pg/mL (range 2.3 to 16.9 pg/mL) and at POD1 was 6.5 pg/mL (range 2.4 to 16.7 pg/mL). Median calcium level at POD1 was 7.8 mg/dL (range 6.2 to 9.2 mg/dL).

Of the 13 patients who received calcitriol supplementation, median 4-hour PTH was 5.2 pg/mL (range 2.3 to 16.9 pg/mL), and only 4 (31%) patients had a 4-hour PTH level >6 pg/mL (range 7.3 to 16.9 pg/mL). Of the 8 patients who did not receive calcitriol supplementation, median PTH at 4 hours was 6.9 pg/mL (range 4.9 to 14.9 pg/mL) and 5 (63%) had a PTH level >6 pg/mL. Overall, 12 (16%) patients had a 4-hour PTH <6 pg/mL and 9 (75%) of these patients were thought to need supplementation with both calcium and calcitriol. In contrast, only 4 (44%) of the 9 patients with a 4-hour PTH >6 pg/mL were thought to need calcitriol in addition to calcium supplementation; therefore, the sensitivity of a 4-hour PTH <6 pg/mL for predicting the need for the addition of calcitriol supplementation was 69%, with a positive predictive value of 75%.

In total, 4 patients were admitted for postoperative hypocalcemia requiring IV calcium; all 4 patients had PTH <10 pg/mL at 4 hours (median 3.6 pg/mL; range 2.4 to 7.7 pg/mL) and on POD1 (median 3.6 pg/mL; range 2.4 to 7.6 pg/mL). Two patients were initially discharged on calcium alone and required admission at 4 and 7 days after discharge despite the addition of calcitriol, including one patient who had previous gastric bypass surgery. The remaining two patients were discharged on calcium and calcitriol and required readmission at 2 and 3 days postoperatively.

**Postoperative follow-up**

Of the 21 patients who received postoperative oral calcium supplementation, median PTH was 6.5 pg/mL (range 2.3 to 13.4 pg/mL) at the first postoperative clinic visit, and 7 (33%) of the 21 patients had a PTH level ≥10 pg/mL. Of the 18 patients with 4-hour PTH <10 pg/mL, the median first outpatient PTH was 5.7 pg/mL (range 2.3 to 12.8 pg/mL) and 5 (28%) of 18 patients had PTH ≥10 pg/mL. Overall, median duration of calcium supplementation was 27 days (range 3 to 286 days) and calcitriol supplementation was 11 days (range 6 to 286 days). At the time of last follow-up (median 150 days; range 10 to 330), 4 (5%) of 77 patients still required calcium and calcitriol supplementation. For these 4 patients, median PTH at 4 hours was 4.3 pg/mL (range 2.4 to 8.7 pg/mL) and at POD1 was 4.1 pg/mL (range 2.4 to 7.6 pg/mL). Median calcium level at POD1 was 7.9 mg/dL (range 7.2 to 8.8 mg/dL). Median follow-up was at 6 days postoperatively (range 2 to 8 days).

**DISCUSSION**

Symptoms consistent with transient hypocalcemia are common after total thyroidectomy and require early identification in an effort to identify those patients at risk for significant hypoparathyroidism. The use of postoperative PTH levels has demonstrated the most promise in identifying high-risk patients and has been widely studied. A single PTH <10 pg/mL obtained the morning after surgery has been shown to predict risk for symptomatic hypocalcemia. In this study, we demonstrate that the sensitivity of a single PTH level measured 4 hours after total thyroidectomy is equal to a POD1 PTH for predicting patients who will not require calcium supplementation, facilitating same-day discharge, if deemed safe, for patients with a PTH ≥10 pg/mL. Early detection of hypoparathyroidism in patients with PTH <10 pg/mL after total thyroidectomy allows for prompt supplementation of at-risk patients, minimizes the number of patients needing calcium supplementation and follow-up calcium and PTH testing, and can facilitate same-day discharge.

For optimal timing of postoperative PTH measurement, Lombardi and colleagues performed a prospective study of 53 patients who underwent total thyroidectomy and they measured PTH levels preoperatively, at the end of the operation, and at 2, 4, 6, 24, and 48 hours postoperatively. They found that PTH levels <10 pg/mL at 4 and 6 hours accurately predicted symptoms of postoperative hypocalcemia with an overall accuracy of 98%. In a follow-up study in 2006, they measured PTH only at 4 hours after surgery, and found that a 4-hour PTH <10 pg/mL was 80% sensitive in predicting hypocalcemia, with a false-negative rate of 13.4%. In contrast, Sywak and colleagues prospectively studied 100 patients after total thyroidectomy and measured PTH levels at 4 and 23 hours postoperatively. They found no significant
difference between mean PTH concentrations at 4 and 23 hours after surgery. When they evaluated the sensitivity and specificity of various cut-off points of PTH concentrations (<3, 10, and 20 pg/mL) for predicting postoperative hypocalcemia, there was no significant difference in accuracy of PTH concentration at the time points studied. The authors recommended a single PTH level >10 pg/mL drawn 4 hours after operation, which provided a sensitivity of 90% and a specificity of 84% in predicting postoperative hypocalcemia.

Raffaelli and colleagues21 reported a prospective evaluation of 230 patients who underwent thyroidectomy and received calcium supplementation based on 4-hour PTH and POD1 calcium levels. All 59 patients with PTH ≤10 pg/mL received calcium and calcitriol supplementation, 25 patients with 4-hour PTH ≥10 pg/mL and POD1 calcium <8.5 mg/dL received calcium supplementation and 146 patients with a 4-hour PTH >10 pg/mL and POD1 calcium ≥8.5 mg/dL received no supplementation initially. Symptoms did develop subsequently in one patient in the cohort with an initial 4-hour PTH >10 pg/mL and POD1 calcium ≥8.5 mg/dL and calcium and calcitriol supplementation was required. Although they reported that only 6.5% of the entire cohort experienced symptomatic hypocalcemia, 37% of the cohort received routine calcium supplementation. In our cohort, 37 (48%) patients had a calcium ≤8.5 mg/dL with a 4-hour PTH ≥10 pg/mL and were discharged without routine calcium supplementation; only 2 initiated calcium supplementation due to reported, transient symptoms of hypocalcemia. Therefore, the Raffaelli protocol would substantially increase the number of patients in our cohort who received, but did not require, calcium supplementation.

The results of our study demonstrate that a single PTH level obtained 4 hours after total thyroidectomy accurately separates the post-thyroidectomy patients into two groups with respect to risk for hypocalcemia; those at risk (PTH <10 pg/mL) and those at no risk (PTH ≥10 pg/mL). For the at-risk patients, earlier supplementation can prevent symptomatic hypocalcemia in those with a PTH level of borderline physiologic significance (range 6 to 10 pg/mL). For those patients with a PTH level that might be too low to prevent symptoms of hypocalcemia (<6 pg/mL), both calcium and dihydroxylated vitamin D (calcitriol) is recommended as soon as the low PTH level is identified. In the entire cohort of 77 patients, only 3 received oral calcium supplementation for a POD1 PTH ≥10 pg/mL. Of these 3 patients, 1 had a 4-hour PTH <10 pg/mL and might have benefited from calcium supplementation in the immediate postoperative period. In the group of 20 patients with 4-hour PTH <10 pg/mL, 10 patients reported symptoms consistent with hypocalcemia; however, it is difficult to assess if earlier supplementation mitigated the severity or duration of hypocalcemic symptoms in these patients. Taken together, these findings support the use of calcium supplementation if the 4-hour PTH level is <10 pg/mL because of the excellent predictive value of this early PTH assessment. The need for calcitriol supplementation is more difficult to predict, however, the findings in this study suggest that patients with a 4-hour PTH level <6 pg/mL can benefit from the addition of calcitriol without the consequence of overtreatment; this threshold has been described previously to define patients who might require additional supplementation.19

Based on the results of this study and a previous randomized controlled trial from our institution, our institutional practice has now been modified to obtain a single PTH level 4 hours after total thyroidectomy, with routine calcium and selective calcitriol supplementation for patients with PTH <10 pg/mL.18 No routine laboratory tests are obtained on POD1. Patients with PTH ≥10 pg/mL who report no symptoms of hypocalcemia are discharged without calcium supplementation and do not have laboratory tests checked at their postoperative visit. Patients discharged on supplementation have a serum calcium and PTH obtained at their postoperative clinic visit and are weaned accordingly.

There are limitations to this study. First, we relied on documentation in the electronic medical record of patient-reported symptoms so under- and over-reporting of symptoms is possible. This assumes that symptoms accurately reflect physiologic hypocalcemia, which is not the case, some symptoms were of course not related to the serum calcium level. In addition, the severity of symptoms was not recorded, therefore, it is difficult to correlate the extent of symptom severity with the need to initiate calcium and/or calcitriol supplementation (in the absence of intravenous administration of calcium, which we interpreted as clear evidence of physiologically significant hypocalcemia). Second, for patients with PTH <10 pg/mL, the optimal supplementation regimen using calcium and calcitriol remains unknown, as only one quarter of our patients had a PTH <10 pg/mL. Despite early supplementation, there were 4 patients who required admission for IV calcium. Three of these patients had a PTH <6 pg/mL at 4 hours and POD1, but only two were started on calcitriol before discharge, therefore, the one patient might have benefited from earlier initiation of calcitriol. The optimal supplementation regimen for patients with low PTH levels requires additional investigation. Still, our data suggest that patients with PTH <6 pg/mL can benefit from calcitriol supplementation. However, the strength of this
study is the focus on clinically significant, symptomatic hypocalcemia requiring calcium supplementation irrespective of serum calcium levels. This is in contrast to previous studies, which have defined hypocalcemia strictly by serum calcium levels and used thresholds for supplementation based on calcium levels alone or in conjunction with PTH levels, irrespective of the presence of hypocalcemic symptoms. Therefore, it is difficult to ascertain from these earlier studies the true rate of symptomatic hypocalcemia that requires supplementation after total thyroidectomy.2,8,10,16,19-22

CONCLUSIONS
The results of this prospective study suggest that a single PTH level ≥10 pg/mL at 4 hours after total thyroidectomy accurately identifies patients who will not require routine postoperative calcium supplementation. A PTH level <10 pg/mL at 4 hours after total thyroidectomy strongly predicts development of clinically significant hypocalcemia (positive predictive value = 96%) and has the predictive ability equivalent to a POD1 PTH <10 pg/mL; a 4-hour PTH level <6 pg/mL might be the threshold for which calcitriol supplementation is beneficial. In summary, a 4-hour PTH can afford the benefit of allowing earlier initiation of selective supplementation with calcium and calcitriol, which might mitigate the development, severity, and duration of hypocalcemic symptoms. In addition, a 4-hour PTH ≥10 pg/mL prevents unnecessary calcium supplementation or additional monitoring of serum calcium levels. Same-day discharge, if deemed safe, can be accomplished with or without calcium supplementation based on the 4-hour PTH level.

Author Contributions
Study conception and design: Carr, Yen, Cayo, Evans, Wang
Acquisition of data: Carr, Yen, Cayo, Misustin, Wang
Analysis and interpretation of data: Carr, Yen, Evans, Wang
Drafting of manuscript: Carr, Yen, Wang
Critical revision: Carr, Yen, Fareau, Evans, Wang

REFERENCES


