

## Use of Parathyroid Hormone Assay after Thyroidectomy: A Survey of US and European Surgeons

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### Abstract

**Introduction:** Hypocalcemia after thyroidectomy results in prolongation of hospitalization and patient discomfort but can be predicted by PTH assays. However, there is considerable variation in their use.

**Methods:** This study was undertaken to document current US and European practice patterns regarding the use of this assay. Anonymous surveys were collected in 2009–2011 from members of the American Academies of Otolaryngology-Head and Neck Surgery and Endocrine Surgery and the European, Italian, French, Spanish and British Societies of Endocrine Surgery.

**Results:** There were 356 American (3% response) and 61 European (10% response) respondents. 105 (29.8%) American and 25 (41%) European respondents reported routine PTH assay use. Fellowship trained surgeons reported increased use of the PTH assay ( $P = 0.004$ ). Shorter reported average post-operative hospital stay was associated with American physicians ( $P = 0.0001$ ), community practice location ( $P = 0.0002$ ) and routine calcium supplementation ( $P = 0.0015$ ).

**Conclusions:** Surgical training was associated with routine use of the PTH assay. Average reported hospital stay was lower for American and community practice physicians and correlated with post-operative oral calcium use.

**Keywords:** thyroidectomy, parathyroid hormone, standard of care, survey study, hypocalcemia, hypoparathyroidism

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## Introduction

Hypocalcemia, a common complication after thyroidectomy, results in prolongation of hospitalization and patient discomfort. It occurs transiently in up to 30%, and permanently in up to 4% of patients after this procedure.<sup>1</sup> Traditionally, predicting this common complication has been accomplished by following calcium trends every 6–12 hours for 24–48 hours, after which levels generally plateau.<sup>2,3</sup>

Since 2002, numerous studies have shown that the parathyroid hormone (PTH) assay, checked minutes to hours after completing surgery, is excellent in predicting those patients who will become hypocalcemic.<sup>4–18</sup> Multiple algorithms detailing clinically-practical and cost-effective means to use PTH assay after thyroid surgery have been documented. A recent meta-analysis of studies published from 2002 through 2007 addressed different methods.<sup>2</sup> The authors concluded that obtaining a PTH level 1 to 6 hours following total or completion thyroidectomy has excellent accuracy in determining who will become hypocalcemic. While there have been many positive studies finding utility in post-operative PTH assays, a few reports have found PTH level is not able to accurately predict post-thyroidectomy hypocalcemia.<sup>19,20</sup> Anecdotally, there appears to be considerable variation in practice regarding routine PTH assays among surgeons performing this procedure.

In light of these practice variations, this survey study was undertaken to document current US and European practice patterns regarding the use of this assay, particularly in terms of how surgeon demographics are associated with use of the assay and whether use of the assay is related to reported length of hospitalization.

## Materials and Methods

Approval for this study was obtained from the Institutional Review Board at Walter Reed Army Medical Center. The survey outlined in Table 1 was sent to 10,618 members of the American Academy of Otolaryngology-Head and Neck Surgery (AAO-HNS) and the American Association of Endocrine Surgeons (AAES). These surveys were distributed via email and paper copy to AAES and AAO-HNS surgeons twice from March 2009 thru November 2010. To ascertain the practice patterns of European physicians, the same survey (in English) was sent via online newsletter

**Table 1.** Survey questions submitted via online and hardcopy.

### Background information

What is your age?

What is your sex?

What type of training do you have (otolaryngology vs. general surgery, fellowship training)?

What type of practice (academic vs. private)?

How many years in practice?

How many thyroidectomies per year?

format to the 600 members of the European, Italian, French, Spanish and British Societies of Endocrine Surgery in 2010 and 2011.

No protected health information was collected. Settings were established electronically to exclude storage of IP addresses and any potential personal identifying information. Survey responses were organized in database format and analyzed using SAS 9.1, SAS Institute, Cary, NC. An alpha of 0.05 was used as the criterion for significance.

We began by examining the cutoffs used for all survey questions.  $N < 5$  was selected as the cutoff for an insufficient number of responses. Individuals age 20–30, rate of permanent hypocalcemia  $> 6\%$ , and rate of autotransplantation  $> 75\%$  all had  $n = 4$  respondents and were collapsed into the closest category. For basic analyses, chi-square tests were used unless predicted values dictated use of Fisher's exact test. For the adjusted analyses, logistic regression was used with PTH assay usage, and rate of temporary/permanent hypocalcemia (ordered multinomial response model). Models were constructed with variables expected to be potential confounders without further refining. Discharge time was also modeled using ordered logistic regression. However, without a priori assumptions of expected contributors, automated backward selection was used with a staying criterion of an alpha of 0.10 to determine factors predictive of inpatient duration.

## Results

Over 10,618 American resident and staff surgeons were surveyed. There were 356 respondents, corresponding to a response rate of 3.35%. Of the 600 European physicians surveyed, 61 returned the survey, corresponding to a response rate of 10.1%. Among the American physicians, most respondents



had completed otolaryngology residency training programs without head and neck fellowship and were employed by either a group practice or academic institution. European physicians in the survey predominately represented general surgeons with a mixture of training levels and were based at academic institutions. American respondents reported a wide range of experience in thyroid surgery with 22% reporting <20 thyroidectomies/yr, 28% reporting 20–50/yr, 22% reporting 50–100/yr, and 28% reporting >100/yr. In contrast, 70% of European physicians reported >100 thyroidectomies per year, with the other frequencies each ~10%. See Table 2 for details.

Routine PTH assay use, whether alone or in conjunction with routine calcium monitoring, was reported by 105 (29.8%) American and 25 (41%) of European respondents. In the unadjusted analyses, assay use was correlated with sex (higher in men), years in practice (lower use in older physicians), fellowship training (higher use in fellowship-trained) and an academic practice location (higher use in academic settings). The same relationships held true in the adjusted analysis, except for academic location, which was no longer significant after controlling for the other factors. See Table 3 for details.

**Table 2.** Survey respondents and training type.

Characteristic	Category	American	European
Sex	Male	87.9%	88.5%
	Female	12.2%	11.5%
Age	20–40	19.2%	9.8%
	40–50	38.3%	42.6%
	>50	42.5%	47.5%
Years in independent practice	<2	8.8%	8.2%
	2–10	26.8%	41.0%
	10–20	33.1%	26.2%
Number/year	>20	31.3%	24.6%
	<20	22.2%	9.8%
	20–50	27.6%	8.2%
Training type	50–100	21.9%	11.5%
	>100	28.4%	70.5%
	General (endocrine) surgery	35.7%	93.4%
Fellowship-trained	Otolaryngology	64.3%	6.6%
	Yes	26.6%	44.3%
Practice type	No	73.4%	55.7%
	Academic	45.8%	93.4%
	Community	54.2%	6.6%

**Table 3.** Correlation between demographic/training patterns and PTH assay use and temporary/permanent hypocalcemia.

Characteristic	PTH assay use		Temporary hypocalcemia		Permanent hypocalcemia	
	Unadjusted#	Adjusted*.,^	Unadjusted#	Adjusted*.,^,\$	Unadjusted#	Adjusted*.,^
Sex (female)	P = 0.0278 (lower in women)	OR = 0.293 (P = 0.0057)	P = 0.0987 (lower in women)	Overall model is not significant—ie, after adjusting for confounding, these characteristics together do not predict reported rate of temporary hypocalcemia	P = 0.5186 (lower in women)	OR = 0.759 (P = 0.4010)
Years in independent practice	P = 0.0006 (lower in more)	OR = 0.640 (P = 0.0004)	P = 0.7569 (increased w/# years)		P = 0.3838 (increased w/# years)	OR = 1.342 (P = 0.0136)
Number of thyroidectomies/year	P = 0.8067 (increase together)	OR = 0.936 (P = 0.5790)	P = 0.0036 (decrease if # is high)		P < 0.0001 (increase together)	OR = 1.250 (P = 0.0451)
Residency (general surgery)	P = 0.0748 (higher in general surg)	OR = 1.329 (P = 0.3758)	P = 0.0021 (lower in general surg)		P = 0.0019 (higher in general surg)	OR = 0.699 (P = 0.2353)
Fellowship training (yes)	P = 0.0005 (higher if fellowship)	OR = 1.865 (P = 0.0145)	P = 0.8336 (higher in fellowship)		P = 0.0067 (higher in fellowship)	OR = 1.315 (P = 0.2704)
Practice type (academic)	P = 0.0045 (academic higher)	OR = 1.149 (P = 0.6455)	P = 0.0116 (academic lower)		P < 0.0001 (academic higher)	OR = 2.589 (P = 0.0010)
Nationality (American)	P = 0.0833 (lower in American)	OR = 0.861 (P = 0.6527)	P = 0.0197 (higher in American)		P = 0.0037 (lower in American)	OR = 0.553 (P = 0.0725)

**Notes:** #Chi-square P-values; \*logistic regression, adjusted for sex, years in practice, fellowship, nationality, number/year, practice type, and residency type; ^odds > 1 indicate a higher chance of reporting elevated rates of hypocalcemia.



There was some variability in survey respondents regarding how they use the PTH assay. The most common usage was 1 hour following total thyroidectomy in the post-anesthesia care unit (35.5%), followed by the next day (27.5%). See Table 4 for details. There was no consensus among survey respondents regarding reasons for not using the PTH assay. Respondents cited lack of change in management (33.8%) and unavailability of assay (24.6%) as the most common reasons for not utilizing the assay. See Table 5 for details.

The survey also queried self-reported estimates of the rates of temporary and permanent hypocalcemia. In the unadjusted analysis, lower self-reported temporary hypocalcemia rate was associated with a higher number of thyroidectomies performed, general surgery residency, academic practice and European physicians, but not sex, number of years in practice, or fellowship training. See Table 3 for details. In the adjusted logistic regression analysis, the available information did not significantly predict the rate of reported temporary hypocalcemia (overall  $P > 0.05$ ), and therefore no individual characteristics were reported.

In both the adjusted and unadjusted analyses, a lower rate of self-reported permanent hypocalcemia rate was associated with number of thyroidectomies performed annually, with an increase in rate as the number of surgeries per year increases (odds ratio = 1.256,  $P = 0.0451$  adjusted), and with academic practice location (odds ratio = 2.589,  $P = 0.0010$  adjusted). Nationality, residency type and fellowship training were significant in the unadjusted analysis only, and years in independent practice became significant only after adjustment. See Table 3 for details. Routine prophylactic use of calcium supplementation regardless of calcium status for post-thyroidectomy patients was split, with 42.5% of respondents using prophylactic calcium and 57.5% of responders not using prophylactic calcium.

**Table 4.** Reasons for assay non-use.

Use time	Number reporting
Intraoperatively	22 (15.9%)
In post-anesthesia care unit	49 (35.5%)
6 hours post-op	6 (4.4%)
Next morning	38 (27.5%)
Other	23 (16.7%)

**Table 5.** PTH assay usage timing.

Reasons	Number reporting
Lack of knowledge	21 (7.7%)
No change in management	92 (33.8%)
Not available	67 (24.6%)
Cost	47 (17.3%)
Not standard of care	33 (12.1%)
Other	12 (4.4%)

Finally, the survey explored self-reported post-operative hospitalizations. The most common time of discharge was the morning after surgery (see Table 6). Ordered logistic regression with backwards selection was used to evaluate for factors correlated with length of stay. Shorter average post-operative hospital stay for thyroidectomy patients was associated with American physicians (OR = 0.333,  $P = 0.0001$ ) and the opinion that holding patients until calcium levels plateau is not necessary (OR = 0.218,  $P < 0.0001$ ). Academic practice location (OR = 2.253,  $P = 0.0002$ ) and lack of routine calcium supplementation (OR = 2.016,  $P = 0.0015$ ) were associated with greater length of stay. Physicians who did not use the PTH assay reported shorter length of stay (OR = 0.630,  $P = 0.290$ ). Years in independent practice, sex, residency type, fellowship and number of thyroidectomies per year were not predictive ( $P > 0.10$ ).

## Discussion

It is well established that one of the most common complications of thyroid surgery is the development of hypocalcemia. The risk of hypoparathyroidism increases in reoperative thyroid surgery and when central neck dissection is associated,<sup>21,22</sup> decreases with the use of Harmonic scalpel.<sup>23</sup> Traditionally, monitoring and managing this complication is based on patient symptoms and serum calcium levels. Parathyroid hormone is widely used in clinical practice in diagnosing

**Table 6.** Discharge timing.

Discharge time	Number reporting
Same day	17 (4.1%)
Next morning	187 (45.5%)
Next afternoon	58 (14.1%)
Two days	115 (28.0%)
Three days	34 (8.3%)



primary and secondary hyperparathyroidism.<sup>24–26</sup> Within the last decade, the use of parathyroid hormone assay has gained increasing use as a reliable tool to predict postoperative hypocalcemia within hours of total or complete thyroidectomy.<sup>1–14</sup>

It was determined through a polling of the audience during an instructional course given at the 2008 American Academy of Otolaryngology—Head and Neck Surgery annual meeting that only about 4.5% of the surgeons in the audience used the PTH assay postoperatively. Thus, it was surmised that the popularity or knowledge of the PTH assay might be less than expected. A formal survey was created to elaborate on the questions posed to the audience at the annual meeting with the objective of exploring demographic factors related to assay use as well as determining any trends in post-thyroidectomy hospitalization.

Based on the results of our combined survey, we determined that a more accurate value of PTH assay utilization (alone or in combination with calcium trends) approximates 30% in the US and 40% in Europe. Furthermore, the provider responses indicate a significant relationship between type of surgical training and likelihood of utilizing the PTH assay. It was evident that individuals with fellowship training in head and neck surgery or endocrine surgery were more likely to use the PTH assay as part of their routine post-thyroidectomy monitoring. The reason for this increased PTH assay utilization by fellowship-trained individuals was not specifically explored with this survey. However, multiple potential explanations for this finding may be advanced. First, fellowship trained surgeons are more likely complete their training at larger tertiary care facilities where the assay is more readily available, thus they become accustomed to using the assay and ultimately make it part of their routine plan of care. Alternatively, these individuals may be more apt to practice at a tertiary care facility once completing their fellowship training, thus maintaining the availability of the assay for their use. Arguing against this second hypothesis is the finding that after adjusting for other factors (including fellowship training), current practice location was not a significant predictor of PTH assay use.

Aside from these demographic trends and assay utilization, the questions posed in this survey were aimed at determining if any factors could be identified associated with post-thyroidectomy

hospitalization protocols. It was determined that practice location, use of the PTH assay, nationality, and routine calcium supplementation are significantly associated with self-reported post-operative hospitalization. The relationship between the longer self-reported hospitalizations associated with PTH assay use is an unexpected finding. Previous studies have explored the association of shorter hospitalization and cost savings with the use of the PTH assay. In particular, Payne et al described a protocol in which 1 and 6-hour post-thyroidectomy monitoring of PTH and corrected calcium have led to fewer blood tests, a 10-hour reduction in length of hospital stay and ultimately a cost savings of \$766 per patient.<sup>27</sup> A similar study published by Cote et al explored using the PTH assay alone as a means for cost savings at their institution.<sup>17</sup> They determined that a 1-hour PTH cutoff of <15 ng/L should serve as an indication for prophylactic calcium supplementation. Per their report, this resulted in an approximate 20% reduction in hospitalization duration that resulted in cost savings for their institution. Given this background, we speculate that our findings of longer hospitalization are more appropriately interpreted in the reverse—physicians with longer length of stay (LOS) are starting to turn to the assay in an attempt to better identify patients who can be discharged safely at an earlier time point. Other factors not explored in this survey, such as complexity of surgery performed, particularly in benign vs. neoplastic disease, may also account for some of this difference.

When interpreting the results of this survey, we acknowledge the inherent weaknesses of this investigation. The study design itself opens itself to bias, as all data is self-reported. We did not prevent repeated completion of the survey by each respondent; however we doubt that many surgeons would be likely to complete the survey more than once. The response rate of 3.35% among the American physicians was low, and the European physicians were polled within a limited group, which restricts our ability to generalize our findings. These low response rates are probably results of time constraints experienced by most surgeons as well as the large number of survey studies that are received by most physicians.

Additionally, our attempts to measure some potential confounding factors probably omitted some contributing factors. Unmeasured confounders may



account for some of the relationships or lack thereof seen in this data.

Despite the low response rate, the results of this surgeon survey provides valuable information suggesting interesting relationships between training type and propensity for PTH assay utilization, as well as post-operative hospitalization patterns related not only to training type but to PTH assay utilization and post-operative calcium supplementation. These results set the stage for considering further studies aimed at considering if and how demographic and training factors, specifically training type as identified in this survey study, impact the use of the assay and ultimately change standards of care. This survey also illuminates the large degree of practice variation in this area, suggesting either that best practices have not yet been determined, or inefficiency in their adoption among surgeons performing this procedure.

## Conclusions

Approximately one-third of thyroid surgeons surveyed routinely obtain PTH assays for patients undergoing thyroidectomy, and the use of the assay is associated with sex, fellowship completion, and years in practice. Further studies about use patterns and adoption of best practices appear warranted.

## Author Contributions

Conceived and designed the experiments: DJS, JPN. Analyzed the data: DJS, JK. Wrote the first draft of the manuscript: DJS, JPN. Contributed to the writing of the manuscript: IKM, SB. Agree with manuscript results and conclusions: IKM, SB. Jointly developed the structure and arguments for the paper: PGC, JK. Made critical revisions and approved final version: PGC, JPN. All authors reviewed and approved of the final manuscript.

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## Disclosures and Ethics

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to compliance with ICMJE authorship and competing interests guidelines, that the article is neither under consideration for publication nor published elsewhere, of their compliance with legal and ethical guidelines concerning human and animal research participants (if applicable), and that permission has been obtained for reproduction of any copyrighted material. This article was subject to blind, independent, expert peer review. The reviewers reported no competing interests.

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