Risk Factors for Neck Hematoma after Thyroid or Parathyroid Surgery: Ten-Year Analysis of the Nationwide Inpatient Sample Database

Ahmed Dehal, MD, MPH; Ali Abbas, MD, MPH; Farabi Hussain, MD; Samir Johna, MD

Perm J 2015 Winter;19(1):22-28
http://dx.doi.org/10.7812/TPP/14-085

ABSTRACT

Context: Postoperative neck hematoma is a well-known complication of thyroid and parathyroid surgery. Better understanding of risk factors for hematoma formation will help define high-risk populations.

Objective: To examine possible risk factors for neck hematoma after thyroid or parathyroid surgery.

Design: Retrospective analysis of hospital discharge data from the Nationwide Inpatient Sample database.

Methods: Using the International Classification of Diseases, Ninth Revision, Clinical Modification diagnosis and procedures codes, we identified adults who underwent thyroid or parathyroid surgery and in whom neck hematoma subsequently developed. Information about demographic, clinical, and hospital characteristics was collected. Multivariate regression analyses were used to predict independent risk factors for neck hematoma.

Results: We identified 147,344 thyroid and parathyroid operations performed nationwide between 2000 and 2009. Overall incidence of postoperative neck hematoma was 1.5% (n = 2210). In multivariate analysis, age 65 years and older (odds ratio [OR] = 1.8, 95% confidence interval [CI] = 1.4-2.1), male sex (OR = 1.3, 95% CI = 1.2-1.4), African-American race (OR = 1.5, 95% CI = 1.2-1.7), being from the South (OR = 1.3, 95% CI = 1-1.4), comorbidity score of 3 or more (OR = 2, 95% CI = 1.6-2.6), history of alcohol abuse (OR = 2.7, 95% CI = 1.6-2.5), Graves disease (OR = 3, 95% CI = 2.1-4.1), and substernal thyroidectomy (OR = 3.3, 95% CI = 2.8-3.9) were associated with a higher risk of neck hematoma.

Conclusion: We identified demographic and clinical factors associated with increased risk of neck hematoma after thyroid or parathyroid surgery.

INTRODUCTION

Postoperative hemorrhage is a well-known complication of thyroid and parathyroid surgery and can be life-threatening because of acute airway obstruction. Because close observation, early detection, and airway management are keys to managing this complication, the risk of postoperative hemorrhage may be a limiting factor for outpatient thyroid surgery or early discharge from the hospital.[1-3]

Previous research has shown that certain patient demographics (age and male sex), underlying thyroid pathology (malignant histology), and extent of resection (total vs partial thyroidectomy) are associated with an increased risk of postoperative hemorrhage.[4-6] Although these subgroups have been identified empirically to be at greater risk of postoperative bleeding complications, there is little evidence from large-scale nationwide studies to support this notion. The rarity of neck hematoma has been a challenge in evaluating the factors associated with it.

A better understanding of risk factors for hematoma formation will help in identifying those who are at risk of this complication. The objective of this study was, using a nationwide database, to identify risk factors for the development of neck hematoma after thyroid or parathyroid surgery.

METHODS

Study Design and Data Source

This is a retrospective analysis of hospital discharge data from the Nationwide Inpatient Sample (NIS) database between 2000 and 2009. The NIS database is a component of the Healthcare Cost and Utilization Project (HCUP), sponsored by the Agency for Healthcare and Quality. This database represents the largest inpatient database in the US. The NIS represents 20% stratified random sampling of US hospitals. The database contains data from 1050 hospitals with more than 38 million discharges annually from a variable number of states, ranging from 8 in 1988 to 44 in 2009. Detailed information on the NIS design can be found online.[7] The NIS database has been used previously in studies addressing various questions across the spectrum of medical specialties, including several studies on thyroid and parathyroid surgery.[8]

We used the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis and procedures codes to identify adult patients who underwent thyroid and parathyroid surgery for treatment of thyroid and parathyroid diseases and in whom neck hematoma (Codes 998.11 and 998.12) developed postoperatively during the same hospitalization. Primary ICD-9-CM diagnosis and procedure codes are shown in the Sidebars: ICD-9-CM Diagnosis Codes and ICD-9-CM Procedure Codes. Because

Ahmed Dehal, MD, MPH, is a Resident at the Fontana Medical Center in CA. E-mail: ahmed.n.dehal@kp.org. **Ali Abbas, MD, MPH,** is a Resident at Shands Hospital at the University of Florida in Gainesville. E-mail: aabbas983@gmail.com. **Farabi Hussain, MD,** is a General Surgeon at the Arrowhead Regional Medical Center in Colton, CA. E-mail: hussainf@armc.sbcounty.gov. **Samir Johna, MD,** is a General Surgeon at the Fontana Medical Center in CA. E-mail: samir.d.johna@kp.org.

Table 1. Patient and hospital characteristics by neck hematoma status (yes/no), Nationwide Inpatient Sample 2000-2009, N = 147,334

Variable		Yes (n = 2210) Number (%)	No (n = 145,134) Number (%)	p value[a]
Age at discharge, years	18-40	339 (15.3)	31,683 (21.9)	< 0.001
	41-65	1137 (51.4)	77,403 (53.3)	
	> 65	734 (33.2)	36,048 (24.8)	
Sex	Male	708 (32.1)	31,325 (21.8)	< 0.001
	Female	1498 (67.9)	112,653 (78.2)	
Race[b]	White	1054 (47.7)	78,001 (53.7)	< 0.001
	African American	351 (15.9)	15,622 (10.8)	
	Hispanic	115 (5.2)	9688 (6.7)	
	Asian	66 (3.0)	4385 (3.0)	
Insurance type[c]	Medicare	889 (40.3)	43,380 (29.9)	< 0.001
	Medicaid	176 (8.0)	9711 (6.7)	
	Private/Health maintenance organization	1022 (46.3)	83,967 (57.9)	
	Self-pay	48 (2.2)	3184 (2.2)	
Residential income[d]	1	479 (22.2)	24,354 (17.1)	< 0.001
	2	534 (24.7)	31,769 (22.4)	
	3	548 (25.4)	35,293 (24.8)	
	4	598 (27.7)	50,724 (35.7)	
Year of discharge	2000-2002	533 (24.1)	40,493 (27.9)	< 0.001
	2003-2006	919 (41.6)	60,889 (42.0)	
	2007-2009	758 (34.3)	43,752 (30.1)	
Geographic region	West	432 (19.5)	34,010 (23.4)	< 0.001
	South	860 (38.9)	47,250 (32.6)	
	Northeast	426 (19.3)	35,566 (24.5)	
	Midwest	492 (22.3)	28,308 (19.5)	
Charlson Comorbidity Index score	0	892 (40.4)	73,875 (50.8)	< 0.001
	1	342 (15.5)	19,232 (13.3)	
	2	508 (23.0)	32,173 (22.2)	
	≥ 3	468 (21.2)	19,854 (13.7)	
Obesity	Nonobese	2064 (93.4)	135,713 (93.5)	0.8
	Obese	146 (6.6)	9421 (6.5)	
Smoking status	Nonsmoker	1878 (85.0)	127,322 (87.7)	< 0.001
	Smoker	332 (15.0)	17,812 (12.3)	
Alcohol abuse	No	2183 (98.8)	144,617 (99.6)	< 0.001
	Yes	27 (1.2)	517 (0.4)	
Hospital bed size	Small	210 (9.5)	14,723 (10.2)	0.6
	Medium	503 (22.8)	33,176 (22.9)	
	Large	1489 (67.6)	96,894 (66.9)	
Location of hospital	Rural	147 (6.7)	9991 (6.9)	0.7
	Urban	2055 (93.3)	134,802 (93.1)	
Teaching status of hospital	Nonteaching	891 (40.5)	61,131 (42.2)	0.1
	Teaching	1311 (59.5)	83,662 (57.8)	
Hospital volume	Low	501 (22.7)	30,053 (20.7)	0.02
	High	1709 (77.3)	115,081 (79.3)	
Diagnosis	Parathyroid diseases	386 (17.5)	26,118 (18.0)	< 0.001
	Benign thyroid disease	1172 (53.0)	78,288 (53.9)	
	Thyroid cancer	530 (24.0)	36,508 (25.2)	
	Graves disease	122 (5.5)	4220 (2.9)	
Surgical procedure	Parathyroidectomy	296 (13.4)	26,259 (18.0)	< 0.001
	Partial thyroidectomy	915 (41.4)	63,662 (43.9)	
	Substernal thyroidectomy	125 (5.7)	4851 (3.4)	
	Total thyroidectomy without neck dissection	777 (35.2)	45,944 (31.7)	
	Total thyroidectomy with neck dissection	97 (4.4)	4418 (3.0)	

[a] Derived from χ^2 test for categorical variables and Student *t* test for continuous variables.
[b] Results for Native Americans, other, and unknown racial groups are not presented in this Table.
[c] Results for no charge and other insurance types are not presented in this Table.
[d] Residential income: the quartiles are identified by values of 1-4, indicating the poorest to wealthiest populations, respectively.

the NIS contains no patient identifiers, it does not require approval from the institutional review board.

Risk Factors

Patients' demographics and clinical and hospital characteristics were examined as possible risk factors. Demographics included age at discharge, sex, race, insurance type, residential income, year of discharge, and geographic region. Hospital characteristics included hospital bed size, location of hospital (urban vs rural), teaching status of hospital, and hospital volume. Clinical characteristics included comorbidity score, obesity, smoking status, alcohol abuse, underlying diagnosis, and type of surgical procedure.

Using unique hospital identification numbers, we estimated hospital volume using a method previously described.[9] First, we calculated the total number of thyroid and parathyroid operations for each hospital during the 10 study years. We then ranked hospitals in order of increasing total volume and selected a volume cutoff (75th percentile) that sorted hospitals into 2 groups: low and high volume. Comorbidities were identified using ICD-9-CM codes and used to calculate the modified Charlson Comorbidity Index (CCI).[10] We divided patients on the basis of CCI score into 4 groups: 0, 1, 2, and ≥ 3. The most recent ICD-9 coding algorithm by Deyo et al[11] was used to identify those comorbidities (see Sidebar: List of ICD-9-CM codes for comorbidities).

The underlying diagnoses were regrouped into four main groups as follows: parathyroid disease, benign thyroid diseases, thyroid cancer, and Graves disease. Types of surgical procedures were also regrouped into five main groups as follows: parathyroidectomy, partial thyroidectomy, substernal thyroidectomy, total thyroidectomy without neck dissection, and total thyroidectomy with neck dissection (see Sidebar: ICD-9-CM Diagnosis Codes and ICD-9-CM Procedure Codes).

ICD-9-CM Diagnosis Codes

Parathyroid disease	
194.1	Malignant neoplasms of parathyroid gland
227.1	Benign neoplasms of parathyroid gland
252	Disorders of parathyroid gland
Benign thyroid disease	
240	Simple and unspecified goiter
241	Nontoxic nodular goiter
242	Thyrotoxicosis with or without goiter (excluding 242.0)
243	Congenital hypothyroidism
244	Acquired hypothyroidism
245	Thyroiditis
246	Other disorders of thyroid gland
226	Benign neoplasms of thyroid gland
Thyroid cancer	
193	Malignant neoplasms of thyroid gland
Graves disease	
242.0	Toxic diffuse goiter

ICD-9-CM Procedure Codes

Parathyroidectomy	
06.8	Parathyroidectomy
Partial thyroidectomy	
06.2	Unilateral thyroidectomy
06.3	Other partial thyroidectomy
Substernal thyroidectomy	
06.5	Substernal thyroidectomy
Total Thyroidectomy	
06.4	Total thyroidectomy
Neck dissection	
40.4	Radical neck dissection, not otherwise specified
40.41	Radical neck dissection, unilateral
40.42	Radical neck dissection, bilateral
40.21	Excision of deep cervical lymph node[a]

[a] Included only if associated with an ICD Procedure Code specific to thyroid.

Outcomes

The primary dependent variable of interest was the incidence of neck hematoma. Patient and hospital characteristics were examined as possible risk factors for neck hematoma after thyroid or parathyroid surgery. Secondary analyses were conducted to examine the clinical and economic consequences of neck hematoma by comparing the hospital charges, length of stay (LOS), and inhospital mortality between patients who experienced neck hematoma and those who did not. Increased hospital charges were defined as charges above the 75th percentile. Prolonged LOS was defined as a LOS above the 75th percentile. Inhospital mortality was defined as death during hospitalization.

Statistical Analysis

Simple descriptive analyses such as counts and percentages were used to describe data. Some continuous data (age and LOS) are reported as mean or median values. Univariate analyses were performed to examine the association between the aforementioned risk factors and the incidence of neck hematoma using the χ^2 test for the categorical variables and the Student *t* test for the continuous variables. Chi squared test also was used to compare the hospital charges, LOS, and inhospital mortality between patients who experienced neck hematoma and those who did not. We then performed a series of multivariate logistic regression analyses using forward and backward stepwise methodology and simultaneous inclusion to calculate the odds ratio (OR) and p value for the association between patients' and hospitals' characteristics as independent risk factors for neck hematoma after thyroid or parathyroid surgery. Our objective was to define the models by keeping only the statistically significant and clinically relevant predictors using backward stepwise elimination of the nonsignificant predictors.

For all statistical analyses, considering the larger sample size in this study, the threshold for significance was 0.001. All analyses were generated using SAS software, Version 9.3 for Windows (SAS Institute Inc, Cary, NC).

RESULTS

We identified 147,344 thyroid and parathyroid operations that were performed between 2000 and 2009. Among those, 2210 patients (1.5%) experienced postoperative neck hematoma. The mean age at diagnosis was 57 years (vs 53 years for patients without neck hematoma). The median LOS was 3 days (vs 1 day for patients without neck hematoma). In univariate analyses, age at discharge, sex, race, type of insurance, residential income, year of discharge, geographic distribution,

smoking and alcohol abuse history, comorbidity, underlying diagnosis, and type of surgical procedure were found to have significant influence on the incidence of neck hematoma ($p < 0.001$). The risk of neck hematoma did not seem to be related to obesity. None of the hospital characteristics were statistically significant in the univariate analyses (Table 1).

Factors that were found to be statistically significant in the univariate analyses were included in the multivariate analyses. The results of multivariate analyses are presented in Table 2. Age 65 years and older (OR = 1.8, 95% confidence interval [CI] = 1.4-2.1), male sex (OR = 1.3, 95% CI = 1.2-1.4), African-American race (OR = 1.5, 95% CI = 1.2-1.7), being from the South (OR = 1.3, 95% CI = 1-1.4), comorbidity score of 3 or more (OR = 2, 95% CI = 1.6-2.6), history of alcohol abuse (OR = 2.7, 95% CI = 1.6-2.5), Graves disease (OR = 3, 95% CI = 2.1-4.1), and substernal thyroidectomy (OR = 3.3, 95% CI = 2.8-3.9) were associated with a higher risk of neck hematoma.

Table 3 presents the results of the univariate analyses for the associations between neck hematoma and certain clinical and economic factors. Increased hospital charges were billed to approximately 60% of patients with neck hematoma, compared with only 23.7% of patients without neck hematoma ($p < 0.001$). The LOS was prolonged in 56.4% of those who had neck hematoma vs only 18% of those without neck hematoma ($p < 0.001$). The total number of deaths was 53 (2.4%) compared with 498 (0.3%) among patients without neck hematoma ($p < 0.001$; see Table 3).

DISCUSSION

In this large nationwide study, we found that neck hematoma is rare after thyroid or parathyroid surgery but is associated with worse clinical and economic outcomes. Age, sex, race, geographic region, comorbidity, alcohol abuse, underlying diagnosis, and type of surgical procedure were found to be independent risk factors for neck hematoma. In contrast, none of the hospital-related factors (hospital bed size, location of hospital, teaching status of the hospital, and hospital volume) were found to be associated with increased risk of this complication.

The incidence of postoperative neck hematoma in our study (1.5%) was similar to that reported in the literature (0.1%-4.7%).[1-4] Consistent with findings from previous studies, demographic characteristics such as older age

Table 2. Multivariate adjusted analysis of risk factors for neck hematoma after thyroid and parathyroid surgery, Nationwide Inpatient Sample 2000-2009

Variable		n	Number of events (%)	OR	CI	p value
Age at discharge, years	18-40 (reference)	32,022	339 (1.1)	1		
	41-65	78,540	1137 (1.4)	1.4	1.1-1.6	0.002
	> 65	36,782	734 (2)	1.8	1.4-2.1	< 0.001
Sex	Female (reference)	114,151	1498 (1.3)	1		
	Male	32,033	708 (2.2)	1.3	1.2-1.4	< 0.001
Race	White (reference)	79,055	1054 (1.3)	1		
	African American	15,973	351 (2.2)	1.5	1.2-1.7	< 0.001
	Hispanic	9803	115 (1.2)	0.9	0.7-1.1	0.26
	Asian	4451	66 (1.5)	1.3	1.0-1.7	0.04
Geographic region	West (reference)	34,442	432 (1.3)	1.0		
	South	48,110	860 (1.8)	1.3	1.1-1.4	< 0.001
	Northeast	35,992	426 (1.2)	0.9	0.8-1	0.37
	Midwest	28,800	492 (1.7)	1.2	1-1.4	0.003
Charlson Comorbidity Index score	0 (reference)	74,767	892 (1.2)	1		
	1	19,574	342 (1.7)	1.4	1.2-1.7	< 0.001
	2	32,681	508 (1.6)	1.8	1.4-2.1	< 0.001
	≥ 3	20,322	468 (2.3)	2	1.6-2.6	< 0.001
Alcohol abuse	No (reference)	146,800	2183 (1.5)	1		
	Yes	544	27 (5)	2.7	1.6-2.5	< 0.001
Diagnosis	Parathyroid diseases (reference)	26,504	386 (1.5)	1		
	Benign thyroid disease	79,460	1172 (1.5)	1.5	1.2-1.8	< 0.001
	Thyroid cancer	37,038	530 (1.4)	0.9	0.8-1.2	0.8
	Graves disease	4342	122 (2.8)	3	2.1-4.1	< 0.001
Surgical procedure	Parathyroidectomy (reference)	26,555	296 (1.1)	1	.	
	Partial thyroidectomy	64,577	915 (1.4)	1.5	1.3-1.7	< 0.001
	Substernal thyroidectomy	4976	125 (2.5)	3.3	2.8-3.9	< 0.001
	Total thyroidectomy without neck dissection	46,721	777 (1.7)	1.7	1.5-2	< 0.001
	Total thyroidectomy with neck dissection	4515	97 (2.1)	2.3	1.7-4.7	< 0.001

CI = confidence interval; OR = odds ratio.

Table 3. Comparison of patient clinical and economic outcomes by neck hematoma status, Nationwide Inpatient Sample 2000-2009, N = 147,344

Variable	Yes (n = 2210) Number (%)	No (n = 145,134) Number (%)	p value[a]
Hospital charges above 75th percentile	1326 (60)	34,419 (23.7)	< 0.001
Length of stay above 75th percentile	1246 (56.4)	26,095 (18.0)	< 0.001
Death during hospitalization	53 (2.4)	498 (0.3)	< 0.001

[a] Derived from a χ^2 test.

and male sex were independent risk factors for neck hematoma.[4-6] African-American race was an independent risk factor for neck hematoma in this study. Similarly, patients from the South had a higher risk of neck hematoma compared with patients from other regions. To the authors' knowledge, no previous studies have examined race or geographic distribution as possible risk factors for this complication. Our findings are consistent with previous studies that failed to show any relation between obesity and risk of hematoma formation.[12] The current study findings show an incremental trend in the incidence of neck hematoma from 2000 to 2009; this trend reaches statistical significance in the univariate but not the multivariate analyses. Promberger et al[6] reported a progressive increase in the incidence of postoperative bleeding gradually over time, reaching 2.4% during 2004 to 2008. They also showed a decline in recurrent nerve injury during the study period, suggesting that the change in surgical technique that resulted in a decline in recurrent nerve injury did not lower the risk of postoperative bleeding.

List of ICD-9-CM Codes for Comorbidities

Myocardial infarction	410.x, 412.x
Congestive heart failure	398.91, 402.01, 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93, 425.4-425.9, 428.x
Peripheral vascular diseases	093.0, 437.3, 440.x, 441.x, 443.1-443.9, 447.1, 557.1, 557.9, V43.4
Cardiovascular diseases	362.34, 430.x-438.x
Dementia	290.x, 294.1, 331.2
Chronic pulmonary diseases	416.8, 416.9, 490.x-505.x, 506.4, 508.1, 508.8
Rheumatic diseases	446.5, 710.0-710.4, 714.0-714.2, 714.8, 725.x
Peptic ulcer diseases	531.x-534.x
Mild liver diseases	070.22, 070.23, 070.32, 070.33, 070.44, 070.54, 070.6, 070.9, 570.x, 571.x, 573.3, 573.4, 573.8, 573.9, V42.7
Diabetes without chronic complications	250.0-250.3, 250.8, 250.9
Diabetes with chronic complications	250.4-250.7
Hemiplegia or paraplegia	334.1, 342.x, 343.x, 344.0-344.6, 344.9
Renal diseases	403.01, 403.11, 403.91, 404.02, 404.03, 404.12, 404.13, 404.92, 404.93, 582.x, 583.0-583.7, 585.x, 586.x, 588.0, V42.0, V45.1, V56.x
Malignancy	140.x-172.x, 174.x-195.8, 200.x-208.x, 238.6
Moderate or severe liver diseases	456.0-456.2, 572.2-572.8
Metastatic solid tumor	196.x-199.x
AIDS/HIV	042.x-044.x

The association between Graves disease and the risk of neck hematoma observed in our study has been previously reported in the literature. In a large retrospective series of more than 7000 patients undergoing thyroidectomy, the highest percentage of patients requiring a repeated intervention for hematoma were those with underlying Graves disease.[13] Similarly, Palestini et al[14] found a statistically significant higher prevalence of Graves disease in patients requiring repeated interventions for hematoma compared with case controls. Contrarily, Graves disease was significant on univariate analysis but not on multivariate analysis in two other studies, possibly because those studies were too underpowered to detect an independent association.[2,12] Another limitation that affects accurately defining Graves disease as a risk factor for postoperative bleeding is the varying use of preoperative iodine (Lugol solution) among surgeons, for which we could not control. The increased vascularity of the thyroid in patients with Graves disease has been well documented.[15] Furthermore, several well-conducted studies have proved the efficacy of Lugol iodine in decreasing thyroid parenchymal blood flow in these conditions.[16]

We were surprised to find that benign but not malignant pathologic findings were associated with neck hematoma. Although neck hematoma was previously reported to increase in patients with malignant pathologic findings,[4] recently, a large multi-institutional international study by Campbell et al[17] reported a similar finding to our study. A possible explanation for this finding is that patients with benign pathologic findings frequently undergo thyroid lobectomy or subtotal thyroidectomy, which leaves behind vascularized thyroid tissue that could continue to bleed and lead to a hematoma.[18] In fact, Chi et al,[19] in a prospective randomized trial comparing bilateral subtotal thyroidectomy vs unilateral total thyroidectomy plus contralateral subtotal thyroidectomy for Graves disease, found a higher incidence of wound hematoma with the former.

Most of the published series in the literature included only patients who underwent a thyroidectomy, with the

exception of two studies. Burkey et al[12] included patients who underwent parathyroidectomy as well as thyroidectomy and identified an equal incidence of hematoma in the two groups. Rosenbaum et al[20] reported no incidence of neck hematoma in the parathyroidectomy group. In our study, the incidence of neck hematoma after parathyroidectomy was lower than its incidence after thyroidectomy.

Although all types of thyroidectomies were found to be associated with a higher risk of hematoma compared with parathyroidectomy, substernal thyroidectomy seemed to carry the highest risk. Intrathoracic goiters have also been postulated to have a greater propensity for postoperative bleeding. This condition was found to be a statistically significant factor in one study.[14] Goudet et al[21] also noted a 2% rate of early postoperative repeated operation for hemostasis in patients with substernal goiters compared with 1% for a matched population with cervical goiters, but this was not found to be significant. Neck dissection was performed in a small percentage (4.3%) of our patients, which is consistent with recent studies that report decreased use of neck dissection currently employed in minimal-access approaches to both the thyroid and parathyroid.[1]

Previous research has shown that neck dissection performed during thyroid surgery is not associated with an increase in the risk of bleeding. In a large meta-analysis, Zhu et al[22] reported results from 9 randomized controlled trials comparing total thyroidectomy with and without neck dissection among patients with thyroid cancer; results showed no difference in the risk of neck hematoma. In our study, both thyroidectomy with and without neck dissection was compared with parathyroidectomy as a reference group. The impact of thyroid resection on risk of bleeding was also evaluated in our study. Data regarding the impact of the extent of thyroid resection (partial vs total thyroidectomy) on the risk of neck hematoma are inconsistent. Several studies showed increased risk of bleeding when total thyroidectomy is performed compared with partial thyroidectomy.[17,20] However, the extent of thyroidectomy did not have an impact on the rate of hematoma formation after thyroid surgery according to other studies.[5,23] Again, we did not compare partial with total thyroidectomy. Instead, both partial and total thyroidectomy (with and without neck dissection) was compared with parathyroidectomy as a reference group. Although there was a statistically significant, progressive trend for the association between the extent of resection and risk of bleeding in our study (OR = 1.4, 1.7, and 2.1 for partial thyroidectomy, total thyroidectomy without and with neck dissection, respectively), the differences were small.

Another important finding of this study was the lack of association between hospital characteristics (including hospital volume) and our outcome of interest. A similar finding has been previously reported by Sosa et al.[24] Sosa and colleagues speculated that most patients with thyroid disease are relatively young and otherwise healthy. As a result, a superior patient outcome generally does not require a large perioperative team of surgeons, intensivists, and consultants, or complex hospital equipment and monitoring. However, their speculation might not be applicable to our study as evident from the age (mean age = 57 years) and the comorbidity (44% moderate or severe comorbidity) of our patients. Furthermore, hospital-related factors failed to reach statistical significance after adjusting for age, comorbidity, and other sociodemographic factors. Although surgeon volume was not evaluated in this study, findings from our previous unpublished work[25] and several other studies[24,26] have demonstrated the relation between surgeon experience and the risk of postoperative bleeding complications. Patients whose operations were performed by less experienced surgeons were more likely to experience complications postoperatively, including neck hematoma.

The current study was conducted using an administrative database and is subject to certain limitations. First, we did not have access to patient identifiers, and, thus, we could not link patient multiple admissions. Therefore, the study did not include patients who experienced this complication after discharge, which may have underestimated the incidence of neck hematoma. Also, for the same reason, we could not adjust for history of recurrent disease or previous surgery, which may increase the risk of neck hematoma.[27,28] On the other hand, it must be noted that the NIS includes mostly inpatient admissions. Procedures performed in an outpatient setting may not be captured. Therefore, those patients might be high-risk patients, and our findings might not be applicable to all patients. Moreover, ICD-9-CM codes used to identify postoperative neck hematoma (998.11 and 998.12) are not specific to thyroid or parathyroid surgery. This may have resulted in capturing hemorrhages that occurred elsewhere in the body but were not necessarily caused by thyroid or parathyroid surgery, thus overestimating the incidence. Finally, the NIS lacks information on the details of the surgical technique such as suture ligation and use of certain hemostatic devices,[29] postoperative vomiting, hypertension,[30] use of drains, and use of antiplatelet and anticoagulation therapies, which have been postulated to affect the incidence of neck hematoma.[18] Moreover, factors that were not accounted for, such as disorders of hemostasis, might be of importance. Finally, the NIS has no data on the weight of the thyroid gland, which is considered by many authors as the main predictor for neck hematoma.[18]

CONCLUSION

Using a large nationwide database, we found that postoperative neck hematoma is a rare but potentially life-threatening complication and is associated with increased economic burden and resource utilization. Patients' demographic and clinical characteristics, but not hospital factors, were associated with the risk of neck hematoma after thyroid or parathyroid surgery. However, all these factors except extent of surgery are patient related and, therefore, difficult to adjust. The extent of surgery might be reduced in some patients, but the choice of procedure is, in most cases, dictated by the disease. Accordingly, it seems

difficult to improve results by changing the identified risk factors. Nonetheless, surgeons should consider these factors when individualizing patient disposition after thyroid and parathyroid surgery. ❖

Disclosure Statement

The author(s) have no conflicts of interest to disclose.

Acknowledgments

This work was presented at the 2013 American College of Surgeons Clinical Congress, October 6-10, 2013 Washington, DC.

Kathleen Louden, ELS, of Louden Health Communications provided editorial assistance.

References

1. Harding J, Sebag F, Sierra M, Palazzo FF, Henry JF. Thyroid surgery, postoperative hematoma—prevention and treatment. Langenbecks Arch Surg 2006 Jun;391(3):169-73. DOI: http://dx.doi.org/10.1007/s00423-006-0028-6.
2. Leyre P, Desurmont T, Lacoste L, et al. Does the risk of compressive hematoma after thyroidectomy authorize 1-day surgery? Langenbecks Arch Surg 2008 Sep;393(5):733-7. DOI: http://dx.doi.org/10.1007/s00423-008-0362-y.
3. Dralle H, Sekulla C, Lorenz K, Grond S, Irmscher B. [Ambulatory and brief inpatient thyroid gland and parathyroid gland surgery]. [Article in German]. Chirurg 2004 Feb;75(2):131-43. DOI: http://dx.doi.org/10.1007/s00104-003-0775-7.
4. Godballe C, Madsen AR, Pedersen HB, et al. Post-thyroidectomy hemorrhage: a national study of patients treated at the Danish departments of ENT Head and Neck Surgery. Eur Arch Otorhinolaryngol 2009 Dec;266(12):1945-52. DOI: http://dx.doi.org/10.1007/s00405-009-0949-0.
5. Hurtado-López LM, Zaldivar-Ramirez FR, Basurto Kuba E, et al. Causes for early reintervention after thyroidectomy. Med Sci Monit 2002 Apr;8(4):CR247-50.
6. Promberger R, Ott J, Kober F, et al. Risk factors for postoperative bleeding after thyroid surgery. Br J Surg 2012 Mar;99(3):373-9. DOI: http://dx.doi.org/10.1002/bjs.7824.
7. Overview of the national (nationwide) inpatient sample (NIS) [Internet]. Rockville, MD: Healthcare Cost and Utilization Project, Agency for Healthcare Research and Quality; updated 2014 Jul 18 [cited 2014 Aug 11]. Available from: www.hcup-us.ahrq.gov/nisoverview.jsp.
8. HCUP publications search [Internet]. Healthcare Cost and Utilization Project. Rockville, MD: Agency for Healthcare Research and Quality; 2010 Feb 5 [cited 2014 Dec1]. Available from: www.hcup-us.ahrq.gov/reports/pubsearch/pubsearch.jsp.
9. Finlayson EV, Goodney PP, Birkmeyer JD. Hospital volume and operative mortality in cancer surgery: a national study. Arch Surg 2003 Jul;138(7):721-5. DOI: http://dx.doi.org/10.1001/archsurg.138.7.721.
10. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. J Chronic Dis 1987:40(5):373-83. DOI: http://dx.doi.org/10.1016/0021-9681(87)90171-8.
11. Deyo RA, Cherkin DC, Ciol MA. Adapting a clinical comorbidity index for use with ICD-9-CM administrative databases. J Clin Epidemiol 1992 Jun;45(6):613-9. DOI: http://dx.doi.org/10.1016/0895-4356(92)90133-8.
12. Burkey SH, van Heerden JA, Thompson GB, Grant CS, Schleck CD, Farley DR. Reexploration for symptomatic hematomas after cervical exploration. Surgery 2001 Dec;130(6):914-20. DOI: http://dx.doi.org/10.1067/msy.2001.118384.
13. Chichoń S, Anielski R, Orlicki P, Krzesiwo-Stempak K. [Post-thyroidectomy haemorrhage]. [Article in Polish]. Przegl Lek 2002;59(7):489-92.
14. Palestini N, Tulletti V, Cestino L, et al. [Post-thyroidectomy cervical hematoma]. [Article in Italian]. Minerva Chir 2005 Feb;60(1):37-44.
15. Woodcock JP, Owen GM, Shedden EJ, Hodgson KJ, MacGregor A, Srivastava A. Duplex scanning of the thyroid. Ultrasound Med Biol 1985 Jul-Aug;11(4):659-63. DOI: http://dx.doi.org/10.1016/0301-5629(85)90037-7.
16. Rodier JF, Janser JC, Petit H, et al. [Effect of preoperative administration of Lugol's solution on thyroid blood flow in hyperthyroidism]. [Article in French]. Ann Chir 1998;52(3):229-33.
17. Campbell MJ, McCoy KL, Shen WT, et al. A multi-institutional international study of risk factors for hematoma after thyroidectomy. Surgery 2013 Dec;154(6):1283-91. DOI: http://dx.doi.org/10.1016/j.surg.2013.06.032.
18. Rosato L, Avenia N, Bernante P, et al. Complications of thyroid surgery: analysis of a multicenter study on 14,934 patients operated on in Italy over 5 years. World J Surg 2004 Mar;28(3):271-6. DOI: http://dx.doi.org/10.1007/s00268-003-6903-1.
19. Chi SY, Hsei KC, Sheen-Chen SM, Chou FF. A prospective randomized comparison of bilateral subtotal thyroidectomy versus unilateral total and contralateral subtotal thyroidectomy for Graves' disease. World J Surg 2005 Feb;29(2):160-3. DOI: http://dx.doi.org/10.1007/s00268-004-7529-7.
20. Rosenbaum MA, Haridas M, McHenry CR. Life-threatening neck hematoma complicating thyroid and parathyroid surgery. Am J Surg 2008 Mar;195(3):339-43. DOI: http://dx.doi.org/10.1016/j.amjsurg.2007.12.008.
21. Goudet P, Ragois P, Guergah M, Cougard P. [Specific morbidity of substernal goiters. A comparative study with a matched series of cervical goiters]. [Article in French]. Ann Chir 1996;50(10):913-7.
22. Zhu W, Zhong M, Ai Z. Systematic evaluation of prophylactic neck dissection for the treatment of papillary thyroid carcinoma. Jpn J Clin Oncol 2013 Sep;43(9):883-8. DOI: http://dx.doi.org/10.1093/jjco/hyt087.
23. Bergamaschi R, Becouarn G, Ronceray J, Arnaud JP. Morbidity of thyroid surgery. Am J Surg 1998 Jul;176(1):71-5. DOI: http://dx.doi.org/10.1016/S0002-9610(98)00099-3.
24. Sosa JA, Bowman HM, Tielsch JM, Powe NR, Gordon TA, Udelsman R. The importance of surgeon experience for clinical economic outcomes from thyroidectomy. Ann Surg 1998 Sep;228(3):320-30. DOI: http://dx.doi.org/10.1097/00000658-199809000-00005.
25. Dehal A, Abbas A, Al-tememi M, Hussain F, Johna S. Impact of surgeon volume on incidence of neck hematoma after thyroid and parathyroid surgery: ten years' analysis of nationwide in-patient sample database. Am Surg 2014 Oct;80(10);948-52.
26. Kandil E, Noureldine SI, Abbas A, Tufano RP. The impact of surgical volume on patient outcomes following thyroid surgery. Surgery 2013 Dec;154(6):1346-52. DOI: http://dx.doi.org/10.1016/j.surg.2013.04.068.
27. Menegaux F, Turpin G, Dahman M, et al. Secondary thyroidectomy in patients with prior thyroid surgery for benign disease: a study of 203 cases. Surgery 1999 Sep;126(3):479-83. DOI: http://dx.doi.org/10.1016/S0039-6060(99)70088-7.
28. Lang BH, Yih PC, Lo CY. A review of risk factors and timing for postoperative hematoma after thyroidectomy: is outpatient thyroidectomy really safe? World J Surg 2012 Oct;36(10):2497-502. DOI: http://dx.doi.org/10.1007/s00268-012-1682-1.
29. Pardal-Refoyo JL. [Hemostatic systems in thyroid surgery and complications]. [Article in Spanish]. Acta Otorrinolaringol Esp 2011 Sep-Oct;62(5):339-46. DOI: http://dx.doi.org/10.1016/j.otoeng.2011.03.007.
30. Bononi M, Amore Bonapasta S, Vari A, et al. Incidence and circumstances of cervical hematoma complicating thyroidectomy and its relationship to postoperative vomiting. Head Neck 2010 Sep;32(9):1173-7. DOI: http://dx.doi.org/10.1002/hed.21313.

The Best Physician

He is the best physician who is the most ingenious inspirer of hope.

— Samuel Taylor Coleridge, 1772-1834, English poet, literary critic, and philosopher