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MAIN ARTICLE

Risk of bleeding after thyroid surgery: matched pairs analysis

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Abstract

Objective: To identify those patients most at risk of developing a compressive post-operative haematoma following thyroid surgery.

Method: Retrospective analysis of patients undergoing thyroid surgery. Factors associated with the group of patients who developed a post-operative haematoma were examined using a matched pairs, case–control design.

Results: Following 355 thyroid operations, seven patients developed a post-operative haematoma requiring return to the operating theatre for bleeding control. A post-operative systolic blood pressure of greater than 150 mmHg, in the post-anaesthetic care unit, was the major significant factor identified by regression analysis ($p = 0.002$). Current smoking status was also a significant factor ($p = 0.04$).

Conclusion: In our facility, a post-anaesthetic systolic blood pressure in excess of 150 mmHg was associated with an increased risk of haemorrhage following thyroid surgery.

Key words: Thyroid; Complications; Haemorrhage; Thyroid Surgery

Introduction

One of the most troubling complications following thyroid surgery is wound haematoma requiring decompression in the operating theatre. It is important to detect this problem early, as an expanding haematoma from a bleeding artery can lead to life-threatening airway compression.

The reported incidence of post-thyroidectomy bleeding varies between approximately 0.4 and 4.0 per cent, but in major centres is commonly reported to be approximately 1 per cent.[1–3] The risk is lower in hospitals that perform a large number of thyroidectomies.[4] However, no consistent relationship with individual surgeon experience has been identified;[5,6] indeed, identical post-thyroidectomy bleeding rates have been reported for both consultants and trainees.[6–8]

There is no known single major risk factor for post-thyroidectomy haematoma formation,[9] although it is generally more prevalent after total thyroidectomy than thyroid lobectomy,[3,10] and haemorrhage is more likely after surgery for Graves' disease.[3,10,11] Other authors have identified anticoagulant usage and a bleeding tendency,[1] and the onset of excessive coughing on reversal of anaesthesia,[12] as potentially important factors.

We decided to review our institution's experience of thyroid surgery in order to attempt to identify any specific factors that may help predict patients at high risk of developing post-thyroidectomy haematoma.

Patients and methods

The Counties Manukau thyroid surgery database was used for this study. All patients undergoing thyroid surgery between 14 January 2002 and 1 December 2007 were included. We searched for patients who had returned to the operating theatre or who had developed a haematoma. Identified patients' clinical and demographic details were extracted.

For each case of post-operative bleeding, a search of the database was made for other patients who matched the index (i.e. post-operative haemorrhage) case for age (within five years), gender, ethnicity, surgical procedure (thyroid lobectomy or total thyroidectomy) and site of surgery (either the Manukau Elective Surgery Centre or Middlemore Hospital). The site of surgery carried specifically different clinical connotations. Manukau Elective Surgery Centre is a short-stay, elective surgery facility with a strong emphasis on close post-operative monitoring prior to transfer to the ward or home. In contrast, Middlemore Hospital

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is a very busy acute and trauma hospital where some elective surgery (e.g. thyroidectomy) is also performed. The emphasis at Middlemore Hospital is often on maintaining blood pressure in severe trauma and burns patients, with less concern regarding 'routine' elective procedure cases.

We identified a group of 37 patients; between two and six cases were found for each index case. For each case, a matched 'control' patient was randomly selected using unique identifiers drawn 'blindly' from corresponding matching cases. This process produced seven matched pairs each comprising a case matched (according to all the above parameters) with an equivalent control (see Table I for group comparisons).

Individual patient medical records were then examined and specific clinical information extracted. This included the extent of surgery, duration of surgery, surgeon grade (i.e. whether a trainee or consultant) and individual anaesthetist, as well as the patient's American Society of Anesthetists status, smoking status and pack-year history, medication at the time of surgery, and co-morbidity (e.g. hypertension, alcoholism or depression). Pre-operative and post-operative systolic blood pressure were also noted, and recorded as normo- or hypertensive depending on whether the blood pressure was less than or greater than 150 mmHg, respectively.

A group comparison was then performed in order to identify any significant differences between cases and controls. A further analysis examined haematoma formation as the dependent variable, compared with duration of surgery, surgeon, American Society of Anesthetists status, smoking status, pack-years, pre-operative blood pressure, post-operative blood pressure and medical co-morbidity (see Table II). Differences between groups were examined using the Mann–Whitney U-test for non-parametric data and the *t*-test for parametrically distributed continuous variables (e.g. age). Logistic regression analysis was then performed, using the factors with the strongest statistical associations from the bivariate analysis.

This study complied with the research requirements stipulated by the relevant institutional review board.

Results

Of the 355 thyroid operations performed, we identified seven patients who needed to return to theatre because of the haematoma control. All these patients had been normotensive pre-operatively, and had developed a haematoma following total thyroidectomy only. There were no significant differences in haematoma rate observed with differences in ethnicity, American Society of Anesthetists status, neck dissection, pathology, gender, age, surgical time or surgical team. The only significant risk factor identified was the institution at which the surgery had been performed; a substantially higher number of haematomas occurred at Middlemore Hospital (six of 166; 3.6 per cent) than at Manukau Elective Surgery Centre (one of 242; 0.4 per cent) ($p = 0.016$).

This case–control study, using matched-pairs analysis, identified no significant differences in haematoma formation for different surgical teams, surgeon grades (i.e. trainees versus consultants), American Society of Anesthetists status grades, clinical histories as regards smoking (versus non-smoking) and hypertension (versus normotension), or drain usage (and number of drains placed), based on chi-square univariate analysis. There were also no such differences for pack-years, body mass index, surgical time and gland weight, based on Mann–Whitney U-test analysis.

Smoking status, surgeon grade and post-operative blood pressure were then entered into a logistic regression analysis. Elevated post-operative blood pressure was the only factor to emerge as statistically significant ($p = 0.005$). Five of the haematoma cases (72 per cent) exhibited a high systolic blood pressure (i.e. greater than 150 mmHg) in the post-anaesthetic care unit, compared with none of the controls.

TABLE I
DEMOGRAPHICS OF CASE–CONTROL PAIRS

Parameter	Cases	Controls*
Male:female ratio	1:6	1:6
Race ratio (European:Pacific:Maori)	1:1:5	1:1:5
Total:completion thyroidectomy ratio	6:1	6:1
Benign:malignant ratio	5:2	5:2
Manukau:Middlemore ratio	1:6	1:6
Age (mean; years)	47.8	45.6

*Matched. Pacific = Pacific Islander; Manukau = Manukau Elective Surgery Centre; Middlemore = Middlemore Hospital

Discussion

In our series, post-operative hypertension was the only major factor to emerge as a significant point of difference between cases and controls. Some of our patients were known to have hypertensive heart disease, controlled with medication. Indeed, one of our controls had had her surgery deferred because she had been hypertensive on initial presentation for surgery; after

TABLE II
FACTORS ASSOCIATED WITH HAEMATOMA AFTER THYROID SURGERY, AND SIGNIFICANCE*

Factor	*p*
Current smoker	0.094†
Smoking pack-years	0.83‡
BMI	0.53‡
ASA status	0.47†
Gland weight	0.91‡
Drain	0.31†
Surgical time	0.62‡
Surgeon grade	0.091†
Post-op syst BP >150 mmHg	0.01†

*Bi-variate analysis. †Chi-square or Fisher's exact test; ‡Mann–Whitney U-test. BMI = body mass index; ASA = American Society of Anesthetists; post-op syst BP = post-operative systolic blood pressure

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a few weeks with a new anti-hypertensive regimen, she became normotensive, and went on to an uneventful procedure.

In Basto and colleagues'[13] case–control study, post-operative haematoma was less frequent in patients receiving ketoprofen (occurring in zero of 107 patients thus treated, versus two of 107 non-treated patients; $p < 0.05$). It is possible that a lower post-operative blood pressure may have been the reason for this result, as the ketoprofen group reported less pain. These patients also had less nausea and vomiting, but the blood pressure in each group was not reported.

Burkey *et al.*[14] conducted a case–control study that specifically examined multiple risk factors for post-operative haemorrhage after thyroid surgery. They also reviewed other studies that evaluated post-thyroidectomy haematoma requiring re-operation.[2,8,12,15,16] None of these studies reported an identifiable risk factor, but only Burkey and colleagues' paper examined post-operative blood pressure.[14] They identified 42 cases of haemorrhage (0.03 per cent of the series), from 13 817 operations, and found no predictive risk factors, including post-operative blood pressure.[13] However, their study is not strictly comparable to ours, because they used a systolic blood pressure threshold of 170 mmHg, whereas we used a threshold of 150 mmHg. Furthermore, more than half (57 per cent) of their patients' haematomas developed 7 or more hours post-operatively (19 per cent of cases developed after 24 hours, none of which involved a threatened airway), whereas all our cases manifested in the first 6 hours after surgery and needed prompt return to theatre to manage an expanding haematoma. While hypertension may be a factor in 'late' haematomas, it is unlikely to be identified, as close monitoring generally does not continue after the first 4 post-operative hours.

In our study, post-operative haemorrhage was not associated with the presence or number of drains, or the duration of surgery; this is consistent with others' results.[17]

We found no relationship with age in our series. In contrast, Prim *et al.*[18] reported a significant association between post-thyroidectomy haematoma and patient age.

Although post-thyroidectomy haemorrhage is unusual, it is life-threatening, and all reasonable steps should be taken to try to minimise its risk of occurrence. Spinelli *et al.*[19] assessed 19 cases of haematoma, from 1800 thyroidectomies, and reported that all secondary bleeding was from the pre-thyroid muscles or the region of the inferior pole; thus, they believed that these areas may require particular attention. Lee *et al.*[20] found that, of 10 patients with post-thyroidectomy haemorrhage, respiratory distress only occurred in those with haematoma deep to the strap muscles.

Precautions that minimise the risk of haematoma formation include meticulous haemostasis and using the Valsalva manoeuvre to check for haemostasis before wound closure. A Trendelenburg tilt has also been described to better identify potential bleeding vessels prior to wound closure.[21] Our practice has been to use a 30-second Valsalva manoeuvre. The method(s) of haemostasis may alter the bleeding risk. Petrakis *et al.*[22] reported a significantly lower ($p < 0.05$) post-operative haematoma rate with use of the LigaSure™ device, compared with conventional suture ligation of vessels, in a study of 517 patients which used historical controls; however, there is generally no evidence that this new technology reduces haematoma rates. Our techniques of vessel haemostasis varied considerably over the period under review, and the data in this regard were not clear from the clinical records. This, together with our small patient number, does not allow meaningful analysis of intra-operative vessel management.

Our findings suggest that early post-operative management may be an important factor in the development of post-thyroidectomy haematoma, and that clinicians should take particular care to ensure that the post-operative blood pressure remains normal. For example, we consider that the lower haematoma rate of the Manukau Elective Surgery Centre patients was due to the short-stay, elective surgery focus of this facility, with high systolic pressure generally being quickly treated in order to facilitate early discharge.

However, our study also raises questions that we are unable to answer, and these represent limitations that need to be considered when interpreting our results.

There were probably patients in our database who had high systolic blood pressure post-operatively but who did not bleed. The only way we could have assessed this possibility would have been to manually search all 355 cases for their post-anaesthetic blood pressure data. This proved impractical at the time of this study, and would not have changed the relevance of our findings, unless the prevalence of hypertension in the post-anaesthetic care unit was very high.

- **The occurrence of a post-thyroidectomy haematoma is an uncommon but life-threatening event**
- **No specific, remediable risk factor for such haematomas has previously been identified**
- **In this study, a post-operative systolic blood pressure of more than 150 mmHg was associated with a high risk of post-thyroidectomy haematoma**

We included no data regarding the process of post-anaesthesia recovery in our retrospective study. Matory and Spiro[12] found that a smooth recovery was crucial to the prognosis of patients recovering from thyroid surgery. Harding *et al.*[23] identified smooth extubation (avoiding significant coughing or retching) and control of both post-operative vomiting and pain

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(in order to avoid raised venous and/or arterial pressures) as important considerations in minimising the risk of post-operative haemorrhage. This principle was examined in a recent paper by Bononi *et al.*[9] reporting a large, prospective study of 562 patients, with a post-operative haematoma rate of 0.53 per cent; all identified haematomas developed after 6 hours, and none was associated with post-operative vomiting (which occurred in 6.4 to 11.4 per cent of cases, depending upon emesis prophylaxis regimen).

The presence of Graves' disease has been cited as a risk factor for post-thyroidectomy bleeding. In our database, only a very small proportion of thyroidectomies were conducted in patients with this disease. We therefore had insufficient numbers to test whether this disease carries an increased risk of post-operative haemorrhage.

Conclusion

In our facility, a post-anaesthetic systolic blood pressure in excess of 150 mmHg was associated with an increased risk of haemorrhage following thyroid surgery.

Since conducting this analysis, we have changed our post-operative management protocols to include active management of blood pressure. Subsequently, the past two years has seen a reduction of post-thyroidectomy haematoma formation, to 0.08 per cent of thyroid surgery patients (two of 234). This change is encouraging but does not reach statistical significance (chi-square = 0.757, $p = 0.38$). In addition, whereas the Manukau Elective Surgery Centre has maintained an excellent record over this time period (zero of 168), the haemorrhage rate at Middlemore Hospital remains unacceptably higher (two of 66, 3 per cent). One of the latter cases involved post-operative hypertension which should be avoidable.

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References

1 Rosenbaum MA, Haridas M, McHenry CR. Life-threatening neck hematoma complicating thyroid and parathyroid surgery. *Am J Surg* 2008;**195**:339–43
2 Reeve T, Thompson NW. Complications of thyroid *surgery*: how to avoid them, how to manage them, and observations on their possible effect on the whole patient. *World J Surg* 2000; **24**:971–5
3 Rosato L, Avenia N, Bernante P, De Palma M, Gulino G, Nasi PG *et al*. Complications of thyroid surgery analysis of a multicentric study on 14,934 patients operated on in Italy over 5 years. *World J Surg* 2004;**28**:271–6
4 Pieracci FM, Faley TJ. Effect of hospital volume of thyroidectomies on outcomes following substernal thyroidectomy. *World J Surg* 2008;**32**:740–6
5 Emre AU, Cakmak GK, Tascilar O, Ucan BH, Irkorucu O, Karakaya K *et al*. Complications of total thyroidectomy performed by surgical residents versus specialist surgeons. *Surg Today* 2008;**38**:879–85
6 Sosa JA, Mehta PJ, Wang TS, Boudourakis L, Roman SA. A population-based study of outcomes from thyroidectomy in aging Americans: at what cost? *J Am Coll Surg* 2008;**206**: 1097–105
7 Martin L, Delbridge L, Martin J, Poole A, Crummer P, Reeve T. Trainee surgery in teaching hospitals: is there a cost? *Aust N Z J Surg* 1989;**59**:257–60
8 Shaha A, Jaffe BM. Complications of thyroid surgery performed by residents. *Surgery* 1988;**104**:1109–14
9 Bononi M, Bonapasta SA, Vari A, Scarpini M, De Cesare A, Miccini M *et al*. Incidence and circumstances of cervical hematoma complicating thyroidectomy and its relationship to post-operative vomiting. *Head Neck* 2010;**32**:1173–7
10 Agarwal A, Mishra SK. Completion total thyroidectomy in the management of differentiated thyroid carcinoma. *Aust N Z J Surg* 1996;**66**:358–60
11 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;**29**:160–3
12 Matory YL, Spiro RH. Wound bleeding after head and neck surgery. *J Surg Oncol* 1993;**53**:17–19
13 Basto ER, Waintrop C, Mourey FD, Landru JP, Eurin BG, Jacob LP. Intravenous detoprofen in thyroid and parathyroid surgery. *Anesth Analg* 2001;**92**:1052–7
14 Burkey SH, van Heerden JA, Thompson GB, Grant CS, Schleck CD, Farley DR. Reexploration for symptomatic hematomas after cervical exploration. *Surgery* 2001;**130**:914–20
15 Bergamaschi R, Becouam G, Ronceray J, Arnaud JP. Morbidity of thyroid surgery. *Am J Surg* 1998;**176**:71–5
16 Lacoste L, Gineste D, Karayan J, Montaz N, Lehuede MS, Girault M *et al*. Airway complications in thyroid surgery. *Ann Otol Rhinol Laryngol* 1993;**102**:441–6
17 Samraj K, Gurusamy KS. Wound drains following thyroid surgery. *Cochrane Database Syst Rev* 2007;(4):CD006099. DOI: 10.1002/14651858.CD006099.pub2.
18 Prim MP, De Diego JI, Hardisson D, Madero R, Gavilan J. Factors related to nerve injury and hypocalcemia in thyroid gland surgery. *Otolaryngol Head Neck Surg* 2001;**124**:111–14
19 Spinelli C, Berti I, Miccoli P. The postoperative hemorrhagic complication in thyroid surgery. *Minerva Chir* 1994;**49**: 1245–7
20 Lee HS, Lee BJ, Kim SW, Cha YW, Choi YS, Park YH *et al*. Patterns of post-thyroidectomy hemorrhage. *Clin Exp Otorhinolaryngol* 2009;**2**:72–7
21 Moumoulidis I, Martinez del Pero M, Brennan L, Jani P. Haemostasis in head and neck surgical procedures: Valsalva manoeuvre versus Trendelenbug tilt. *Ann R Coll Surg Engl* 2010;**92**:292–4
22 Petrakis IE, Kogerakis NE, Lasitheotakis KG, Vrachassotakis N, Chalkiadakis GE. LigaSure verus clamp-and-tie thyroidectomy for benign nodular disease. *Head Neck* 2004;**26**:903–9
23 Harding J, Sebag F, Sierra M, Palazzo FF, Henry JF. Thyroid surgery postoperative hematoma prevention and treatment. *Langenbecks Arch Surg* 2006;**391**:169–73

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