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Otolaryngology -- Head and Neck Surgery 2012 146: 362 originally published online 11 January 2012
DOI: 10.1177/0194599811433557

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What is This?
Calcium Management after Thyroidectomy: A Simple and Cost-Effective Method

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

Abstract

Objective. Hypocalcemia is one of the principal complications of total or completion thyroidectomy. A number of different protocols for managing this potential complication have been published. Our simple postoperative regimen is described and the safety and cost-effectiveness assessed.

Study Design. Case series with planned data collection.

Setting. Academic medical center.

Subjects and Methods. All patients undergoing total or completion thyroidectomy from January 2008 through June 2010 were evaluated. Data collected included age; gender; procedure performed; levels of ionized calcium, parathyroid hormone, and vitamin D; complications; and need for readmission. Standard descriptive statistics were used to summarize these data.

Results. In total, 526 patients had thyroid surgery during the 30-month study period. Of these, 307 underwent completion or total thyroidectomy and were prescribed a 3-week tapering course of calcium carbonate postoperatively. Twenty-three patients (7.5%) experienced symptoms of hypocalcemia that were managed on an outpatient basis with additional doses of oral calcium. Two patients (0.7%) required readmission. The cost of a 3-week regimen of calcium carbonate is approximately $15. This is considerably less expensive than either the cost of overnight admission or published laboratory protocols for managing this potential complication.

Conclusions. Prophylactic calcium supplementation without routine laboratory assessment proved to be a safe and cost-effective method of preventing and managing postoperative hypocalcemia following total or completion thyroidectomy.

Keywords

thyroidectomy, hypocalcemia, parathyroid hormone, postoperative management

Received August 22, 2011; revised November 3, 2011; accepted November 30, 2011.

Postoperative hypocalcemia after total or completion thyroidectomy is due to inadequate parathyroid hormone (PTH) production. As severe hypocalcemia can lead to tetany, seizures, and arrhythmias, it has been a major concern for surgeons historically and remains a crucial issue in modern thyroid surgery.

Meticulous dissection techniques and knowledge of the anatomy are used to avoid devascularizing the parathyroid glands or inadvertently excising them during thyroidectomy. Despite these efforts, patients continue to experience postthyroidectomy hypocalcemia. Adding to the challenge of managing these patients is the fact that many will develop subclinical hypocalcemia in the first 24 hours after surgery unrelated to parathyroid gland function.1 However, symptomatic hypocalcemia requiring calcium supplementation usually does not occur until between 24 and 72 hours postoperatively.2 Consequently, patients have traditionally been hospitalized for monitoring for several days, undergoing serial evaluation of their serum calcium levels and surveillance for symptom development. The introduction of rapid tests for PTH levels in the past decade promoted efforts to better predict which patients are at increased risk for hypocalcemia, thereby reducing the need for repeated blood tests and minimizing hospitalization times. Several protocols designed to calculate the estimated risk of developing postoperative hypocalcemia have been published.3–5 These protocols use tests of PTH and calcium levels in different combinations to assess risk. Some surgeons use these protocols to determine need for hospitalization or supplementation with oral calcium and vitamin D. Postoperative management options for patients now range from admission to the hospital to 23-hour stays and ambulatory management without oral supplementation.

An ideal postoperative regimen would be simple for physicians and patients to follow and would minimize costs while preventing any serious sequelae of hypocalcemia. To manage...
patients after total or completion thyroidectomy, we use a straightforward protocol to prevent postoperative hypocalcemia that avoids the use of any laboratory tests and facilitates ambulatory management. Others have reported similar protocols to this one, with the use of calcium carbonate alone or in some combination with vitamin D, with positive outcomes.\textsuperscript{6-8}

Our protocol is described, and its safety and cost-effectiveness are assessed.

**Methods**

We prospectively gathered data on consecutive patients undergoing thyroidectomy at our institution between January 2008 and June 2010, by a single surgeon (DJT), under the approval of the institutional review board (Human Assurance Committee). Patients underwent surgery for both benign and malignant disease. Several surgical techniques were employed as determined by disease and patient factors.\textsuperscript{9}

Data collected included age; gender; procedure performed; admission status; levels of ionized calcium, parathyroid hormone, and vitamin D; pathology; complications; and need for readmission. Standard descriptive statistics were used to summarize these data.

The postoperative calcium management was the same for all patients undergoing total or completion thyroidectomy, regardless of their admission status. Patients were prescribed a 3-week taper of Os-Cal with D (GlaxoSmithKline, Brentford, UK), which contains 500 mg oyster-shell calcium carbonate and 200 IU cholecalciferol (vitamin D\textsubscript{3}) in each tablet. In the first week after surgery, patients take 1 g of calcium 3 times daily, in the second week 1 g twice daily, and in the third week 1 g once a day. Patients and family members are carefully educated regarding symptoms of hypocalcemia, particularly perioral and extremity tingling or numbness. They are instructed that if symptoms occur, they should notify the physician and then take additional doses of 1 g of calcium every 1 to 2 hours until resolution. This information is provided verbally to the patients by the attending surgeon. On the day of surgery, both the attending surgeon and the perioperative nurse reinforce this information again. Finally, detailed written instructions are given to all patients. On the evening of surgery, patients are contacted by phone by the attending surgeon and queried regarding the presence of hypocalcemia symptoms. In addition, they are given the hospital after-hours phone number and directed to contact the on-call physicians if any symptoms develop. No laboratory tests are used in this protocol, and patients are not admitted with the purpose of observation for postoperative hypocalcemia.

In our practice, the first postoperative visit occurs 4 weeks after surgery (glue is used for skin closure, obviating the need for suture removal). By this point, patients have in most instances completed their course of calcium. If even marginally symptomatic (any tingling or numbness or the presence of a positive Chvostek sign), calcium, 25-hydroxy vitamin D, and parathyroid hormone levels are drawn and patients are treated with additional oral calcium supplementation.

The cost of the postoperative regimen is based on the number of Os-Cal with D caplets the typical patient consumes over a 3-week course. Assuming no additional doses are necessary, 82 tablets are used. A 160-count bottle of Os-Cal with D would be sufficient to cover the required amounts. The approximate cost for performing laboratory assessment of calcium, ionized calcium, and PTH levels was obtained from the chemistry laboratory at our institution.

**Results**

During the 30-month study period, 526 patients underwent thyroidectomy. Of these, 307 cases represented either a total (n = 280) or completion thyroidectomy (n = 27) and were included in the study. These surgeries were achieved by a conventional approach (n = 165), a minimally invasive technique (n = 93), or an endoscopic technique (n = 49). Concurrent central neck dissections were performed in 12 patients, and 13 patients underwent lateral neck dissections.

Of those who underwent a total or completion thyroidectomy, 282 patients (91.9%) did not report symptoms of hypocalcemia. Twenty-three patients (7.5%) experienced symptoms of hypocalcemia at some point in their postoperative course. Twenty-one of these were managed on an outpatient basis with supplemental doses of oral calcium. Because of persistent symptoms despite additional supplementation, 2 patients (0.7%) were admitted to the hospital for intravenous calcium supplementation and monitoring. Both patients had undergone total thyroidectomy (a 32-year-old woman with papillary thyroid carcinoma and a 46-year-old woman with a multinodular goiter). On the day after surgery, both presented to the hospital emergency department with perioral and extremity paresthesias and biochemical evidence of hypoparathyroidism (serum calcium, ionized calcium, and PTH levels were 7.4 mg/dL, 3.4 mg/dL, and <3.0 pg/mL and 8.0 mg/dL, 3.2 mg/dL, and 5.5 pg/mL, respectively). Both patients were discharged after intravenous supplementation, and the hypocalcemia eventually resolved. Among the 12 patients who underwent concurrent central neck dissections, 2 experienced symptoms of hypocalcemia. Neither required readmission.

The cost of a 3-week regimen of Os-Cal with D is approximately $15. The cost to the patient for laboratory evaluation of his or her calcium, ionized calcium, or PTH levels is $86, $86, and $293, respectively.

**Discussion**

The importance of the parathyroid glands and their vulnerable status during thyroid surgery has been recognized since the late 19th century. When all parathyroid glands have been put at risk (as with a total or completion thyroidectomy), patients may develop temporary or permanent hypoparathyroidism with hypocalcemia. Despite careful and judicious surgical technique, the parathyroid glands may be unintentionally excised or devascularized during surgery. The reported rate of temporary or permanent hypocalcemia after thyroidectomy varies considerably and can be as high as 46% and 13%, respectively, and may lead to significant complications.\textsuperscript{10,11}

As a result, surgeons historically have been aggressive in pursuing monitoring following surgery with both laboratory tests and clinical examinations. However, most patients do
not need extensive postoperative management, such as intravenous calcium supplementation. With the advent of accurate, rapid assays to measure PTH levels and the trend toward outpatient surgery, surgeons have sought to be able to predict which patients are most at risk for developing hypocalcemia.

In the past several years, a number of different protocols have been described that use assessment of PTH and calcium levels to stratify risk for postoperative hypocalcemia. The level of risk determines decisions related to postoperative management. The protocols differ, but possible management options include admission and monitoring in the hospital, discharge with supplemental calcium and calcitriol, discharge with calcium, or discharge with no calcium supplementation. These protocols may be effective, but they also can belogistically difficult, painful for the patient, and expensive.

Our approach to the management of these patients is feasible because of the reliable and readily apparent nature of the symptoms of hypocalcemia. This allows patients to easily recognize them and report them to the physician. Educating patients and their family members is a crucial component of this protocol.

The results of the current study show that a postoperative strategy of routine calcium supplementation for patients undergoing total or completion thyroidectomy is safe and inexpensive. Only 7.5% of patients experienced symptoms of hypocalcemia, and of these, only 2 patients (0.7%) required admission to the hospital for symptoms that did not respond to additional doses of oral calcium. Both were female patients who had undergone total thyroidectomy, and both had prompt resolution after a brief hospitalization. The remaining 21 patients who developed hypocalcemia-related symptoms had resolution of their symptoms simply with additional doses of oral calcium.

Our protocol offers several advantages over others that have been proposed. This regimen is easy to follow for both the surgeon and patient. It avoids the logistics and expense associated with performing laboratory tests. Physicians can use the same approach in all patients undergoing total or completion thyroidectomy, regardless of whether a concurrent neck dissection is performed, what pathology is present, and whether a patient is to be admitted. Patients know prior to surgery how they will be managed postoperatively, obviating the need for lengthy explanations of different possible treatment options. Patients also benefit by avoiding the discomfort involved in obtaining blood tests. This protocol is inexpensive, as it does not incur the cost of expensive monitoring and laboratory tests. Although education of the patient and the family members regarding this approach is time-consuming, this is considered part of the global service provided. However, any investment in time spent preoperatively is offset by reduced time required for explanation in the postoperative period. Finally, the performance of surgery on an outpatient basis is facilitated.

Some experts have expressed concern regarding the routine use of prophylactic calcium after surgery because a large number of patients are treated unnecessarily. There is the theoretical risk of constipation, kidney stones, and alterations in iron and zinc absorption. We have not witnessed these issues in our patients. As in our experience, a small number of patients may require admission to the hospital for intravenous calcium supplementation and monitoring. However, these patients would have likely required admission to the hospital with the use of any postoperative protocol. For these few patients, there may be inconvenience associated with the return to the hospital and admission, but in balance, this is an acceptable downside relative to the vast majority who enjoy a streamlined process.

This protocol could be easily exported and introduced at other centers. In fact, in our institution, although the majority of thyroidectomies are performed by the senior surgeon, other surgeons in our group follow this protocol when they perform thyroidectomies. However, to successfully and safely implement this approach, several factors must be considered. Education of patients and their caretakers regarding the clinical manifestations of hypocalcemia and the critical nature of complying with the calcium regimen (starting on the evening of surgery) is of paramount importance in this approach. In our institution, this is a well-developed clinical pathway, and all members of the management team, including residents, fellows, and nurses, are familiarized with the protocol and are involved with education of the patients. This information is reviewed multiple times with the patient before surgery and again following surgery. A second factor likely contributing to the success of this protocol is meticulous surgical technique used in identifying and preserving at-risk parathyroid glands. Great care is taken during surgery to manage the parathyroid glands in an atraumatic manner. Consequently, the number of patients at risk for developing marked hypoparathyroidism is probably relatively low, likely limiting the number of patients in actual jeopardy of becoming hypocalcemic.

In conclusion, prophylactic calcium supplementation without routine laboratory assessment after completion or total thyroidectomy is a safe and cost-effective method of preventing and managing postoperative hypocalcemia.

**Author Contributions**

Michael C. Singer, study design, data collection and analysis, author, final approval; Dimpal Bhakta, data collection and analysis; Melanie W. Seybt, study design, data collection and analysis, final approval; David J. Terris, study conception and design, draft author, final approval.

**Disclosures**

**Competing interests:** Melanie W. Seybt has been a speaker and medical adviser for Cook Medical. David J. Terris has directed a series of thyroid courses sponsored by Johnson & Johnson.

**Sponsorships:** None.

**Funding source:** None.

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