Guidelines for complications after thyroid surgery: pitfalls in diagnosis and advices for continuous quality improvement

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Abstract

Background

There are four major complications after thyroidectomy, including palsy of the recurrent laryngeal nerve (RLN), hypoparathyroidism, postoperative bleeding and surgical site infection (SSI). Another clinical problem is the injury and palsy of the external branch of the superior laryngeal nerve (EBSLN). We present a one-year analysis of our prospective data on complications and outline our guidelines for follow-up and management including quality assessment.

Methods

We prospectively analyzed 1384 thyroid operations. Vocal fold/RLN function was determined routinely before surgery and on postoperative day 1 or 2 by laryngoscopy and/or stroboscopy. Postoperative hypoparathyroidism was defined as hypocalcemia in conjunction with low or low normal parathormone levels or symptoms. Postoperative bleeding was specified as bleeding after wound closure that required re-operation. SSI was classified according to the Centers for Disease Control and Prevention. Palsy of the EBSLN was not determinable. Permanent impairment was defined if the complication persisted for more than 6 months.

Results

Postoperative palsy of the RLN occurred in 96 of 2458 nerves at risk (3.9 %), of which 78 % fully recovered. The overall incidence of permanent palsy was 0.7 % per nerve-at- risk and highly dependent from the surgeon (range 0 to 3.2 %, p < 0.001) Postoperative hypoparathyroidism was diagnosed in 487 patients (35.2 %), of which full recovery was noted in 93.0 %. There were 26 postoperative bleedings (1.9 %) requiring re-operation. Three patients (0.2 %) developed superficial SSI with *Staphylococcus aureus* after a postoperative interval of 2, 6, and 7 days, respectively.

Conclusions

Our definitions and diagnostic and therapeutic approaches are presented and should be a proposal for standardization. Standardization will facilitate benchmarking, comparison of complication rates and surgical techniques among surgeons and institutions. An interdisciplinary team is necessary for quality control. Only continuous quality improvement of the individual surgeon will ultimately improve quality of a surgical department.

Introduction

Thyroidectomy is one of the most commonly performed operations in general surgery [<link rid="bib1">1</link>]. In Austria, more than 10,000 operations are performed annually [<link rid="bib2">2</link>]. With growing specialization and establishment of high-volume endocrine surgery centres, extent of resection and indications for surgery have been changing dramatically, which now include multinodular benign goiter, thyroid cancer, Graves’ disease and Hashimoto’s thyroiditis [<link rid="bib3">3</link>, <link rid="bib5">5</link>].

The two main outcome measures include perioperative complications and disease-specific outcomes. In all, disease-specific outcomes are excellent for all indications. There are four procedure-specific complications, including palsy of the recurrent laryngeal nerve (RLN), palsy of the external branch of the superior laryngeal nerve (EBSLN), hypoparathyroidism and postoperative bleeding [<link rid="bib6">6</link>, <link rid="bib9">9</link>]. In addition, surgical site infection (SSI) is a general complication that can occur in every surgical procedure [<link rid="bib10">10</link>]. Proper monitoring, management and documentation of these complications are prerequisites to assure high-quality care and continuous quality improvement. Our department is a high-volume institution with 1300 + thyroid surgeries performed annually. For more than 30 years, patients are prospectively documented in a computerized database. The analyses of this unique database formed the basis for multiple publications [<link rid="bib4">4</link>, <link rid="bib6">6</link>, <link rid="bib9">9</link>, <link rid="bib11">11</link>, <link rid="bib17">17</link>] and the continuous interdisciplinary dialogue led to the development and continuous refinement of guidelines for diagnosis, follow-up and management of complications. Here we present a one-year analysis of our data on complications and outline our institutional guidelines for follow-up and management.

Patients and Methods

Prospective observational study

Our prospective surgical database from all patients undergoing thyroid surgery was analyzed. The database is maintained in the CHIRDOK system (Micom MediCare, Wiener Neustadt, Austria). Data are entered prospectively by primary care physicians and subsequently cross-checked by senior surgeons. Diagnoses, therapy, pathology, surgical details, overall and surgeon-specific complications and follow-up data are abstracted. For the current study, we have analyzed all patients who underwent surgery in 2009, as long-term follow-up data on complications are available in this cohort. The CHIRDOK database was queried and the variables age, gender, histology, operative procedure, surgeon, complications, and follow-up of complications were exported to the statistical program R 3.0.1 (The R Foundation for Statistical Computing, Vienna Austria). Data were analyzed by descriptive statistics.

Evidence acquisition for institutional guidelines

A-non systematic review of the literature was performed using MEDLINE on October 1st 2013. We searched the published literature between 1990 and 2013 using the keywords “thyroid surgery”, “complications” and “surveillance”. Based on the consensus of all authors, articles providing the highest evidence and the results of our observational study were included in the development of the institutional guidelines for management and follow-up of complications.

Description of our surgical technique

Our standard procedure is open (if possible, open minimally invasive) thyroid surgery without perioperative antibiotic prophylaxis. The patient is placed in half-sitting position with slight neck extension. Kocher’s incision is carried out and the (micro)dissection is performed with bipolar forceps and scissors using magnification glasses. Every surgical procedure is done with neuromonitoring. Pole vessels are ligated and not cauterized. In the retrothyroid space, no electrocautery is used to avoid collateral damage to the RLN. The nerve is exposed over its entire course. In the majority of cases, an active Redon drain is inserted and commonly removed after 12 to 24 h. Valsalva’s manoeuvre is performed at the end of each operation to identify occult venous bleeding. The blood pressure is kept high to identify occult arterial bleeding [<link rid="bib18">18</link>].

Our surgical procedure concerning the parathyroid glands (PG) has been described previously [<link rid="bib9">9</link>]. In brief, the relative position of the PGs to the thyroid gland varies widely and they may be located ventrally in the surgical high risk zone. It is our aim to preserve all PGs, with the PGs away from the resection line. Importantly, it is not mandatory to see all PG during surgery, but it essential not to overlook a single one. If PG are found in an exposed position adherent to the thyroid capsule in benign thyroid disease, we try to leave a remnant of the thyroid capsule to preserve their blood supply. Following resection, the thyroid specimen is inspected, and inadvertently removed PGs are autotransplanted in the sternocleidomastoid muscle. PGs are preserved when their blood supply is considered maintained through a vessel pedicle, vascularized connective tissue, or vessels from a thyroid remnant. Devascularized PGs are autotransplanted. Parathyroid discoloration is not an indication for autotransplantation [<link rid="bib9">9</link>].

Definitions

Palsy of the recurrent laryngeal nerve

Vocal fold function is determined routinely in all patients before surgery and on postoperative day 1 or 2 by laryngoscopy and/or stroboscopy. Palsy of the RLN is defined as impaired vocal fold function in patients with normal preoperative vocal fold function. Preoperative laryngeal nerve palsy and necessity of oncological resection of the nerve is not regarded as complication. A palsy is considered permanent if it persists for at least 6 months. ESBLN function was not assessed, as there were no routine diagnostic procedures.

Hypocalcemia and hypoparathyroidism

In 2009, postoperative hypocalcemia was defined as serum calcium levels < 2.1 mmol/l on the first or second postoperative day irrespective of age (reference range of our laboratory: 2.1 to 2.7 mmol/l). In 2012, age-specific reference ranges were introduced and are now used for our current classification (Table <link rid="tb1">1</link>). The reference range for parathormone (PTH) is 10.0 to 65.0 pg/ml. In all patients, calcium, PTH and vitamin D levels are determined preoperatively.

<tb id="tb1"><number>Table 1</number> Age-specific calcium reference values from our laboratory. For conversion in mg/dl, the values should be multiplied by 4.01.</tb>

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| Age (years) | Reference range (mmol/l)\* |
| 2 to 12 | 2.2–2.7 |
| 12 to 18 | 2.1–2.55 |
| 18 to 59 | 2.15–2.50 |
| 59–90 | 2.20–2.55 |
| >90 | 2.05–2.40 |

We define postoperative hypoparathyroidism as hypocalcemia in conjunction with low or low normal PTH levels irrespective of hypocalcemia-related symptoms [<link rid="bib17">17</link>]. Calcium is bound to proteins, especially to albumin. It has been suggested that in patients with hypoalbuminemia or hyperalbuminemia, serum calcium is corrected for albumin [<link rid="bib19">19</link>]. We do not use corrected serum calcium routinely, as > 99 % of patients undergoing thyroid surgery have normal albumin serum levels. Permanent *manifest* hypoparathyroidism is defined as a PTH or calcium levels below normal range or the need for calcium and/or vitamin D supplementation to treat hypocalcemia-related symptoms (paresthesia, muscle cramps, convulsions, stridor, cognitive impairment, abnormal QT interval on ECG), for more than 6 months. Permanent *latent* hypoparathyroidism is defined as low or low normal serum calcium, a normal PTH with or without hypocalcemia-related symptoms for more than 6 months [<link rid="bib9">9</link>]. Hypoparathyroidism is classified as “recovered” if serum calcium and PTH are within the normal range, there are no hypocalcemia-related symptoms and the patient receives no therapy. Patients with preoperative vitamin D deficiency receiving postoperative vitamin D supplementation are also classified as hypoparathyroidism, although this remains unclear (see discussion).

Postoperative bleeding

Postoperative bleeding is defined as bleeding after wound closure that required re-operation because of rapid accumulation of blood with more than 150 ml in the suction bottle of the active Redon drain, visible swelling of the neck or symptoms of airway compression [<link rid="bib8">8</link>].

Surgical-site infection

According to the Centers for Disease Control and Prevention (CDC), a surgical site infection is defined as infection related to an operative procedure, which occurs at or near the surgical incision within a 30 day-period [<link rid="bib20">20</link>, <link rid="bib21">21</link>].

Results

Observational study

In 2009, our department performed a total of 1384 thyroid operations for benign and malignant thyroid disease. Diagnoses are summarized in Table <link rid="tb2">2</link>. The majority of patients were operated for euthyroid nodular goiter with cold nodules suspicious for malignancy or moderate/severe airway compression. There were 221 surgeries for thyroid cancer, 131 for Hashimoto’s thyroiditis and 86 for Graves’ disease. Two thousand four hundred and fifty-eight lobes were operated, including 1267 total lobectomies (= hemithyroidectomy), 1089 near-total lobectomies (i.e. thyroid remant < 1 mL), 29 subtotal lobectomies (i.e. thyroid remant 3–4 mL) and 73 selective excisions of nodular lesions.

<tb id="tb2"><number>Table 2</number> Diagnoses of 1384 patients, who underwent thyroid surgery at the Department of Surgery at the Kaiserin-Elisabeth-Spital in 2009. Patients operated for nodular goiter, Grave’s disease, Hshimoto’s thyroiditis or recurrent benign disease and found to have malignancy were grouped in thyroid carcinoma.</tb>

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| --- | --- | --- |
| Diagnosis | N | % |
| Euthyroid nodular goiter | 734 | 53 |
| Autonomous nodular goiter | 151 | 11 |
| Thyroid carcinoma Papillary microcarcinoma Papillary carcinoma > 10 mm Follicular carcinoma Medullary carcinoma Poorly differentiated carcinoma | 221 136 51 20 10 4 | 16 |
| Graves’ disease | 86 | 6 |
| Hashimoto's thyroiditis\* | 131 | 9 |
| Recurrent thyroid disease | 61 | 4 |
| Total | 1384 | 100 |

\*Indication for surgery were concomitant suspicious nodules, undulating function and moderate/severe airway compression

A total of 2458 RLN were at risk for palsy (“nerves-at-risk”). Postoperative palsy was diagnosed in 96 nerves (3.9 %) of 93 patients. Three palsies were bilateral. Termination of surgery after failed neuromonitoring was not established at this time. Seventy-eight percent of the nerves fully recovered after a median interval of 3 months (Fig. <link rid="fig1">1</link>) and 22 % became permanent, reflecting an overall incidence of permanent palsy of 0.7 % per nerve-at-risk. The surgeon-related rate of postoperative and permanent palsy ranged from 1.7 to 7.8 % (p < 0.001) and 0–3.2 % (p < 0.001) per nerve-at-risk, respectively (p < 0.001). All patients with palsy were primarily managed with voice therapy and surveillance. Medialization surgery of a permanently paralyzed vocal fold was not necessary.

<fig id="fig1"><number>Fig. 1</number> Kaplan-Meier estimates for recovery of 96 RLN palsies. The median time to recovery was 3 months. Among postoperative palsies, 78 % fully recovered and 22 % became permanent. </fig>

According to our strict criteria, postoperative hypoparathyroidism was diagnosed in 487 patients (35.2 %). There was a wide range of postoperative hypoparathyroidism among surgeons, which ranged from 22.1 to 46.7 %. Of these patients, follow-up data were available for 426 (87.4 %). Full recovery (normal PTH, normal calcium, no symptoms) was noted in 396 (93.0 %), but permanent hypoparathyroidism occurred in 30 patients. According to our definition, 22 suffered from manifest permanent hypoparathyroidism and 8 from latent permanent hypoparathyroidism. Thus, the overall incidence of manifest permanent and latent permanent hypoparathyroidism was 1.6 % and 0.6 %, respectively.

There were 26 postoperative bleedings (1.9 %). There was one patient who underwent a second re-operation due to recurrent bleeding. In accordance with our previous publication, 25 (96.2 %) bleedings were diagnosed within the first 24 h and the incidence of postoperative bleeding was surgeon-dependent [<link rid="bib8">8</link>].

Three patients (0.2 %) developed SSI after a postoperative interval of 2, 6, and 7 days, respectively. All infections were superficial-incisional. The wound was reopened over a small distance and antibiotic treatment with aminopenicillin-sulbactam was administered. No patient required re-admission and none required cervical re-exploration in general anesthesia. Bacterial culture showed *Staphylococcus aureus* in all cases.

Institutional guidelines and discussion

Our institutional guidelines (Standard Operating Procedures, SOP) are based on our continuous quality management program, our previous reports and the MEDLINE review (Table <link rid="tb3">3</link>). The SOPs are continuously updated, for example after introduction of neuromonitoring in 1999 and introduction of routine measurements of calcium, PTH and vitamin D in the preoperative and postoperative period. Continuous education of nurses, anesthesiologists, surgeons and new staff members assures implementation in clinical practice.

<tb id="tb3"><number>Table 3</number> Recommendations for preoperative and postoperative diagnostics and follow-up of complications after thyroid surgery</tb>

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|  | Preoperative assessment | Postoperative assessment | Follow-up of complication |
| Recurrent laryngeal nerve | Laryngoscopy/stroboscopy | Laryngoscopy/stroboscopy (day 1 or 2) | Laryngoscopy/stroboscopy until palsy resolved (2 weeks, 3, 6, 9, 12 months) |
| Parathyroid glands | Calcium, PTH, vitamin D | Calcium and PTH (day 1 and 2) | Calcium and PTH until resolved (2 weeks, 6 weeks, 3, 6, 9, and 12 months) |
| Bleeding | History for risk assessment (bleeding diathesis, medication), coagulation tests | Surveillance, measurement of cervical circumference | - |
| SSI | History for risk assessment (prior infections, carrier for microbes, ASA score, expected duration of operation) | Surveillance of the wound | Surveillance of the wound (patient instruction) |

Palsy of the RLN

A thorough operative technique prevents RLN injury. The gold standard is the visual identification over its entire length [<link rid="bib6">6</link>, <link rid="bib22">22</link>]. In addition, we perform intraoperative neuromonotoring for identification and monitoring of the nerve’s function in every patient [<link rid="bib11">11</link>, <link rid="bib23">23</link>, <link rid="bib24">24</link>]. We have shown in 2004, that neuromonitoring is useful for identifying the RLN, but it was not reliable for prediction of postoperative outcomes [<link rid="bib11">11</link>]. Improved techniques and continuous research on quantitative parameters with regard to amplitude, latency and duration of signal have standardized definitions of “normal” parameters [<link rid="bib25">25</link>] and allow for better prediction of outcomes. A randomized trial comparing visualization versus neuromonitoring showed that the incidence of transient but not permanent RLN may be decreased after neuromonitoring [<link rid="bib26">26</link>], but confirmatory studies are awaited. In all, it appears that there is little uniformity in application of results from neuromonitoring [<link rid="bib27">27</link>]. Since 2011, we terminate surgery if there is loss of signal on the first side and decide for a two-stage procedure. With this approach, bilateral RLN palsy was virtually eliminated.

Vocal fold mobility and thus RLN function is evaluated by laryngoscopy and/or stroboscopy in all patients before surgery and on postoperative day 1 or 2. Postoperative RLN palsies are followed up at regular intervals by the ear-nose-throat (ENT) department on postoperative day 14, and after 3, 6, 9 and 12 months by laryngoscopy and stroboscopy. Patients with symptomatic RLN paralysis are treated according to ENT—phoniatric guidelines with voice therapy and/or surgical vocal fold medialization procedures [<link rid="bib28">28</link>, <link rid="bib29">29</link>].

Similarly to hypoparathyroidism, there is no consensus on the time interval to define permanent palsy [<link rid="bib30">30</link>]. A recent review showed that the incidence of postoperative and permanent RLN palsy varies from 0 to 7.1 % and 0–11 %, respectively [<link rid="bib22">22</link>]. Importantly, this incidence greatly varies according to patient selection and the method of examination [<link rid="bib30">30</link>]. To make a sufficient diagnosis of vocal fold immobility, pre- and postoperative laryngoscopy is mandatory and cannot be replaced by voice assessment techniques [<link rid="bib31">31</link>]. From different evaluation schemes, investigation on the first or second postoperative day has been recommended [<link rid="bib31">31</link>]. In addition, proper documentation of these findings allows quality assurance for the surgeon. To exclude preexisting laryngeal palsies (which can be asymptomatic) or other abnormalities (ie asymmetries of the larynx) a preoperative assessment is necessary also from the forensic point of view, as palsies of the RLN are a frequent matter of malpractice claims [<link rid="bib32">32</link>].

A difficult issue represents the so called “incomplete” palsy, which refers to impaired but not absent vocal fold mobility. An impaired vocal fold mobility is not always caused by a neurogenic paralysis but can be due to intubational trauma, muscular or joint disorders or even functional. The only way of proving the diagnosis of a (complete or incomplete) paralysis is to perform a laryngeal EMG which is available in specialized centers only. Minor impairments of vocal fold mobility a few days after the operation are frequently seen and should be re-evaluated after some days before establishing a diagnosis. Following laryngoscopy and stroboscopy, our ENT specialists judge if there is a minor impairment of a normally mobile vocal fold or if there is remaining minimal mobility of a paretic vocal fold. The latter, but not the former form is included in the group of RLN palsies. This may be judged differently among different surgeons and ENT specialists, and additionally hampers comparison of surgical series regarding RLN palsy.

We previously described the phenomenon of delayed RLN palsy, which is defined as deterioration of the RLN function that occurs later than 3 days postoperatively in patients with initially normal voice and normal laryngoscopic findings. This is a rare phenomenon, but may be associated with an increased risk of permanent impairment [<link rid="bib33">33</link>].

Palsy of the external branch of the superior laryngeal nerve (EBSLN)

In addition to the RLN, palsy of the EBSLN is possible during thyroid surgery due its proximity to the superior pole of the thyroid gland. Cernea et al. [<link rid="bib34">34</link>] distinguished three distinct anatomic routes of the EBSLN. EBSLN type 2 crosses the superior thyroid pedicle less than 1 cm above the pole. More than 50 % of nerves are classified as type 2b and thus at high risk for injury, with the nerve crossing the vessels below the pole. Notably, the frequency of type 2b is higher in patients with large glands [<link rid="bib35">35</link>].

The EBSLN supplies the cricothyroid muscle. The contraction of this external laryngeal muscle can be observed very easily after stimulation during intraoperative neuromonitoring [<link rid="bib36">36</link>]. Its contraction leads to a stretching and tensioning of the vocal folds, which is needed for producing high pitched voice sounds (“head register”). Palsy of the EBSLN is therefore symptomatic mainly in professional voice users and especially singers who rely on their complete pitch range. In laryngoscopy and stroboscopy, an asymmetric tension of the vocal folds and an asymmetric positioning of endolaryngeal structures can be seen typically. As all the signs and symptoms of EBSLN lesions can be very discrete, even pre-existing or also due to an intubational trauma, establishing a diagnosis is challenging and demanding and can ultimately only be proven by an EMG of the cricothyroideus muscle. Especially in forensic cases it is therefore of special importance to have a pre- and postoperative comparison of the findings.

The diagnosis may not be made prior to three months postoperatively, when internal wound healing and the re-adaptation of the muscular tension is finalized. The estimated number of unreported cases of EBSLN palsy is high, and greater attention should be paid to this issue.

Hypoparathyroidism

In general, several criteria are taken into account to define hypoparathyroidism, including blood levels of calcium, PTH, vitamin D, as well as patient’s symptoms. However, there is no consensus on the criteria (Table <link rid="tb4">4</link>). We have previously reported on a survey regarding the definition of postoperative and permanent hypoparathyroidism. Seven different definitions were given from 22 surgical departments. Further, there is no consensus regarding the interval, after which a hypoparathyroidism is classified as permanent. Of 21 survey responders, the timecut for permanent was 3 months in 1, 6 months in 10, and 1 year in 10 departments, respectively. Our definition is shown above. Due to differing definitions, data are difficult to interpret and compare [<link rid="bib37">37</link>].

<tb id="tb4"><number>Table 4</number> Different definitions for hypoparathyroidism</tb>

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| Reference | Calcium | PTH | Symptoms | Transient/permanent |
| Sitges-Serra A British J Surg. 2010 | <2 mmol/l | <13 pg/ml | + | 12 months |
| Barczynski M World J Surg 2010 | <2 mmol/l | - | +/- | 12 months |
| Youngwirth L J Surg Res 2010 | Calcium supplementation | <10 pg/ml | + | 6 months |
| Wilhelm SM World J Surg 2010 | <2.1 mmol/l | - | +/- | 6 months |
| Digonnet A Eur Arch Otorhinolaryngol 2010 | Calcium supplementation | <15 pg/ml | + | 12 months |
| Lee Y J Korean Med Sci 2010 | Calcium supplementation | - | + | 6 months |
| Efremidou E Can J Surg 2009 | <2 mmol/l | - | + | 6 months |
| Asari R Arch Surg 2008 | <1.9 mmol/l | - | +/- | 6 months |
| Harris V Thyroid Vol 19, 2009 | Calcium supplementation | - | + | 6 months |
| Emre A Surg today 2008 | <2 mmol/l | - | + | 6 months |
| Palazzo F World J Surg 2005 | <2 mmol/l | - | + | 6 months |
| Rosato L World J Surg 2004 | Calcium supplementation | - | + | 12 months |
| Thomusch O Surgery 2002 | Calcium or vitamin D supplementation | - | + | 12 months |
| Trupka A Zentralbl Chir. 2002 | <2.12 mmol/l | <15 pg/ml | + | 6 months |
| Thomusch O World J Surg 2000 | Calcium or vitamin D supplementation | - | + | 12 months |

For diagnosis of hypoparathyroidism, we routinely determine serum calcium and PTH on postoperative day 1 and 2. In patients with low calcium and/or PTH, the nadir values are commonly reached on postoperative day 2 [<link rid="bib7">7</link>]*.* A detailed protocol for prospective studies on hypoparathyroidism was published by our group [<link rid="bib38">38</link>].

The goals in therapy of postoperative hypoparathyroidism are to eliminate symptoms and signs of hypocalcemia and to reach low normal calcium levels in order to stimulate PTH secretion and recovery of PG. In tetanic crisis, 10 mL calcium gluconate 10 % is slowly administered intravenously. If the patient has no or mild symptoms, calcium is not substituted routinely. If calcium levels are < 2 mmol/L and thus the patient is at high risk to develop symptoms, we recommend calcium substitution. In symptomatic cases, calcium is substituted in a daily dosage of 1000 to 3000 mg. In case of very low PTH, we additionally prescribe the active vitamin D calcitriol (daily dosage 2 × 0.25 µg or 2 × 0.5 µg). Intake of calcidiol is not recommended, as conversion to calcitriol requires PTH. It represents an alternative therapy in patients with low normal PTH [<link rid="bib37">37</link>].

It remains unclear if the necessity of postoperative vitamin D supplementation in patients with preoperative vitamin D deficiency should be judged as complication, i.e. as hypoparathyroidism. Vitamin D deficiency is common in Austria [<link rid="bib39">39</link>], and supplementation in patients with low calcium levels is common practice. Using our strict criteria, we included these patients as having hypoparathyroidism. Other authors and research groups, however, may judge this issue differently and may therefore report lower rates of postoperative and permanent hypoparathyroidism. Without a proper consensus, it is not possible to compare rates of hypocalcemia and hypoparathyroidism between centers.

At our institution, age-dependent reference values for serum calcium levels were introduced in 2012. Currently, the impact of these values on the frequency of postoperative hypoparathyroidism and its prognosis remains unknown. If the lower limit of serum calcium is used to diagnose hypoparathyroidism, it is very likely that the proportion of diagnosed patients changes. Once again, a consensus definition would be of utmost importance.

If hypoparathyroidism is diagnosed, serum calcium and PTH are monitored in our outpatient clinic 2 weeks after discharge, at 6 weeks, 3 months, 6 months, 9 months, and 12 months. Importantly, patients with permanent hypoparathyroidism need life-long follow-up and calcium supplementation even if they are asymptomatic, as hypocalcemia may severely influence multiple organ systems [<link rid="bib37">37</link>].

Postoperative bleeding

Primary prevention through a thorough surgical technique is the cornerstone. We perform Valsalva’s manoeuvre at the end of each surgery to detect occult venous bleeding. It is imperative to have a high or high normal blood pressure at the end of the operation. If occult arterial bleeding is suspected and the blood pressure is low, the blood pressure is increased pharmacologically at the end of surgery with phenylephrine and etilefrine, especially when the source of bleeding is not identified in reoperation and the blood pressure is low [<link rid="bib18">18</link>].

Postoperative bleeding is usually noted in the recovery room or early after the patient is transferred back to the ward. In all, postoperative bleeding almost exclusively occurs within 24 h after the primary surgery [<link rid="bib8">8</link>]. It is therefore crucial that patients are continuously surveilled. This includes symptoms, documentation of blood in the suction bottle and measurement of the cervical circumference. In addition, patients are instructed to report symptoms immediately to personnel. The responsible senior surgeon is called upon every abnormality. If postoperative bleeding is diagnosed, we have developed a flowchart for management and specific surgical equipment for bedside neck opening (Fig. <link rid="fig2">2</link>). This can be found in every recovery room and on the ward. As the risk of postoperative bleeding is particularly present on the first postoperative day, we do not discharge patients in the first 24 postoperative hours [<link rid="bib8">8</link>].

<fig id="fig2"><number>Fig. 2</number> Flowchart for managment of postoperative bleeding.</fig>

There are some variations in the indication for re-operation in case of postoperative bleeding and hematoma. In these cases, it is our policy to re-operate early and not to wait for expanding hematomas that may cause airway compression. Furthermore, there is no international standard on the definition of postoperative bleeding. We define postoperative bleeding as every bleeding after wound closure, even if it occurs with the patient still on the operating table. These two facts explain the relatively high rate of postoperative bleeding. An international consensus on the definition would be of paramount importance and would allow comparison among institutions.

Surgical site infection

SSI are on the most common nosocomial infections [<link rid="bib40">40</link>] and cause substantial morbidity to patients and costs to the healthcare system [<link rid="bib41">41</link>]. Thyroid surgery is considered a clean procedure in a well-vascularized area. The incidence of SSI is between 0.3 % and 2.9 % [<link rid="bib10">10</link>, <link rid="bib42">42</link>, <link rid="bib48">48</link>].

SSI commonly develops following hospital discharge. The majority of SSI develop within the first postoperative week, but follow-up for up to 30 days is necessary [<link rid="bib49">49</link>]. Patients are therefore instructed for surveillance of their wound. Site visits are performed on demand.

Routine perioperative antibiotic prophylaxis is not recommended by us and the guidelines, but is considered in selected patients, such as those with expected long operations [<link rid="bib50">50</link>]. A first/second generation cephalosporin or aminopenicillin-sulbactam are effective against the most common pathogen *(Staphylococcus aureus)* and thus represent first choice agents for treatment, but local resistance patterns should be considered. A single dose is administered 30 to 60 min prior to incision and repeated if the procedure lasts more than 4 h [<link rid="bib51">51</link>]. To date, there are no appropriately powered prospective randomized trials in thyroid surgery.

Although the overall incidence of SSI is low, it can be serious and life-threatening. From the different microbes, infection with beta-hemolytic *streptococcus* is specifically critical. These bacteria have specific virulence factors, which support continuous spread in tissues [<link rid="bib52">52</link>]. Although it is sensible to the majority of antibiotics, streptococcal SSI carries a high mortality [<link rid="bib53">53</link>]. Therefore, an SOP for SSI is crucial. A smear from the wound should be always taken before antibiotics are initiated. In addition, we recommend performing smear analysis from the patient’s nose and throat in order to identify if the patient is the carrier of the microbe. In specific situations such as infection with beta-hemolytic *streptococcus*, it is further important to screen the entire surgical team.

Surgeon related outcomes

The surgeon is a risk factor for complications in thyroid surgery, independent of the initial learning curve [<link rid="bib54">54</link>]. In our current analysis on surgeons with an experience of 500 + thyroid operations, the surgeon-related rate of postoperative and permanent RLN palsy ranged from 1.7 to 7.8 % and 0–3.2 % per nerve-at-risk, respectively. In addition, we have previously reported that the rate of postoperative bleeding is related to the surgeon [<link rid="bib8">8</link>]. Similar results have been observed for hypoparathyoidism [<link rid="bib55">55</link>], although this has been opposed by a prospective randomized study [<link rid="bib56">56</link>]. In our center, every senior surgeon receives a detailed description of his complication data semi-annually. If complication rates differ considerably from the remaining senior surgeons, the surgical technique is reviewed.

Insertion of a drain

The question on whether to insert a drain after uncomplicated thyroid surgery is a matter of debate. It is our practice to place a drain in the majority of cases. Several randomized controlled trials and a meta-analysis showed that insertion of a routine drain is probably not necessary and may be associated with an increased length of hospital stay [<link rid="bib57">57</link>, <link rid="bib59">59</link>]. Similar data have been shown in conjunction with cervical neck dissection [<link rid="bib60">60</link>, <link rid="bib61">61</link>]. Despite these data, it remains our practice in order to avoid hematomas or seromas, and we have shown that postoperative bleeding requiring re-operation can be identified through the drain output [<link rid="bib8">8</link>].

Continuous quality improvement

The term surgical “quality” is difficult to define, although there is some agreement that quality embodies notions of efficiency, effectiveness and patient satisfaction. Continuous quality improvement can be defined as a comprehensive management philosophy that focuses on continuous improvement by applying scientific methods to gain knowledge and control over variation and work processes [<link rid="bib62">62</link>]. In thyroid surgery, two quality parameters should be taken into account: perioperative complications and disease-specific outcomes. Monitoring of complications, management according to SOPs and prospective documentation of short-term and long-term data in an interdisciplinary team are prerequisites. Our team meets on a monthly basis in order to identify and resolve issues. Semi-annually, senior surgeons are provided with a detailed analysis of their surgical and outcomes data. We conduct semi-annual interdisciplinary conferences on complications and develop pathways to improve patient care. Finally, specialists on microbiology, pathology, endocrinology and ENT are invited regularly to present updated knowledge in their field related to thyroid diseases. Continuous quality improvement remains an everlasting process; once problems are identified, evaluated and improved or resolved, the cycle begins again.

Conclusions

Our definitions and diagnostic and therapeutic approaches are presented and should be a proposal for standardization. Standardization will facilitate comparison of complication rates and surgical techniques among surgeons and institutions. An interdisciplinary team is necessary for quality control. Only continuous quality improvement of the individual surgeon will ultimately improve quality of a surgical department.

Conflict of Interest

The authors have no conflict of interest.

References

<bib id="bib1"><number>1.</number>Foster RS, Jr. Morbidity and mortality after thyroidectomy. Surg Gynecol Obstet. 1978;146:423–9.</bib>

<bib id="bib2"><number>2.</number>Statistik-Austria. www.statistik.at (access: 05-September-2013). 2013.</bib>

<bib id="bib3"><number>3.</number>Dralle H, Musholt TJ, Schabram J, et al. German Association of Endocrine Surgeons practice guideline for the surgical management of malignant thyroid tumors. Langenbecks Arch Surg. 2013;398:347–75.</bib>

<bib id="bib4"><number>4.</number>Ott J, Promberger R, Kober F, et al. Hashimoto's thyroiditis affects symptom load and quality of life unrelated to hypothyroidism: a prospective case-control study in women undergoing thyroidectomy for benign goiter. Thyroid. 2011;21:161–7.</bib>

<bib id="bib5"><number>5.</number>Musholt TJ, Clerici T, Dralle H, et al. German Association of Endocrine Surgeons practice guidelines for the surgical treatment of benign thyroid disease. Langenbecks Arch Surg. 2011;396:639–49.</bib>

<bib id="bib6"><number>6.</number>Hermann M, Alk G, Roka R, Glaser K, Freissmuth M. Laryngeal recurrent nerve injury in surgery for benign thyroid diseases: effect of nerve dissection and impact of individual surgeon in more than 27,000 nerves at risk. Ann Surg. 2002;235:261–8.</bib>

<bib id="bib7"><number>7.</number>Hermann M, Ott J, Promberger R, Kober F, Karik M, Freissmuth M. Kinetics of serum parathyroid hormone during and after thyroid surgery. Br J Surg. 2008;95:1480–7.</bib>

<bib id="bib8"><number>8.</number>Promberger R, Ott J, Kober F, et al. Risk factors for postoperative bleeding after thyroid surgery. Br J Surg. 2012;99:373–9.</bib>

<bib id="bib9"><number>9.</number>Promberger R, Ott J, Kober F, et al. Intra- and postoperative parathyroid hormone-kinetics do not advocate for autotransplantation of discolored parathyroid glands during thyroidectomy. Thyroid. 2010;20:1371–5.</bib>

<bib id="bib10"><number>10.</number>Bergenfelz A, Jansson S, Kristoffersson A, et al. Complications to thyroid surgery: results as reported in a database from a multicenter audit comprising 3,660 patients. Langenbecks Arch Surg. 2008;393:667–73.</bib>

<bib id="bib11"><number>11.</number>Hermann M, Hellebart C, Freissmuth M. Neuromonitoring in thyroid surgery: prospective evaluation of intraoperative electrophysiological responses for the prediction of recurrent laryngeal nerve injury. Ann Surg. 2004;240:9–17.</bib>

<bib id="bib12"><number>12.</number>Hermann M, Keminger K, Kober F, Nekahm D. [Risk factors in recurrent nerve paralysis: a statistical analysis of 7566 cases of struma surgery]. Chirurg. 1991;62:182–7; discussion 8.</bib>

<bib id="bib13"><number>13.</number>Hermann M, Richter B, Roka R, Freissmuth M. Thyroid surgery in untreated severe hyperthyroidism: perioperative kinetics of free thyroid hormones in the glandular venous effluent and peripheral blood. Surgery. 1994;115:240–5.</bib>

<bib id="bib14"><number>14.</number>Hermann M, Roka R, Richter B, Freissmuth M. Early relapse after operation for Graves' disease: postoperative hormone kinetics and outcome after subtotal, near-total, and total thyroidectomy. Surgery. 1998;124:894–900.</bib>

<bib id="bib15"><number>15.</number>Hermann M, Roka R, Richter B, Koriska K, Gobl S, Freissmuth M. Reoperation as treatment of relapse after subtotal thyroidectomy in Graves' disease. Surgery. 1999;125:522–8.</bib>

<bib id="bib16"><number>16.</number>Ott J, Meusel M, Schultheis A, et al. The incidence of lymphocytic thyroid infiltration and Hashimoto's thyroiditis increased in patients operated for benign goiter over a 31-year period. Virchows Arch. 2011;459:277–81.</bib>

<bib id="bib17"><number>17.</number>Promberger R, Ott J, Kober F, Karik M, Freissmuth M, Hermann M. Normal parathyroid hormone levels do not exclude permanent hypoparathyroidism after thyroidectomy. Thyroid. 2011;21:145–50.</bib>

<bib id="bib18"><number>18.</number>Tonninger-Bahadori K, Bures C, Zipko HT, Klatte T, Hermann M. Intraoperative pharmacologic increase of systemic blood pressure to detect the source of hemorrhage in thyroid surgery and reoperation: a case report. Eur Surg (in press). 2013.</bib>

<bib id="bib19"><number>19.</number>de Andrade Sousa A, Salles JM, Soares JM, de Moraes GM, Carvalho JR, Rocha PR. Course of ionized calcium after thyroidectomy. World J Surg. 2010;34:987–92.</bib>

<bib id="bib20"><number>20.</number>Garner JS, Jarvis WR, Emori TG, Horan TC, Hughes JM. CDC definitions for nosocomial infections, 1988. Am J Infect Control. 1988;16:128–40.</bib>

<bib id="bib21"><number>21.</number>Horan TC, Gaynes RP, Martone WJ, Jarvis WR, Emori TG. CDC definitions of nosocomial surgical site infections, 1992: a modification of CDC definitions of surgical wound infections. Infect Control Hosp Epidemiol. 1992;13:606–8.</bib>

<bib id="bib22"><number>22.</number>Dralle H, Sekulla C, Lorenz K, Brauckhoff M, Machens A. Intraoperative monitoring of the recurrent laryngeal nerve in thyroid surgery. World J Surg. 2008;32:1358–66.</bib>

<bib id="bib23"><number>23.</number>Schneider R, Bures C, Lorenz K, Dralle H, Freissmuth M, Hermann M. Evolution of nerve injury with unexpected EMG signal recovery in thyroid surgery using continuous intraoperative neuromonitoring. World J Surg. 2013;37:364–8.</bib>

<bib id="bib24"><number>24.</number>Schneider R, Lamade W, Hermann M, et al. [Continuous intraoperative neuromonitoring of the recurrent laryngeal nerve in thyroid surgery (CIONM) - Where are we now? An update to the European Symposium of Continuous Neuromonitoring in Thyroid Surgery]. Zentralbl Chir. 2012;137:88–90.</bib>

<bib id="bib25"><number>25.</number>Lorenz K, Sekulla C, Schelle J, Schmeiss B, Brauckhoff M, Dralle H. What are normal quantitative parameters of intraoperative neuromonitoring (IONM) in thyroid surgery? Langenbecks Arch Surg. 2010;395:901–9.</bib>

<bib id="bib26"><number>26.</number>Barczynski M, Konturek A, Cichon S. Randomized clinical trial of visualization versus neuromonitoring of recurrent laryngeal nerves during thyroidectomy. Br J Surg. 2009;96:240–6.</bib>

<bib id="bib27"><number>27.</number>Randolph GW, Dralle H, Abdullah H, et al. Electrophysiologic recurrent laryngeal nerve monitoring during thyroid and parathyroid surgery: international standards guideline statement. Laryngoscope. 2011;121 Suppl 1:S1–16.</bib>

<bib id="bib28"><number>28.</number>Miller S. Voice therapy for vocal fold paralysis. Otolaryngol Clin North Am. 2004;37:105–19.</bib>

<bib id="bib29"><number>29.</number>Schuster M, Eysholdt U. [Therapy for unilateral vocal fold palsy]. HNO. 2005;53:756–65.</bib>

<bib id="bib30"><number>30.</number>Jeannon JP, Orabi AA, Bruch GA, Abdalsalam HA, Simo R. Diagnosis of recurrent laryngeal nerve palsy after thyroidectomy: a systematic review. Int J Clin Pract. 2009;63:624–9.</bib>

<bib id="bib31"><number>31.</number>Dionigi G, Boni L, Rovera F, Rausei S, Castelnuovo P, Dionigi R. Postoperative laryngoscopy in thyroid surgery: proper timing to detect recurrent laryngeal nerve injury. Langenbecks Arch Surg. 2010;395:327–31.</bib>

<bib id="bib32"><number>32.</number>Dralle H, Lorenz K, Machens A. Verdicts on malpractice claims after thyroid surgery: emerging trends and future directions. Head Neck. 2012;34:1591–6.</bib>

<bib id="bib33"><number>33.</number>Bures C, Goulin Lippi Fernandez E, Bobak-Wieser R, Koppitsch C, Klatte T, Hermann M. Delayed palsy of the recurrent laryngeal nerve after thyroid surgery: prevalence, risk factors and outcome. Langenbecks Arch Surg 2013;398:1009.</bib>

<bib id="bib34"><number>34.</number>Cernea CR, Ferraz AR, Nishio S, Dutra A, Jr., Hojaij FC, dos Santos LR. Surgical anatomy of the external branch of the superior laryngeal nerve. Head Neck. 1992;14:380–3.</bib>

<bib id="bib35"><number>35.</number>Aina EN, Hisham AN. External laryngeal nerve in thyroid surgery: recognition and surgical implications. ANZ J Surg. 2001;71:212–4.</bib>

<bib id="bib36"><number>36.</number>Barczynski M, Randolph GW, Cernea CR, et al. External branch of the superior laryngeal nerve monitoring during thyroid and parathyroid surgery: International Neural Monitoring Study Group standards guideline statement. Laryngoscope. 2013;123 Suppl 4:S1–14.</bib>

<bib id="bib37"><number>37.</number>Hermann M. Der postoperative Hypoparathyreoidismus nach Schilddrüsenoperation - eine unterschätzte Komplikation. Viszeralchirurgie. 2005;40:185–94.</bib>

<bib id="bib38"><number>38.</number>Ott J, Promberger R, Karik M, Freissmuth M, Hermann M. Protocol of a prospective study for parathyroid function monitoring during and after thyroidectomy. Eur Surg. 2005;38:368–73.</bib>

<bib id="bib39"><number>39.</number>van Schoor NM, Lips P. Worldwide vitamin D status. Best Pract Res Clin Endocrinol Metab. <link rid="tb">2011</link>;<link rid="tb">25</link>:671–80.</bib>

<bib id="bib40"><number>40.</number>Burke JP. Infection control - a problem for patient safety. N Engl J Med. 2003;348:651–6.</bib>

<bib id="bib41"><number>41.</number>Perencevich EN, Sands KE, Cosgrove SE, Guadagnoli E, Meara E, Platt R. Health and economic impact of surgical site infections diagnosed after hospital discharge. Emerg Infect Dis. 2003;9:196–203.</bib>

<bib id="bib42"><number>42.</number>Alvarado R, Sywak MS, Delbridge L, Sidhu SB. Central lymph node dissection as a secondary procedure for papillary thyroid cancer: Is there added morbidity? Surgery. 2009;145:514–8.</bib>

<bib id="bib43"><number>43.</number>Barbaros U, Erbil Y, Aksakal N, et al. Electrocautery for cutaneous flap creation during thyroidectomy: a randomised, controlled study. J Laryngol Otol. 2008;122:1343–8.</bib>

<bib id="bib44"><number>44.</number>Dionigi G, Rovera F, Boni L, Castano P, Dionigi R. Surgical site infections after thyroidectomy. Surg Infect (Larchmt). 2006;7 Suppl 2:S117–20.</bib>

<bib id="bib45"><number>45.</number>Dionigi G, Rovera F, Boni L, Dionigi R. Surveillance of surgical site infections after thyroidectomy in a one-day surgery setting. Int J Surg. 2008;6 Suppl 1:S13–5.</bib>

<bib id="bib46"><number>46.</number>Serpell JW, Phan D. Safety of total thyroidectomy. ANZ J Surg. 2007;77:15–9.</bib>

<bib id="bib47"><number>47.</number>Suslu N, Vural S, Oncel M, et al. Is the insertion of drains after uncomplicated thyroid surgery always necessary? Surg Today. 2006;36:215–8.</bib>

<bib id="bib48"><number>48.</number>Zambudio AR, Rodriguez J, Riquelme J, Soria T, Canteras M, Parrilla P. Prospective study of postoperative complications after total thyroidectomy for multinodular goiters by surgeons with experience in endocrine surgery. Ann Surg. 2004;240:18–25.</bib>

<bib id="bib49"><number>49.</number>Bures C, Klatte T, Gilhofer M, et al. A prospective study on surgical site infections in thyroid surgery Langenbecks Arch Surg 2013;398:1009.</bib>

<bib id="bib50"><number>50.</number>AORN. Recommended practices for skin preparation of patients. AORN J. 2002;75:184–7.</bib>

<bib id="bib51"><number>51.</number>Weber WP, Marti WR, Zwahlen M, et al. The timing of surgical antimicrobial prophylaxis. Ann Surg. 2008;247:918–26.</bib>

<bib id="bib52"><number>52.</number>Faibis F, Sapir D, Luis D, et al. Severe group a streptococcus infection after thyroidectomy: report of three cases and review. Surg Infect (Larchmt). 2008;9:529–31.</bib>

<bib id="bib53"><number>53.</number>Hardy RG, Forsythe JL. Uncovering a rare but critical complication following thyroid surgery: an audit across the UK and Ireland. Thyroid. 2007;17:63–5.</bib>

<bib id="bib54"><number>54.</number>Hermann M. Schilddrüsenchirurgie. 1 ed. Vienna: Springer; 2010.</bib>

<bib id="bib55"><number>55.</number>Paek SH, Lee YM, Min SY, Kim SW, Chung KW, Youn YK. Risk factors of hypoparathyroidism following total thyroidectomy for thyroid cancer. World J Surg. 2013;37:94–101.</bib>

<bib id="bib56"><number>56.</number>Acun Z, Cihan A, Ulukent SC, et al. A randomized prospective study of complications between general surgery residents and attending surgeons in near-total thyroidectomies. Surg Today. 2004;34:997–1001.</bib>

<bib id="bib57"><number>57.</number>Deveci U, Altintoprak F, Sertan Kapakli M, et al. Is the use of a drain for thyroid surgery realistic? A prospective randomized interventional study. J Thyroid Res. 2013;2013:285768.</bib>

<bib id="bib58"><number>58.</number>Memon ZA, Ahmed G, Khan SR, Khalid M, Sultan N. Postoperative use of drain in thyroid lobectomy - a randomized clinical trial conducted at Civil Hospital, Karachi, Pakistan. Thyroid Res. 2012;5:9.</bib>

<bib id="bib59"><number>59.</number>Samraj K, Gurusamy KS. Wound drains following thyroid surgery. Cochrane Database Syst Rev. 2007:CD006099.</bib>

<bib id="bib60"><number>60.</number>Abboud B, Sleilaty G, Rizk H, Abadjian G, Ghorra C. Safety of thyroidectomy and cervical neck dissection without drains. Can J Surg. 2012;55:199–203.</bib>

<bib id="bib61"><number>61.</number>Lee SW, Choi EC, Lee YM, Lee JY, Kim SC, Koh YW. Is lack of placement of drains after thyroidectomy with central neck dissection safe? A prospective, randomized study. Laryngoscope. 2006;116:1632–5.</bib>

<bib id="bib62"><number>62.</number>Kahan B, Goodstadt M. Continuous quality improvement and health promotion: can CQI lead to better outcomes? Health Promot Int. 1999;14:83–91.</bib>