Use of loupes magnification and microsurgical technique in thyroid surgery: ten years experience in a single center

V. D’ORAZI, A. PANUNZI, E. DI LORENZO, A. ORTENSI, M. CIALINI, S. ANICHINI, A. ORTENSI

SUMMARY: Use of loupes magnification and microsurgical technique in thyroid surgery: ten years experience in a single center.

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Aim. The use of microsurgical technique and loupes magnification as a support to traditional surgery can help surgical performance and prevent complications in thyroid surgery.

Patients and methods. Between January 2004 and December 2014, 782 patients with thyroid diseases were operated by our team with microsurgical technique and loupes magnification 4.5x. All patients had pre and postoperative vocal cords assessment and biochemical analysis and the collected data were analyzed.

Results. Among the 782 patients, only six patients (0.77%) had unilateral vocal fold immobility treated with medical therapy, phoniatric and neck physiotherapy. All six patients showed complete laryngeal recovery of mobility 6/8 weeks after treatment. There were not cases of permanent monolateral or bilateral vocal cord palsy. In 84 patients there were signs and symptoms of hypocalcemia. In 81 patients (10.36%) the restoring of biochemical parameters and the resolution of symptoms occurred between 2 and 6 weeks and in 3 cases (0.38%) there was permanent hypocalcemia more than six months.

Conclusion. The use of microsurgical technique and loupes magnification in thyroid surgery are safety and effective procedures, that require an appropriate training in reconstructive microsurgery, but may significantly reduce post-operative complications. Here, we report for the first time the largest series of thyroid surgery performed with the use of microsurgical technique and loupes magnification, analysing the postoperative morbidity. In view of our results, we suggest the routine use of 4.5X loupes and microsurgical technique in thyroid surgery.

KEY WORDS: Microsurgery - Loupes magnification - Thyroid - Hypocalcemia - Recurrent laryngeal nerve injury - Vocal cord palsy - Hypoparathyroidism.
magnification in thyroid surgery it is important to present additional studies with a larger number (n) of patients. Our experience in many areas of general surgery and reconstructive microsurgery (8, 20-27), has prompted us to consider the benefits related to the application of microsurgical technique and the use of loupes in neck surgery. Therefore, the aim of the present retrospective study was to review ten years of thyroid surgery performed with use of loupes magnification and microsurgical technique by our team in a single institution and analyze the outcomes with respect to those reported in the literature with other surgical techniques.

Patients and methods

Patient enrollement

During the ten years study period, from January 2004 to December 2014, a group of 782 patients (633 females and 149 males; age range: 22-82) (Figure 1) was identified as eligible to undergoing surgery for thyroid disease at the Department of General Microsurgery, “Fabia Mater” Hospital in Rome, Italy. Informed consent was obtained by each patient for both the operation with loupes and data analysis; the clinical protocol for this study was approved by the local Independent Ethical Committee of the Institution. Clinical information was collected on sex, age, thyroid disease, and histology. In particular, the incidence of complications related to injuries of inferior laryngeal nerves and parathryoid glands after surgery was analyzed.

Thyroid surgery

In all patients, thyroid surgery was performed with microsurgical technique and loupes magnification 4.5X with focal range of about 17 inches. Surgery was carried out by the same microsurgical team with a high level of expertise in thyroid surgery and microsurgical technique. There must be emphasized that all the two microsurgeons used loupes magnification 4.5x not only during the dissection of the recurrent laryngeal nerve and parathyroid glands but for the entire period of surgery, that is, from the skin incision until the final suture. The operators wear also a led coaxial light to increase operative field brightness. The operative time was between 60 and 180 minutes (mean 90 minutes). The mean postoperative stay was 3 days (range 2-5 days) and the mean follow-up was 20 days (range 14-180 days). Thanks to the results obtained (more than 50 thyroidectomies per year), our Institution has been accredited in 2014 as the Reference Center of the Italian Association of Endocrine Surgery Unit (www.clubdelleuec.it) for the surgical treatment of thyroid diseases.

Pre- and postoperative evaluations

All patients had pre and postoperative mirror vocal cords assessment. To improve the quality of the assessment, all patients had pre and postoperative (about 4-8 weeks) fiber-optic naso-laryngoscopy combined with videostrobolaryngoscopy and voice evaluation (28, 29). All patients received, from the day after surgery until normalization of serum calcium, 1gram (gr) of calcium carbonate and 1 microgram (mcg) of vitamin D supplement for each day; serum calcium and ionized calcium have been dosed at day 1, 2 and 7 after surgery. We consider permanent hypocalcemia a low serum dose of calcium after six months to surgery. We did not record cases of operative or postoperative mortality in our series.

Results

The 782 patients underwent surgery for benign disease (n=548, 70%) and neoplastic disease (n=234, 30%) (Figure 1). The diagnosis of the benign disease included multinodular goiter, toxic multinodular goiter, Graves’ disease and thyroiditis, while the diagnosis of the neoplastic diseases was differentiated tumor (n=218), medullary carcinoma (n=3), insular carcinoma (n=2), anaplastic cancers (n=2) and tumor of unknown malignant potential (n=9) (Table 1). The patients underwent total thyroidectomy (n=676), lobectomy (n=16) and totalization (also known as completion) thyroidectomy (n=90) (Figure 2), of which 43 unilateral and 47 bilateral for a total of 1505 “nerves at risk”. Totalization thyroidectomy was applied in 32 patients (out of the 90), already treated in other hospitals, for neoplasms arising within residual thyroid. In 75 patients with thyroid cancer at high risk and/or enlargement of cervical lymphadenopathy, the thyroidectomy was associated with lymphadenectomy (central and lateral compartment). There were no cases of operative or postoperative
Microsurgery to reduce thyroid complications

Table 1 - Descriptive characteristics of histological findings by patients number.

<table>
<thead>
<tr>
<th>Disease</th>
<th>Number of patients</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malignant disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Differentiated carcinoma</td>
<td>218</td>
<td>27.9</td>
</tr>
<tr>
<td>Medullary carcinoma</td>
<td>3</td>
<td>0.4</td>
</tr>
<tr>
<td>Insular carcinoma</td>
<td>2</td>
<td>0.2</td>
</tr>
<tr>
<td>Unknown malignant potential</td>
<td>9</td>
<td>1.1</td>
</tr>
<tr>
<td>Anaplastic cancers</td>
<td>2</td>
<td>0.2</td>
</tr>
<tr>
<td>Benign disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multinodular goiter</td>
<td>490</td>
<td>62.8</td>
</tr>
<tr>
<td>Toxic multinodular goiter</td>
<td>5</td>
<td>0.6</td>
</tr>
<tr>
<td>Graves’ disease</td>
<td>25</td>
<td>3.2</td>
</tr>
<tr>
<td>Thyroiditis</td>
<td>28</td>
<td>3.6</td>
</tr>
</tbody>
</table>

Deaths in our series. Due to the clinical relevance of such microsurgical approach, compared to more traditional ones, we paid particular attention to the incidence of complications related to injuries of inferior laryngeal nerves and parathyroid glands. Indeed, the two most common early complications of thyroid surgery are hypocalcemia (20-30%) and recurrent laryngeal nerve injury (5-11%) (2). Bilateral recurrent nerve paralysis resulting in adduction of the vocal cords is a rare life-threatening complication occurring in less than 0.1% of cases that requires emergency management (2). In our series there were no cases of unilateral or bilateral permanent vocal cord palsy (Figure 3) except for one patient with preoperative unilateral vocal cord palsy (indirect laringoscopy) without modification of voice quality. In this case, we performed total thyroidectomy and resection of the recurrent nerve infiltrated by high risk carcinoma. In the same time it was applied microsurgical reinnervation by ansa cervicalis (branch innervating the sternothyroid muscle) to recurrent laryngeal nerve, as reported (30). At 6-month follow-up there were no phoniatric alterations and reinnervated vocal cord was tensioned and stopped at laringoscopy. Postoperatively, 8 symptomatic patients (1.02%) with dysphonia were recorded and they had early phoniatric evaluation within 10 days. Six of these patients (0.76% of total thyroid operated) had unilateral vocal fold immobility with dysphonia but without dysphagia while two patients had ipercinetic vocal cord that already was present preoperatively. Patients with unilateral vocal fold immobility were treated with medical therapy associated with phoniatric speech therapy and neck physiotherapy. The aim of physiotherapy is to relax the neck muscle groups as a result of postoperative contracture (due
to surgical stress, surgical operating position and postoperative attitude of defense of the neck) alongside the rehabilitation speech therapy for better and more rapid recovery of the vocal function. All patients showed complete laryngeal recovery of motility in 6/8 weeks.

Regarding the injuries of parathyroid glands, 698 patients (89.2%) did not show signs and symptoms of hypocalcemia while 84 patients (10.7%) presented signs of paresthesias and numbness of the fingertips and perioral area and Chvostek’s sign positivity, associated with alteration of biochemical parameters of serum calcium and ionized calcium. None of the patients presented Trousseau’s sign or tetany. In 81 (10.36% of all patients) the restoring of the biochemical parameters and the resolution of symptoms occurred between 2 and 6 weeks (mean 20 days) and only in 3 cases (0.38% of all patients) there was permanent hypoparathyroidism with permanent hypocalcemia (Figure 3). Bleeding complication, occurring within the first few hours after surgery, were observed only in one patient, and we proceeded to immediate revision of hemostasis. Of note, the only 3 cases of permanent hypoparathyroidism and the bleeding case occurred in the first three years of the study, meaning that the surgical experience acquired by the operative surgeons strongly improved the outcome of the following surgical treatment. No morbidity regarding bilateral inferior laryngeal nerves palsy, esophagus, trachea, or carotid artery was ever observed in this series (Figure 3).

**Discussion**

In this retrospective study we analysed the outcomes of 782 patients that underwent thyroid surgery by using microsurgical technique and loupes magnification 4.5x, between January 2004 and December 2014 in our Institution in Rome, Italy.

The microsurgical technique for the total thyroidectomy that we adopted in our Department of Microsurgery was based on the experience made in the early years of 1900 by Frank Howard Lahey (5) who stressed the importance of the systematic identification and preparation of the recurrent nerves for the purpose of their protection. It is surprising that the same author in 1938 first reported the concept that anyone performing thyroid surgery should have a magnification loupes 2.5x, with a focal range of about 18 inches; in particular, he wrote: “... it is a very valuable means by which one can see the striations in nerves and distinguish them from vessels” (31). For this reason, we adopted microsurgical technique and loupes magnification in all thyroid surgery, instead of standard surgical technique. As reported above, the two most common early complications of thyroid surgery are hypocalcemia and recurrent laryngeal nerve (RLN) injury, respectively 20-30% and 5-11% (2). In agreement with the concept that microsurgical technique allows to remarkably reduce the complications of thyroid surgery, in our series there were no cases of unilateral or bilateral permanent vocal cord palsy, six patients (0.76%) had transient unilateral vocal fold immobility with dysphonia without dysphagia, 10.36% of patients reported transient hypocalcemia while only 0.38% reported permanent hypocalcemia (Figure 3).

The microsurgical technique and the use of loupes are essential in identifying the thin branches of the inferior laryngeal nerve, which is particularly exposed at risk in the last extralaryngeal 2 centimeters (cm), especially to perform a real total excision of thyroid parenchyma. Thus, closed to the Zuckerkandl tubercle and fascial layers, there is a frequent site of injury due to transaction, clamping, ligation, traction, diathermy injury and ischaemia (7, 32). At that level, great caution must be taken in ligating and dividing such structures, in particular the arterial branches located behind the nerve, to prevent the bleeding whose hemostasis would damage the nerve. For this purpose, we used microsurgical ligatures with absorbable suture 4/0 and 6/0 so as to avoid thermal nerve damage and local edema, avoiding the use of bipolar diathermy. To ensure the integrity of the external branch of the superior laryngeal nerve we paid special attention during dissection of upper vascular pole, tying first the anterior branch of the artery and then the posterior branches, leaving no residual thyroid tissue at ligatures, in agreement with the literature (33). Particular care should be taken during the dissection of the recurrent nerve near the trunk of the inferior thyroid artery (34), avoiding devascularization of the parathyroid glands and dissecting the arterial branches with thin ties near their entry into the gland. In addition, increased complications can also occur during re-surgery on parenchymal residues (2, 35). In our series, nonetheless we treated 90 patients (58 benign and 32 malign) coming from other hospitals, re-surgery using loupes magnification and microsurgical technique did not affect patients’ motility of the vocal cords.

A technique that has been proposed to prevent RLN injuries and to aid nerve localization before visualization is the intra-operative neuromonitoring (IONM) (36). According to some authors, IONM reduces the rate of transient inferior laryngeal nerve palsy, it is useful in the case of thyroid re-surgery, and can help in the identification of the RLN during dissection before visualization (37). However, the role and the utility of IONM during thyroid surgery is still under debate (38) and, at the moment, there is not consensus regarding the prevention of RLN injury (39). In our experience, the use of IONM did not reduce the risks of laryngeal nerves injury (data not shown), suggesting that IONM
doesn’t improve the surgeon’s capability to identify and dissect the nerve, but rather it can be helpful in the reoperations and in the cervical lymphadenectomy. Moreover, IONM should not be considered standard of care and should not play a “coroner” role. Higgins in a meta-analysis study of a large series (64699 nerves-at-risk), compared the role IONM of RLN versus RLN identification alone on true vocal fold palsy rates after thyroidec- tomy, demonstrating no statistically significant difference (38). In a recent systematic review with meta-analysis of studies comparing IONM of RLN versus visualization alone during thyroidec- tomy of 35513 nerves-at-risk, the authors demonstrated no statistically significant difference in the incidence of RLN palsy when using IONM versus RLN visualization alone (38). In comparison, the advantages of the magnified vision are clearly evident in video-assisted surgery, and recently it has been proposed the use of three-dimensional minimally invasive video-assisted thyroidectomy for a better perception of depth and easy recognising of anatom- ic structures, especially concerning the upper and lower vascular pedicle, the parathyroids and the laryngeal nerves (41). To the best of our knowledge, there are only five previous studies reporting microscope-assisted thyroidectomy (4, 12-14, 16). The largest study to date is a series of 573 procedures published over a decade ago by Nielsen who reported 0.6% permanent RLN injury (13). Other authors prospectively compared microscopic with conventional thyroidectomy and found the former to result in significantly lower rates of transient hypocalcaemia and reduced rates of RLN injury (16). Recently, in one of the largest microscope-assisted thyroidec- tomy series to date and the first from a United Kingdom institution, the authors suggested that micros- copic dissection may help to prevent inadvertent injury to adjacent structures during crucial dissection steps (notably around the parathyroid glands and their vascular pedicles) and as such proposed microscope-assisted thyroidectomy as a reliable, safe and potentially advantageous method (4). Microscope-assisted thyroidec- tomy has also been championed for its ergonomic benefits to the surgeon. The operating microscope has been proposed as a method to maintain an upright po- sture with neutral cervical position during thyroid sur- gery, so reducing occupational musculoskeletal risk (18). The authors, though, noted a significant increase in operating time especially in case of lateral neck dissection. Nielsen also reported slight increases in operating time (11) while, in a more recent prospective controlled trial, a direct comparison of thyroidec- tomy performed with and without the operating microscope found no significant differences in operating time (16). Based on our more than thirty years’ experience in other fields of general microsurgery (limb replantation, microvascular free flap, vasectomy reversal and seminal tract recon- struction, inferior laryngeal nerve reconstruction, etc.) (8, 20-27), we believe that the use of the operating mi- croscope during thyroid surgery might be replaced by 4.5x loupes which allows a larger operating field with consequent benefits in surgical procedures and patients outcome. Moreover, the use of the operating microscope also allows recording which has obvious benefits for both teaching purposes and for a medico-legal standpoint (4). In this regard, in 2013 it was developed by the Direc- tor of our Microsurgical Department a prototype of high-definition head-on camera (Italian patent request n. RM2013A000601), that the operating surgeon can wear during the operation, able to record the images of the operative field directly and coaxial with his vision. This system records in full high definition at the same focal distance of operator’s loupes (about 17 inches), and is equipped with an anti-vibration optical system and an integrated software for images transfer. To the best of our knowledge, this system is the first in the world able to disclose the difference between the eye vision and the magnified loupes vision of operator, finally demonstrating the undoubted advantages of optical magnification in all surgical specialties and in particular in thy-roid surgery.

It is now widely accepted that the rate of thyroid sur- gery complications is directly related to the extent of thy- roidec- tomy (42) and to the radical thyroid excision as well as to the surgeon’s experience (7). This surgery re- quires a meticulous dissection of delicate structures, such as laryngeal nerves and parathyroid glands, whose da- mage can have serious repercussions on the patients life quality. The application of microsurgery in thyroid sur- gery, as well as in other areas of general surgery, requi- res experience with microsurgical instruments and confidence with magnifying optical devices. This tech- nique makes no changes to the surgical steps of the traditional technique, but adds the use of dedicated in- struments particularly thin and precise as well as optical magnification for the success of the interventions. Indeed microsurgical technique is not essential for iden- tification of the recurrent nerve, rather it is essential for the identification and respect of superior and inferior laryngeal nerve, for the nerve dissection along its cer- vical course till the larynx, for safeguarding parathyroid glands with their vascularity, for meticulous hemosta- sis and for performing a “real” total parenchimal excision (11). Moreover, this treatment approach allows completeness of total thyroidec- tomy with reduced tissue trauma and respect of the strap muscles integrity. Furthermore, the application of microsurgical technique improves complete parenchymal excision. Radical excision avoids, in the case of benign disease, the risk of recurrence and helps the endocrinologist to assess the hormone therapy, and, in the case of cancer, avoids the risk of re-surgery.
Conclusions

To the best of our knowledge this is the first largest series in the literature specifically analysing postoperative morbidity in thyroid surgery with the use of loupes magnification and microsurgical technique suggesting that such treatment approach might significantly reduce thyroid post-operative complications. Although we did not have a control group of patient undergoing standard thyroid surgery, we are pretty confident that the use of microsurgical technique and loupes magnification could have remarkably reduced the post-operative complications, in agreement with the first observation made with the use of magnification (31) and in accordance with the few literature reported using microsurgical techniques and magnification (11-19) and compared to the literature reporting the use of other surgical techniques.

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Disclosure

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