Complications of Thyroid Surgery: Analysis of a Multicentric Study on 14,934 Patients Operated on in Italy over 5 Years

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Abstract. Complication rates associated with thyroid surgery can be evaluated only through analysis of case studies and follow-up data. This study covers postoperative data from 14,934 patients subjected to a follow-up of 5 years. Among them, 3130 (20.9%) underwent total lobectomy (TL), 9599 (64.3%) total thyroidectomy (TT), 1448 (9.7%) subtotal thyroidectomy with a monolateral remnant (MRST), and 757 (5.1%) subtotal thyroidectomy with bilateral remnants (BRST). A total of 6% of the patients had already been operated on. Persistent hypoparathyroidism occurred after 1.7% of all the operations, and temporary hypoparathyroidism was noted in 8.3%. Permanent palsy of the laryngeal recurrent nerve (LRN) occurred in 1.0% of patients, transient palsy in 2.0%, and diplegia in 0.4%. The superior laryngeal nerve was damaged in 3.7%; dysphagia occurred in 1.4% of cases, hemorrhage in 1.2%, and wound infection in 0.3%. No deaths were reported. A significant rate of LRN damage was noted, which has an important impact on the patient's social life. Hypoparathyroidism after total thyroidectomy is an important complication that can be successfully treated by therapy, although it is not always easily managed in special circumstances such as in young persons or pregnant women. The complications associated with thyroid surgery must be kept in mind so the surgeon can carefully evaluate the surgical and medical therapeutic options, have more precise surgical indications, and be able to give the patient adequate information.

Before any surgical operation patients must be precisely informed of the extent of their pathology, the indications for surgical treatment, the possible alternative therapies, the advantages provided by the operation, and the possible complications and their remedies. They must be especially carefully informed of the complications and their incidence. Only after they are given this information can patients assent to or refuse the operation.

The results of 42 Italian endocrine surgery units affiliated with the UEC (Italian Endocrine Surgery Units Association), where thyroid operations are routine, were considered. In this multicenter study, we collected data on the complications for every thyroid pathology and for each operative technique over a definite period of time.

Methods

A retrospective observational analysis has been performed. During the 5 years from June 1, 1995 to May 31, 2000 each endocrine surgery unit has provided us with data for at least 50 unselected patients operated on every year, who were submitted to a scrupulous postoperative follow-up; the total number of patients was 14,934. The follow-up lasted until December 31, 2001. A database and data forms were set up for the detailed collection of data on surgical techniques and their related complications. We included transient or definitive paralysis of one or both vocal cords [all patients underwent postoperative ear/nose/throat (ENT) optical fiber laryngoscopy assessment], transient or definitive hypocalcemia (recurrent lesions and hypocalcemia that persisted for a year were considered definitive), intra- and postoperative hemorrhage, and lesions of the superior laryngeal nerve. We included also such rare complications as lesions of the thoracic duct, lesions due to malpositioning on the operating table, and corneal lesions.

The following operative techniques have been scrutinized: total thyroidectomy, total lobectomy, subtotal thyroidectomy with bilateral remnants, and subtotal thyroidectomy with a monolateral remnant. The following pathologies were examined: benign nodular and diffuse thyroid goiters; differentiated, medullary, and undifferentiated cancers. The patterns evaluated were the mean age of the patients, absolute incidence of thyroid pathologies, distribution by pathology in relation to the type of intervention and gender, and frequency of complications. To determine the cases with an equitable risk of complications, the odds ratio was considered based on a univariate analysis of the correlations between all the operating
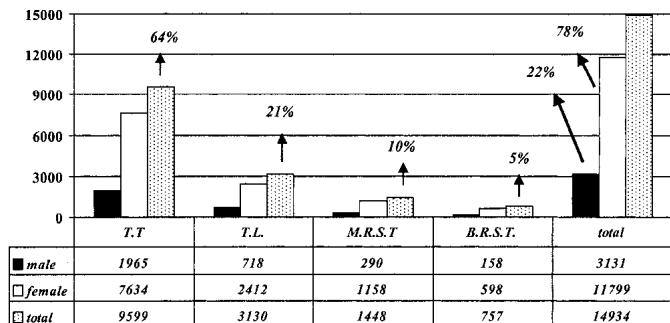
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272

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Fig. 1. Gender and operating techniques distribution. T.T: total thyroidectomy; T.L.: total lobectomy; M.R.S.T.: subtotal thyroidectomy with monolateral remnant; B.R.S.T.: subtotal thyroidectomy with bilateral remnants.

Fig. 2. Postoperative hypocalcemia.

Fig. 3. Hypocalcemia after thyroid cancer surgery.

techniques and the total number of complications. The scientific rigor regarding the choice of cases and information gathering has been assumed also by the eventual evaluation of a specific technical committee accepted by all the units participating in the study.

Results

The 14,934 cases evaluated were split into two major groups: (1) 13,023 (87%) patients who had benign pathology 1953 (15%) in whom it was diffuse and 11,700 (85%) in whom it was nodular, and (2) 1911 (13%) patients with a malignant pathology. The latter pathologies were differentiated in 1731 (91%) cases, medullary in 95 (5%), and undifferentiated in 85 (4%).

Altogether there were 11.799 (78%) women and 3131 (22%) men for a female/male ratio of 3.8:1.0. The mean age was 49 years. The following interventions were performed: 9599 (64.3%) total thyroidectomies (TTs), 3130 (20.9%) total lobectomies (TLs), 1448 (9.7%) subtotal thyroidectomies with a monolateral remnant (MRSTs), and 757 (5.1%) subtotal thyroidectomies with bilateral remnants (BRSTs) (Fig. 1).

Among all the patients, 14,057 (94%) were operated on for the first time, and there were 877 (6%) reoperations. Regarding techniques, 5% of the surgeons stated that they did not take the parathyroid glands into consideration to avoid damaging them, whereas 95% of them sought the parathyroids out or isolated them to protect them. A total of 56% of surgeons individuated the recurrent laryngeal nerve (RLN), 40% uncovered it anatomically, and 4% did not search for it. All the surgeons noted that they took special care not to injure the external branch of the superior laryngeal nerve. Considering the interventions overall, the rate of complications was 17.4%. If we do not consider transient complications, however, the overall definitive complication rate was 7.1%.

Symptomatic hypocalcemia, which was seen in 10.0% (8.3% transient, 1.7% definitive) of the entire population, accounted for 63% of all complications. The data indicated that 0.4% of the hypocalcemia occurred after lobectomy, with 0.07% of these cases definitive (a single case); 14.0% after TTs, with 2.2% of the cases permanent; and 5.0% after MRSTs and BRSTs, with definitive cases in 0.6% and 0.8%, respectively (Fig. 2). The incidence of definitive permanent hypocalcemia after surgical interventions for thyroid cancer was significantly higher (3.3%) (Fig. 3).

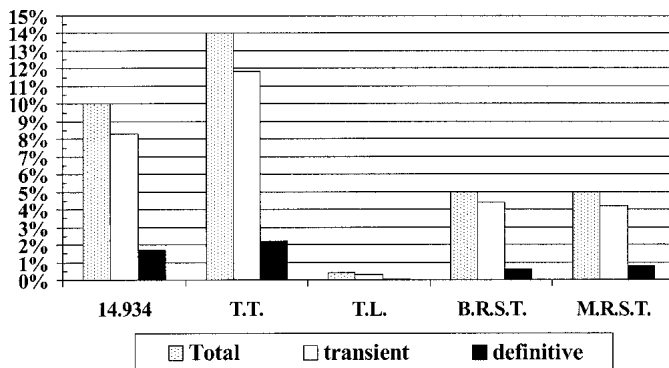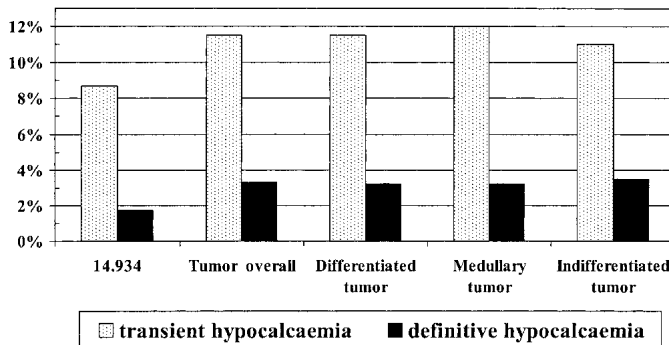*Laryngeal recurrent nerve (LRN) lesions* occurred in 3.4% of all patients with operated thyroids and represented 22.2% of all complications. Recurrent monoplegia had a frequency of 2.0%, the definitive lesion had a frequency of 1.0%, and diplegia had an incidence of 0.4%. After TT there was a total incidence of recurrent lesions of 4.3% (2.4% transient, 1.3% definitive); the incidence of bilateral lesions was 0.6% (half of these patients, or 0.3%, underwent a tracheotomy.

After TL the overall incidence of LRN lesions was 2.0% (1.4% transient, 0.6% definitive). After MRST and BRST the total incidences of the recurrent lesions were, respectively, 3.0% and 2.0% (1.4% and 1.1% transient, 1.0% and 0.6% definitive, and 0.6% and 0.1% bilateral lesions, respectively).

In the BRST group all bilateral lesions required tracheotomy, but none in the MRST group did so (Fig. 4). Among all the patients with thyroid cancer, the incidence of the LRN lesion was 5.7%. Significantly different were the percentages for the different types of cancer. Monoplegia was seen in 1.4% of those with differentiated tumors (DTs), 5.4% of those with medullary tumors (MTs), and 16.5% of those with anaplastic tumors (ATs). Among those with a DT, diplegia was seen in 0.5%, and tracheotomy was done in 0.2%. In those with an MT diplegia was seen in 3.2%, and in those with an AT it was seen in 3.5% (Fig. 5).

Lesions of the external branch of the superior laryngeal nerve were suspected in 3.7% of the cases because of the typical symptoms (vocal fatigue, difficulty singing note intonation, limitations to the high voice tones). It was documented in only 0.4% cases.

Hemorrhage occurred in 1.2% of all operated thyroids and accounted for 8.0% of the total complications. It occurred in these percentages: 1.6% in the TT patients; 0.4% in the TL patients; 2.1% in the BRST patients; 0.5% in the MRST patients (Fig. 6). It was intraoperative in 15% of the cases and postoperative in the
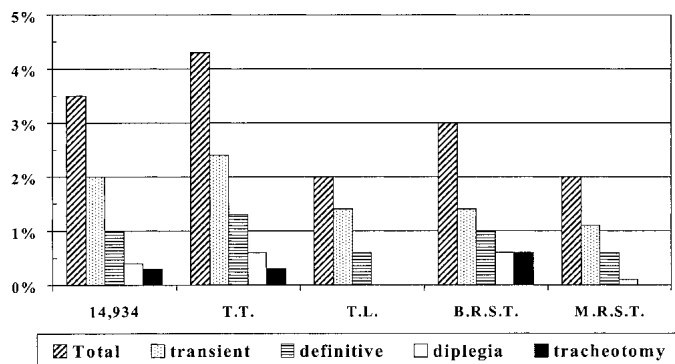
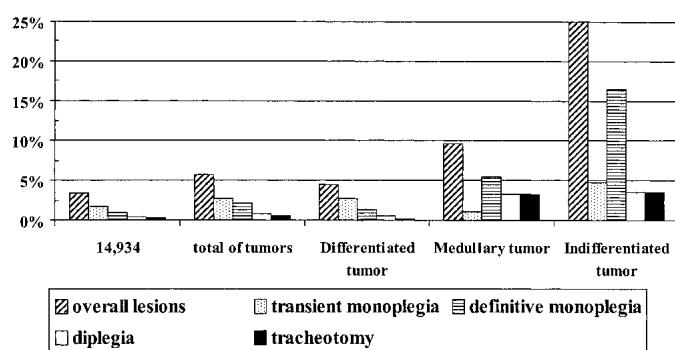**Fig. 4.** Laryngeal recurrent nerve (LRN) lesions. TL: no diplegia or tracheotomy; MRST: no tracheotomy.

Fig. 5. Rate of LRN lesions after thyroid cancer surgery.
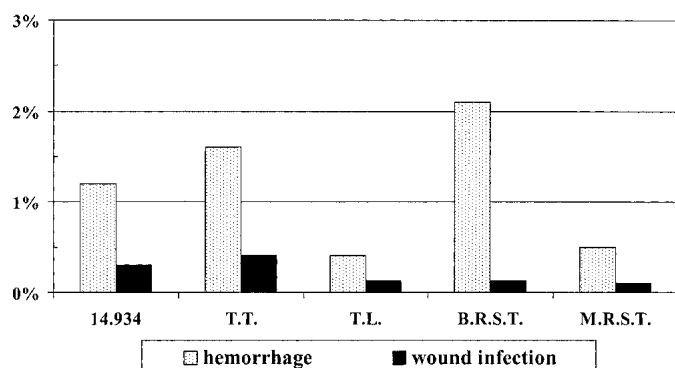

Fig. 6. Hemorrhage and wound infection rates.

remaining 85%. Blood transfusion was necessary in 1% of all cases of hemorrhage (i.e., in 0.12% of all operated thyroids). Altogether, 80% of the surgeons had not prepared any blood units before thyroidectomy.

Wound infection occurred during 0.3% of all operations, accounting for 2.0% of all the complications. It occurred in the following percentages: 0.4% in Tt patients; 0.13% in TL patients; 0.13% in BRST patients; 0.1% in MRST patients (Fig. 6).

Half (50%) of the surgeons applied antibiotic prophylaxis and 17% antibiotic therapy; 33% did not apply any prophylaxis or therapy. Despite these differences, the incidence of infections did not show significant differences in these groups. *Rare complications* were as follows: There were four lesions of the thoracic duct, one of

which occurred in a patient with an intrathoracic goiter and three after lymphectomy. Three of these patients were treated with medical therapy and one with surgery. These rare complications occurred with only 0.03% of the total interventions and accounted for 0.2% of all the complications. Another four patients experienced ulnar nerve paralysis (one definitive case and three transient cases) caused by malpositioning on the operating table. The paralysis occurred in 0.02% of the total interventions and accounted for 0.2% of all the complications. Finally, there was one case of Claude-Bernard-Horner syndrome and one patient with a punctiform corneal lesion who had serious permanent visual damage. In addition to these rare complications, however, there were a large number of disturbances caused by hyperextension of the head during surgery, including vertigo, headache, and postoperative nausea. No deaths were reported in the data.

Discussion

Complications have been receiving increasing attention so surgeons have the tools to conduct a careful evaluation of surgical and medical therapeutic options, have more precise surgical indications, and be able to give the patient adequate information [1, 2]. Knowledge of the surgical anatomy of the neck, thyroid pathology, and required surgical treatment is essential to keep complications within reasonable limits [3].

Hypocalcemia caused by transient or definitive hypoparathyroidism was the most frequent complication after thyroidectomy, occurring in 63% of the cases. Obviously, the incidence of definitive hypoparathyroidism was relevant after total thyroidectomy. It was less relevant after subtotal resections, and its incidence slightly increased after operations for tumor pathology (3.3%).

The problem of how many parathyroids must be preserved to maintain a normal serum calcium level remains unresolved. Most authors [4] believe that a single functioning gland is enough to restore normal parathyroid activity, whereas others believe that the integrity of at least three glands is necessary [5]. Parathyroid tissue is functionally unique, even if it is divided into four glands, each weighing about 30 to 40 mg (total 120–160 mg). Therefore either the residual tissue becomes hyperplastic to replace the missing tissue, or parathyroid function remains insufficient. Each parathyroid has its own set point, which can be defined as the extracellular calcium level that determines the halving of maximal parathyroid hormone (PTH) secretion, but it does not always respond in a foreseeable way to the hyperplasiogenic input. This may account for the slight but persistent hypocalcemia sometimes found with intact PTH levels (within the normal range though closer to minimal values). When the hypocalcemia is definitive, the arterial or venous (or both) vascular anatomy of the parathyroids is damaged. Even if no factors can predict the seriousness of the hypocalcemia and particularly its persistence, tetany develops within 12 hours after the operation. With the low calcium and high phosphate levels in the blood, one can reasonably expect it to lead to definitive hypoparathyroidism. Therefore it is necessary to take some technical precautions to reduce as much as possible the persistent hypocalcemic complications.

1. If the parathyroids are anatomically well protected in the parathyroid capsule, the surgeon may easily preserve them without any handling. In contrast, if they are attached to the thyroid capsule, as is often the case, they must be accurately separated, and

274

World J. Surg. Vol. 28, No. 3, March 2004

Table 1. Classification of laryngeal recurrent nerve lesions.

Transient or definitive
Monolateral or bilateral
Complete (either adduced chorda or in paramedian position)
Partial (hypomobility, hypotonia)
Immediate, early or late

Table 2. Causes of transient laryngeal recurrent nerve palsy.

Excessive nerve skeletalization
Neuritis (caused by scar tissue, myelinic lesion)
Axon damage caused by excessive strain
"A frigore" or "a calore" paralysis
Thermic lesions caused by electrocoagulation
Viral neuritis
After difficult orotracheal intubation paralysis

pericapsular ligature of the branches of the inferior thyroid artery must be carefully executed. This is an attempt to safeguard venous vascularization. Some [6, 7] believe that correct functioning of the parathyroids does not depend on ligating the inferior thyroid artery at the main trunk.

2. The posterolateral branch of the superior thyroid artery must be ligated only after having determined that it does not vascularize the superior parathyroid gland [8].
3. If a parathyroid is incidentally devascularized, it is necessary to reimplant it in a sternocleidomastoid muscle pouch. The gland must be previously fragmented and the muscle pouch shut with a nonabsorbable suture to recover it, if necessary (hyperparathyroidism) [9, 10].
4. If venous congestion or gland hemorrhagic infiltration occurs, it is necessary to decompress it by incising the parathyroid capsule [9].

Transient or definitive injuries to the lower laryngeal nerve are the most important complications because they deeply influence the patient's social life. They represent 22.2% of total post-thyroidectomy complications. The LRN lesions occur equally in the TT and BRST patients. In the TT group there is a mild increase in transient monoplegia and a similar incidence of diplegia. Total lobectomy and MRST, as was expected, was associated with only about half this incidence, as the approach to the nerve is unilateral. Altogether, 96% of the surgeons participating in our multicentric study individuated anatomically or uncovered the recurrent nerve up to its inlet under the lower pharyngeal constrictor muscle. The literature proposes various options, and therefore different techniques are used. In fact, some surgeons believe that it is prudently important to save some thyroid tissue around the nerve junction to the larynx [11] or to perform a capsular dissection [3]. Others note that simply viewing the nerve can safeguard it from injuries with anatomic certainty [2, 12–15].

There are several clinical symptoms associated with LRN lesions (Table 1), and the causes of transient palsy (Table 2) are various and often unknown. A malfunction of vocal cords documented by optical fiber laryngoscopy that does not regress within a year must be considered definitive. It occurs with only partial or complete nerve damage or because of the persistence of other causes (Table 2). When cord paralysis with dysphonia appears some days or weeks after the operation, the surgeon is seriously disappointed. Even if it is difficult to find or to demonstrate the causes, it can probably be ascribed to initial flaccid paralysis that becomes spastic, giving rise to dysphonia. Alternatively, overlapping neuritis may cause the dysphonia. It is important to start logopedic rehabilitation early (within 2–3 weeks) in all cases of vocal cord paralysis. The accessory laryngeal musculature plays an important function, especially if the surgeon has preserved the anatomic integrity of the prethyroidal muscles. In our case records, logopedic physiotherapy was undertaken in 53% of patients with an LRN lesion (262/496), 49% of patients with transient damage, 69% of patients with permanent damage, and 31% of patients with bilateral lesions.

Damage from nerve injuries can be reduced to a minimum if the following techniques are considered.

1. Individuate the main landmarks for thyroid surgery: the carotid artery and trachea.
2. No structure is interrupted below the carotid level, but the surgeon should proceed with the dissection until the nerve is detected.
3. Preferably, uncover the LRN location up to the inlet of the lower pharyngeal constrictor muscle (cricopharyngeal muscle) and leave it adherent to the back of the connective tissue, which protects and vascularizes it.
4. When removing the thyroid from the laryngotracheal axis it is necessary to cover the bare nerve with a lukewarm wet gauze.
5. It is better not to use a unipolar electrotome near the nerve. Moreover, the bipolar electrotome must be used carefully and only in a few cases.
6. To avoid dangerous hemostatic maneuvers it is preferable to ligate carefully the small retroneural arterial vessel near the nerve entry under the cricopharyngeal muscle.
7. Attention must be paid, especially on the right side, to a nonrecurrent inferior laryngeal nerve, which is present in about 1% of cases [16].

It is interesting to note the method proposed by some authors [17] regarding LRN intraoperative monitoring by an electrode inserted in the endotracheal tube. However, this technique seems more suitable for experimental use than as a practical application.

Laryngeal superior nerve (LSN) transient or permanent injuries are relatively frequent and are often underestimated. They manifest as a lowered voice tone, vocal fatigue, and difficulty singing note intonation. If the omolateral LRN lesion is present, dysphagia for liquids often occurs. It is caused by impaired coordination of glottis closure by the epiglottis, which determines liquid inhalation in the airway. Even if dysphagia regresses in a few weeks, sometimes it is so severe it compromises adequate hydration. Therefore it is well to stretch out the superior pole of the thyroid laterally and to ligate the three branches coming from the thyroid artery next to the glandular tissue, thereby reducing to a minimum the risk of LSN lesions. It is rarely possible to individuate easily and immediately the external branch of the laryngeal superior nerve because it is extremely thin or incorporated in the lower pharyngeal constrictor muscle sheath. An obstinate anatomic search may cause nerve damage [18]. The incidence of *hemorrhage* was not large in our case records (1.2%). Hemorrhage occurred chiefly postoperatively, and a blood transfusion was needed in only 18 cases (0.12%). Most of the hemorrhages can be explained by the large number of patients affected by Graves' diseases (1914) who underwent thyroidectomy. If thyroidectomy is performed according to the extracapsular technique, intraoperative bleeding is not usual; however, it is more frequent in BRST patients because of the double resection of the thy-
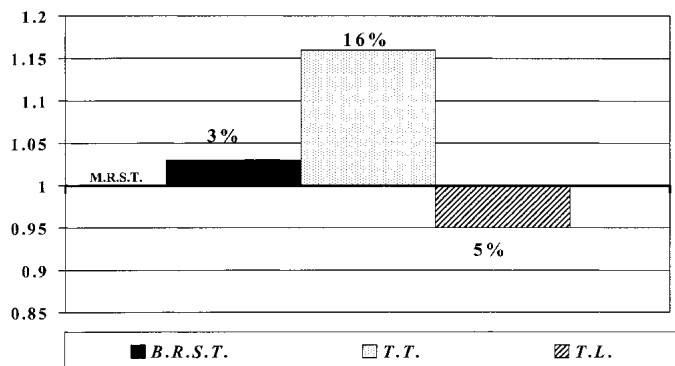
Fig. 7. Odds ratio according to the operative technique.

roid lobes. Most delayed bleeding is of venous origin; and because of the negative pressure on the large vessels of the neck, it occurs on waking or at the first cough. To prevent this problem, it is well to verify hemostasis carefully at the end of the operation. This can be done while the anesthetist simulates a Valsalva maneuver, raising the intrapulmonary pressure to 40 cm H_2O. We believe it necessary to use drainage, although some disagree [19] because they consider it a source of infection, necessitating a longer stay in hospital.

Infections in thyroid surgery are considered rare and have a low incidence: 0.3% of the cases in our study. No differences were noted among patients given an antibiotic as prophylaxis, as therapy, or not at all. Therefore the use of antibiotics is justified only when patients manifest severe diabetes, valvular heart disease, or immunodeficiency. Disinfection and cleaning of the skin must be absolute. If there is a neoplastic pathology, it is preferable to use a non-iodated disinfectant (Ibitane) so as not to invalidate an eventual postsurgical scintiscan.

Thyroid pathology recurrence is not usually considered a complication, even if it is a consequence of an inadequate, somehow useless operation. Among our case histories, 6% of the patients had already undergone surgery.

Hypothyroidism is considered an expected result. Hence it is not a complication if we consider that total thyroidectomy has its own logic [20].

Malpositioning on the operating table may cause less important complications. To avoid rare but severe paralysis caused by brachial plexus stretching, the patient must be positioned with arms adducted. To prevent paralysis of the ulnar nerve the patient's elbows must be protected with adequate padding. Moreover, the patient's eyes must be protected with an appropriate plastic mask.

No deaths were reported in our case histories. It is a rare and unexpected event. However, as early as 1898 Theodor Kocher (1841–1917) reported a single death, which was due to a toxic dose of chloroform [21], in a case study of 600 patients.

Based on the study of the 14,934 operations for thyroid pathology performed by experienced surgeons who practice thyroid surgery as a routine in 42 Italian centers, we determined which of the examined techniques was the most "advantageous." To evaluate which operative technique presented the least risk of complications, we considered the correlation between each operative technique and the number of the complications that occurred. The univariate analysis indicated that MRST was the reference technique (value 1). In a comparison with it, the odds ratio (i.e., the higher or lower risk of postoperative complications) was calculated for the other techniques. The results showed that the most protective technique was TL, with a 5% lower risk; the BRST has a 3% risk and the TT a 16% risk (Fig. 7). In light of these data, although TT is mandatory for the most complex cases (tumors, substernal goiter, multinodular goiter, Graves-Basedow) with necessarily higher risk, the surgeon, whenever preferring TT (because it is a more protective technique) must justify his or her decision by drawing up a careful and complete operational chart. MRST must be considered preferable to BRST because if another operation is required the surgeon must reoperate on only one side.

Résumé. Les taux de complications après chirurgie de la thyroïde ne peuvent être évalués que par une analyse clinique complète avec suivi. A partir des données post-opératoires provenant de 14,934 patients suivis pendant une période de 5 ans, on a étudié les dossiers de 3130 (20.9%) patients ayant eu une lobectomie totale (TL), 9599 (64.3%), une thyroïdectomie totale (TT), 1448 (9.7%), une thyroïdectomie sub-totale avec conservation d'un moignon monolatéral (MRST) et 757 (5.1%) ayant eu une thyroïdectomie sub-totale avec conservation de deux moignons bilatéraux (BRST). Six pourcent des patients ont déjà eu au moins une intervention antérieure. Une hypoparathyroïdie persistante a été observé chez 1.7% des opérés, alors qu'une hypoparathyroïdie temporaire a été notée chez 8.3%. Une paralyse permanente du nerf laryngé récurrent (NLR) a été observée chez 1% des patients, une paralyse transitoire chez 2% et une paralysie bilatérale chez 0.4%. On a observé une lésion du nerf laryngé supérieur dans 3.7% des cas, une dysphagie dans 1.4% des cas, une hémorragie dans 1.2% et une infection du site opératoire dans 0.3%. Aucune mortalité n'a été rapportée. Un taux significatif de lésions du NLR a été noté avec un retentissement important sur la vie sociale du patient. L'hypoparathyroidie après thyroïdectomie totale est une complication importante qui peut être traitée avec succès mais ce traitement n'est pas toujours facile surtout en cas de patients jeunes ou en cas de grossesse. Les complications secondaires à la chirurgie de la glande thyroïde doivent être traitées avec une attention particulière afin de pouvoir évaluer avec précision les options thérapeutiques chirurgicales et médicales, améliorer les indications thérapeutiques et fournir une information satisfaisante aux patients.

Resumen. Para valorar la tasa de complicaciones de la cirugía tiroidea ha de analizarse la casuística y los resultados de los hallazgos obtenidos en revisiones más o menos prolongadas en el tiempo. Se recogen los hallazgos postoperatorios de 14934 pacientes con seguimientos superiores a 5 años. De ellos, 3130 (20.9%) sufrieron una lobectomía total (TL), 9599 (64.3%) una tiroidectomía total (TT), 1448 (9.7%) una tiroidectomía subtotal con remanente monolateral (MRST) y 757 (5.1%) una tiroidectomía subtotal con remanente bilateral (BRST). El 6% de los pacientes habían sido ya operados. El 1.7% de todos los intervenidos desarrollaron un hipoparatiroidismo permanente, mientras que hipoparatiroidismo transitorio se registró en el 8.3%. En el 1% de los pacientes operados se constató parálisis permanente del n. laríngeo recurrente (LRN) mientras que en un 2% la parálisis fue transitoria y la diplegía alcanzó una incidencia del 0.4% de los casos. El nervio laríngeo superior fue lesionado en un 3.7%, apareció disfagia en el 1.4%, hemorragia en el 1.2% e infección de la herida operatoria en el 0.3% de los casos. No hubo mortalidad alguna. La tasa de lesiones del LRN es significativa y tiene una importante repercusión en la vida social del enfermo. Tras tiroidectomía el hipoparatiroidismo también es una complicación frecuente, que puede tratarse con éxito excepto en alguno casos: pacientes jóvenes y embarazadas en las que el tratamiento no es siempre tan sencillo. Por todo lo expuesto, debe concederse una especial atención a las complicaciones de la cirugía tiroidea, con objeto de valorar cuidadosamente las opciones terapéuticas tanto médicas como quirúrgicas, definiéndose con precisión las indicaciones quirúrgicas, para proporcionar, en todo caso, la información adecuada al paciente.

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