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editorial article

Difficult thyroidectomies

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SUMMARY: **Difficult thyroidectomies.**

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The "difficult thyroidectomies" (DT) are motivated by several factors that, alone or in association with each other, make surgery more laborious and increase the related risks. Topographical, technical and anatomical criteria have been used by us to classify DT with a view to illustrating specific problems and suggesting appropriate strategies. According to topographical criteria we considered mediastinal goiter and resurgery; according to technical criteria we considered the presence of auto-immune thyroiditis and locally advanced malignancies; on the basis of anatomical criteria, we considered the presence of "non recurrent" laryngeal nerve and of a pre-operatory vocal cord palsy.

KEY WORDS: Difficult thyroidectomies - Goiter - Thyroid carcinoma.

Introduction

It is only fairly recently that the adjective "difficult" has been applied to thyroidectomies. This description has nothing to do with the surgeon's skill, but is motivated by several factors, including the volume and/or mediastinal extent of the diseased thyroid, its relationship with surrounding structures, the underlying disease, the thyroiditic component, adhesions from previous surgery and/or unexpected anatomical features, but also the shape of the neck, a stiff nape or humped back, and obesity. These are all well-known factors that, alone or in association with each other, make it more laborious and, importantly, increase the related risks.

Topographical, technical and anatomical criteria (Table 1) have been used by us in an effort to classify difficult thyroidectomies (DT) with a view to illustrating specific problems and suggesting appropriate strategies.

Topographical criteria

The cervico-mediastinal goiter takes its rightful place among the DT, defined by Merlier and Eschapasse in 1973 as, *"…les goitres qui, en position opératoire, descendent au minimum de deux travers de doigt dessous de l'orifice supérieur du thorax"* (1). This condition is far from rare among elderly people, but often goes undiagnosed because it is asymptomatic, and only found incidentally when patients are examined for other medical conditions (Table 2).

It is strategically important to distinguish between "**plongeant**" and **ectopic/autonomous goiters.** The lack (ectopic) or loss (autonomous) of any connection to the cervical thyroid and the likewise autonomous vascularization of the ectopic goiter subtends the possible use of a complementary route

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TABLE 1 - DIFFICULT THYROIDECTOMIES: CRITERIA.

• Topographical	- mediastinal goiter:	- plongeant - ectopic
• Technical	- resurgery - auto-immune thyroiditis - locally advanced malignancies	
• Anatomical	- "non-recurrent" laryngeal nerve - pre-operatory vocal cord palsy	

TABLE 2 - MEDIASTINAL GOITER.

• PLONGEANT (connected to the cervical thyroid)	- ANTERIOR or PREVASCULAR - POSTERIOR or RETROVASCULAR (retrotracheal, retroesophageal, crossed)
• ECTOPIC or AUTONOMOUS (unconnected to the cervical thyroid)	- ANTERIOR or PREVASCULAR - POSTERIOR/RETROVASCULAR

to the cervicotomy, and the choice is not always easy. The supra-aortic vessels form a barrage that may make the sternal split ineffective and oblige the surgeon to perform a service thoracotomy. The same problem is encountered with posterior mediastinal or retrovascular "plongeant" goiters, which are sometimes crossed (Figures 1, 2)

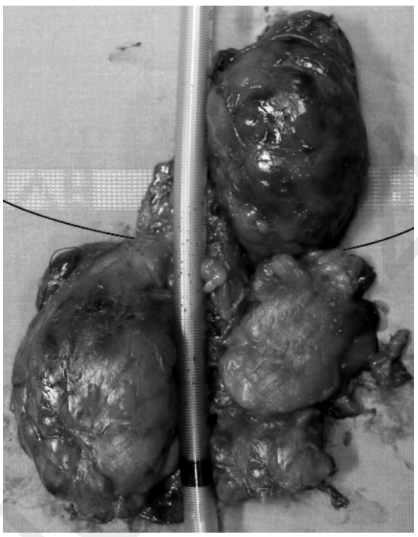


Fig. 1 - A posterior view of cervico-mediastinal goiter.

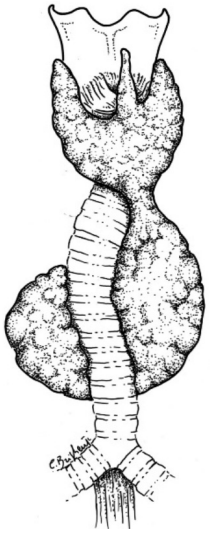


Fig. 2 - Picture of the crossed cervico-mediastinal goiter.

Providing certain steps are taken, the majority of extensively "plongeant" goiters do not necessitate an accessory route, since they maintain the parenchymal connection with the cervical thyroid and share the same vascularization. A broad and low cervicotomy, extending the distal opening of the linea alba to the retrosternal insertion of the pre-thyroid muscles, their subsequent detachment from the sternocleidomastoid and, if necessary, their partial or total section are useful ways to stretch the thyroid loggia and make space for the cleavage (2).

After ligating and dissecting the middle vein (if any, and if accessible), and then the superior peduncle, the strict plane of extracapsular dissection guarantees a gradual finger dissection with an upward traction by "halage", using a levering action on the laterally and medially immersed portion (Figures 3, 4).

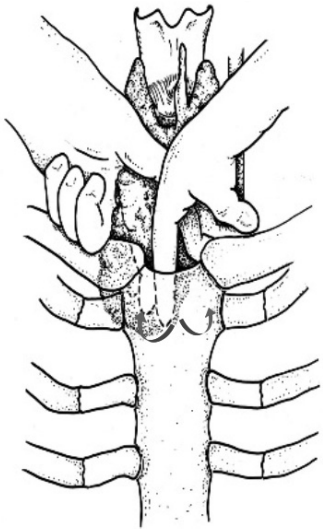


Fig. 3 - The "halage" maneuver.

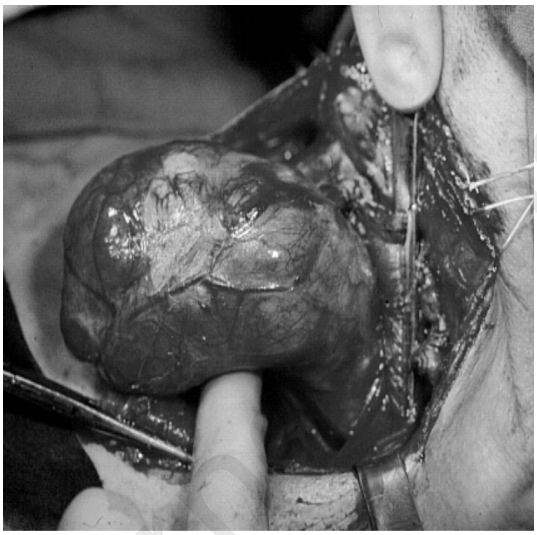


Fig. 4 - Upward traction by digital mobilization.

After the inferior thyroid artery (ITA) has been identified, it can be loaded on a tape to facilitate the search for the recurrent nerve, which is sometimes displaced posteromedially to the goiter and fused with the capsular plane. It sometimes proves necessary to ligate the ITA closely to the carotid artery, as a preventive measure to ensure hemostatic control, or even to cut the artery if it interferes with the luxation of the sunken portion (Figure 5). It is important to bear in mind that medial traction on the peripheral stump of the artery risks pulling on the recurrent nerve as well, and that this nerve may be undetectable, flattened against the goiter. It is advisable to search for the nerve either by a retrograde route from the point it enters the larynx, and using the inferior horn of the thyroid cartilage as a marker, or by palpation below the ITA after exteriorization of the goiter, where the nerve emerges from the mediastinum, starting from the lateral side of the tracheal wall and proceeding towards the carotid.

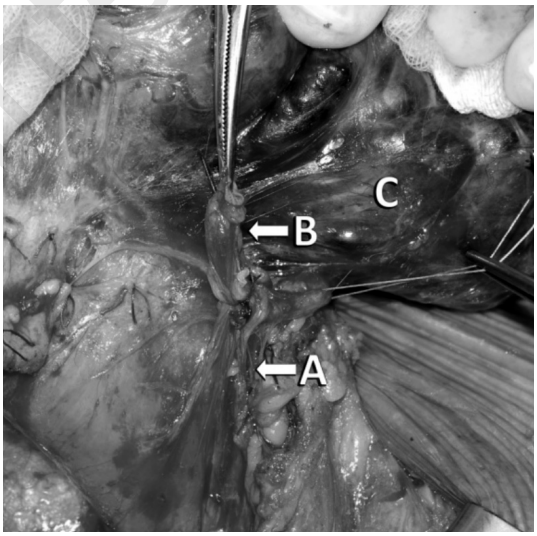


Fig. 5 - A) The recurrent nerve. B) The medial traction on the peripheral stump of ITA risks pulling on the recurrent nerve as well, making it undetectable, flattened against the thyroid. C) The thyroid.

It may be useful to begin from the side that is less affected by the goiter (and less difficult for the surgeon), and then to enlarge the surgical chamber and identify (digitally at least) the tracheal plane, which is another indispensable landmark in thyroid surgery (Figures 6, 7). Its exposure is facilitated by dividing the thyroid isthmus (if accessible), an action that enables the surgeon to proceed along the pretracheal route, if necessary. A dual-purpose operating field is thus prepared, not only for the cervicotomy, but also for sternal splitting (if necessary), so the sternotomy saw should be readily available (Figures 8, 9). In necks with a pronounced lower throat, splitting the inferior skin flap alone may sometimes help to widen the access route.

In elderly patients with no suspected monolateral goiters, complete retrosternal hemithyroidectomy is a prudent and sufficient therapeutic measure. It avoids hypoparathyroidism and the residual healthy lobe may not need replacement therapy. Above all, it places at risk only one recurrent nerve. In the case of particularly laborious nerve dissection, its anatomical preservation cannot always guarantee its functional integrity, so a temporary deficit cannot be ruled out *a priori*. The authors would not recommend total thyroidectomy "in principle", especially in elderly patients, for fear of recurrences.

Fig. 6 - An inter-tracheo-esophageal goiter.

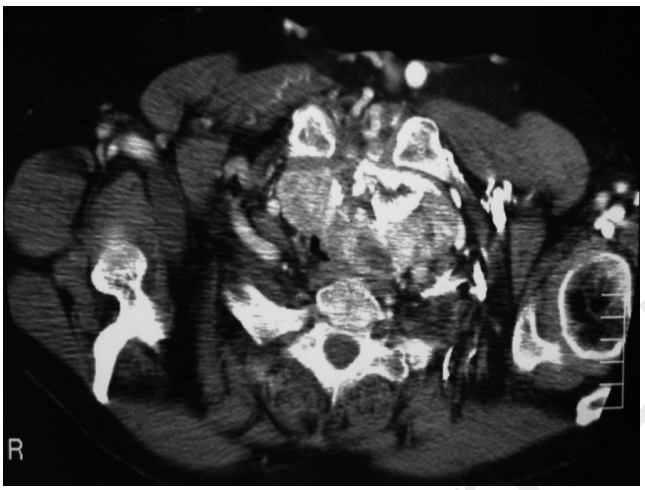


Fig. 7 - Computed tomography of the neck and thorax. An important tracheal deviation and compression by a large retrosternal goiter can be observed.

Fig. 8

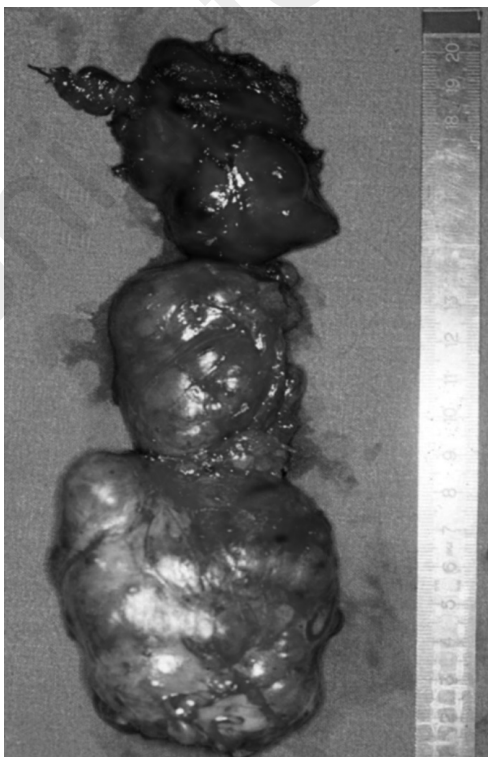
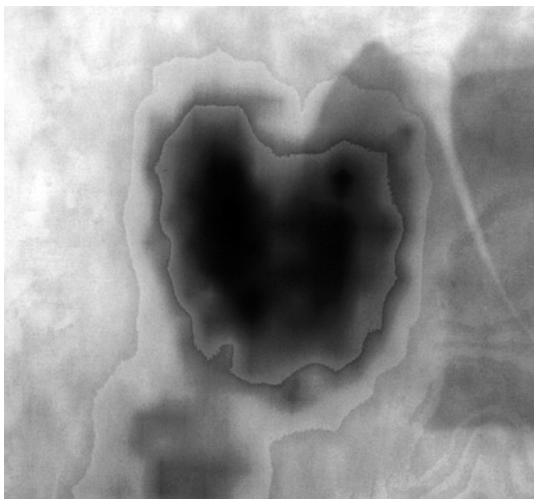


Fig. 9

Figg. 8, 9 - Complementary sternotomy required in a case of a cervico-mediastinal goiter.

In an analysis of our experience concerning the years between 1996 and 2003, mediastinal goiter - as defined by Merlier and Eschapasse - was the surgical indication for 569 (12.2%) of 4,668 thyroidectomies, but as many as 564 of them were cervico-mediastinal: 73.11% were prevascular, and 66.43% were monolateral; 20 of the 148 retrovascular goiters crossed from left to right; only 5 were autonomous/ectopic with no parenchymal connection to the cervical thyroid.

As far the access route, with the exception of one case (1/564 cases, 0.2%) of an anterior cervico-mediastinal recurrence in which an associated complementary sternotomy became necessary, the tra-



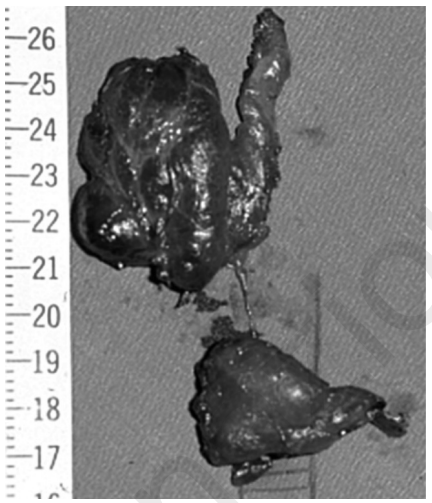


Fig. 10 **Fig. 11**

Figg. 10, 11 - An ectopic goiter at preoperative SCAN and at surgery.

ditional transverse cervicotomy sufficed for all the other cases (even the ectopic goiters), which were anterior and fortunately high enough to be "ensnared" with ring-shaped forceps or anchor points using a cervical route (Figures 10, 11).

It is worthy the comparison between these findings and an analysis conducted in 1979 on 47 cases of goiter developing in the endothoracic region (during the period when our Surgical Unit was concerned mainly with thoracic surgery and only marginally with thyroid surgery).

More use of a complementary access was made in earlier series: in 7 of 47 cases (8.5%) an access route was necessary. A thoracotomy was performed in 3 cases, completed with a cervicotomy in 2, for a generic diagnosis of a mediastinal mass, no recognized goiter; another 2 patients required cervicotomy plus thoracotomy; cervicotomy with sternotomy was performed in another 3 (3).

Technical criteria

In the context of the technical difficulties associated with thyroidectomy, **resurgery** takes first place - but not always, and not necessarily alone. Numerous procedures and various factors, some of them unrelated to the disease or the procedure *per se*, may concur in making a thyroidectomy difficult (including its mediastinal extension, Basedow disease, local infiltration, short and thick neck, obesity). The issue of resurgery was analyzed in an Editorial on Thyroid Resurgery in 2011 (4). Data were subsequently published on the complications encountered in a series of 233 reoperations out of a total of 4,752 thyroidectomies performed between 2006 and 2010 (5).

The procedures with the greatest impact are the bilateral totalizing reoperations after prior subtotal bilateral thyroidectomies, or after prior monolateral thyroidectomies (especially when partial), with contralateral recurrent nerve palsy - both situations that place the residual intact recurrent nerves at risk.

This consideration also applies to the residual parathyroids, which deficiencies may have been partly influenced by the frequent tendency to ligate the ITA for hemostatic purposes. Although the only statistically significant difference emerging for the various resurgery procedures concerned the percentages of transient hypoparathyroidism (32% for the monolateral and 48.7% for the bilateral totalizing procedures), permanent hypoparathyroidism (1.7% and 5.5%, respectively), recurrent nerve lesions (4.9% vs 9.6% for transient lesions, and 0.8% vs 2.7% for permanent damage), and hemorrhage (1.5% vs 4%), these differences correlated with the mono- versus bilateral extent of the redo surgical procedure.

It is worth emphasizing that there is no alternatives to thyroid lobectomy as an initial minimal approach to any type of thyroid disease in order to escape the need for subsequent homolateral resurgery. That is not to say that thyroidectomy should always be total and bilateral, in principle.

Exclusively contralateral totalizations in a virgin site pose much the same problems as a first-hand operation.

Among the most feared situations is the need to reoperate for Basedow disease (which generally coincides with robust, vascularized, woody or fragile goiters that are refractive to alternative treatments), but also cases with relatively small but bilateral residuals, fused with the prethyroid muscles and the tracheal plane for which radioactive Iodine therapy is an option to bear in mind.

From the technical standpoint, it is important to remember the value in resurgery of a lateral access to the prethyroid muscles, as already described and documented in previous works (6). This access enables a ready identification of the internal jugular vein, the carotid and the ITA medially thereto, and transit in virgin terrain in search of the recurrent nerve.

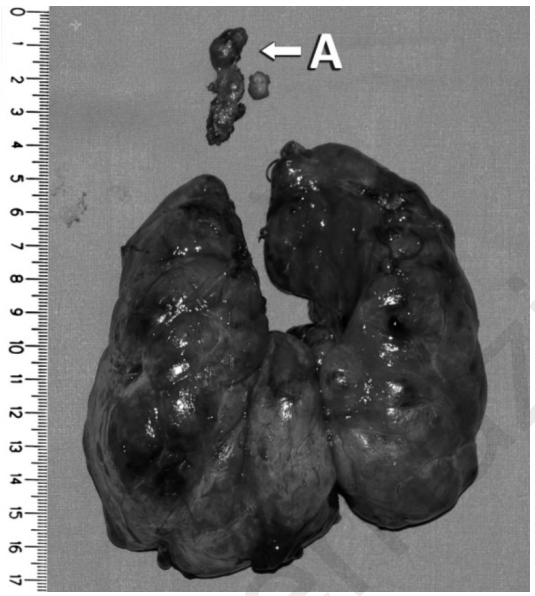


Fig. 12 - A voluminous goiter in a Basedow's disease. A: pyramidal lobe of thyroid.

Thyroidectomies for **autoimmune diseases**, whether the thyroid is hypo- or hyper-functioning, can prove technically demanding. Paradoxically, this is true even in the case of relatively small, sclerotic thyroids lacking in planes of cleavage, often with major adenopathies around the recurrent nerve. That is why cases of so-called "**thyroiditis**" represent one of the contraindications for minimally-invasive surgery. By comparison with Hashimoto's, Basedow disease has the added drawback of a marked vascularization and a consequent risk of bleeding, especially when patients are refractory to thyreostatic therapy and do not benefit from the usual preparation, and/or have an associated bulky goiter (Figure 12) (7).

The **benign or malignant nature** of a given thyroid disease has less influence on the technical difficulties that the surgeon faces, unless the malignancy is locally advanced. Extensive infiltrations of the trachea or esophagus demanding laryngectomy or tracheal or pharyngeal resection are beyond the scope of this paper because, rather than making the thyroidectomy difficult, they are complex for other reasons and belong to other fields of specialization. No additional problems are posed by infiltration of the surrounding soft tissues (adjacent vessels or muscles) or minimal tracheal infiltrations in which limited tracheal resection or shaving can ensure a radical treatment; for differentiated carcinoma at least, since we can rely on the fact that differentiated carcinomas retain

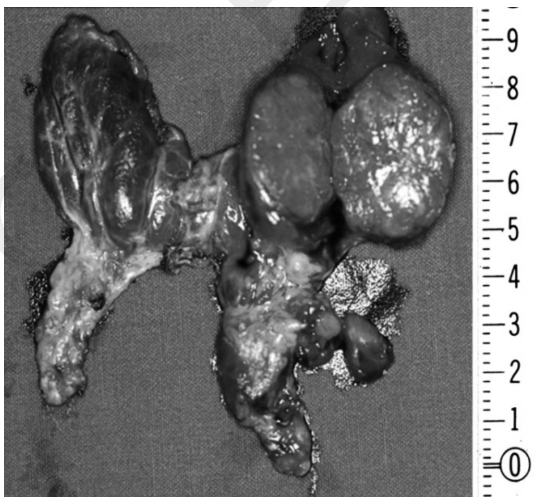


Fig. 13 - Total thyroidectomy and central node dissection in a patient with papillary thyroid carcinoma (PTC).

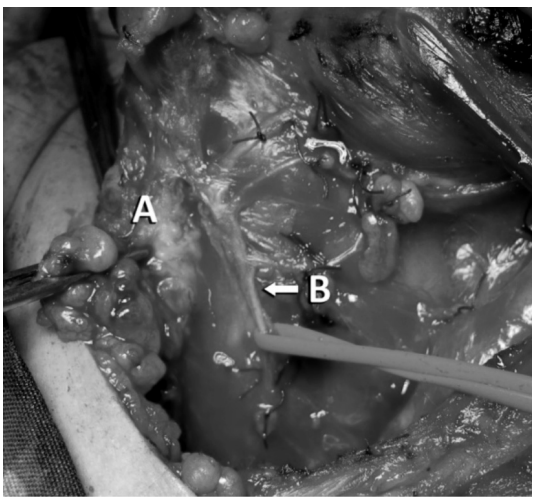


Fig. 14 - Central adenopathy in a case of autoimmune disease. A) central lymph nodes; B) recurrent nerve.

the ability to uptake 131-Iodine, especially in younger people.

In the setting of ATDs, especially hypofunctioning, their frequent coexistence with papillary cancer cannot be ignored. This poses the problem of the diagnosis and staging of papillary carcinoma in ATDs, and treatment for the level VI lymph nodes (Figures 13, 14).

Lymph node dissection is another factor that has a far from negligible influence in practical terms, given the rising incidence of thyroid carcinoma which is now in second place among the most common cancers in both genders, after the breast in females and the prostate in males. In our experience, the incidence of papillary carcinoma among all thyroidectomies performed has been gradually rising from 15% of 874 thyroidectomies performed in 2000 to 17% of 1,278 operations in 2003, to 24% of 1,173 performed in 2004, to 32% of 1,029 procedures in 2010, to 43% of 1,097 in 2013 (40% of which were cases of carcinoma on thyroiditis).

Fig. 15 - The "lusoria" right subclavian artery with a retroesophageal course.

Anatomical criteria

Among the thyroidectomies that are difficult, or that it might be better to describe as **insidious** for anatomical reasons, there are several unexpected nerve **anomalies,** the best known of which relates to the embryological development of the non-recurrent inferior laryngeal nerve (8,9). Experience has shown that the anomaly can be identified intraoperatively when the nerve cannot be found at the emergence from the mediastinum and the vagal nerve is located medially to the carotid in the surgical field.

The situation must be suspected preoperatively when there is indirect evidence of a vascular anomaly, which is usually associated with a pulsing on esophageal compression (dysphagia lusoria) detectable on EGD/X-ray of the digestive tract; or directly on CT or MRI/scanning of the "lusoria" right subclavian artery with a retroesophageal course (Figure 15). The anomaly comes true in two variants: in type I, the nerve follows a "descending" cervical course at risk when the superior peduncle is tied (Figure 16); in type II, the laryngeal nerve has an "ascending" course that is variably associated with the ITA, with which it may be confused (Figure 17).

Fig. 16 - A non-recurrent laryngeal nerve type I: descending course from cervical vagus.

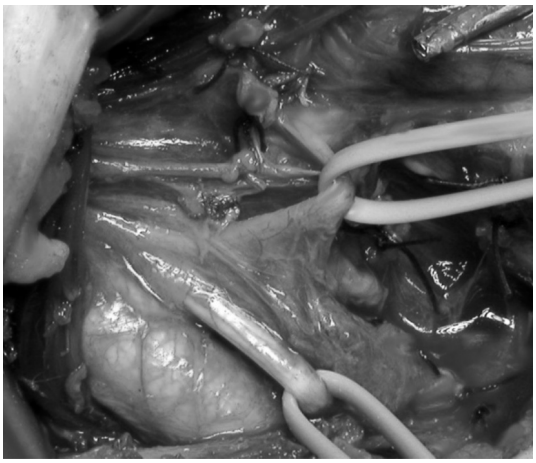


Fig. 17 A non-recurrent laryngeal nerve type II: medialization of the vagus nerve.

The anomaly is not particularly rare. When it was searched systematically in a prospective study on 60 right inferior laryngeal nerves exposed during 60 right thyroid lobectomies, there were 4 cases (6.7%) presenting an atypical non-recurrent nerve course, 3 of which were type II anomalies, and one was type I (9).

According to a currently unpublished recent observation of ours concerned a nerve anomaly that was predicted preoperatively (on the grounds of a known vascular anomaly documented on a CT scan performed for the purpose of staging a metastatic thyroid carcinoma), but was not confirmed intraoperatively. The inferior laryngeal nerve was normally "recurrent", emerging orthotopically from the mediastinum and not originating from the cervical vagus nerve. This situation has not been reported in the literature before. There is still no embryological explanation for it, but the fact that it has not been described before leads us to assume that this is because candidates for thyroidectomy only rarely undergo tests preoperatively to identify any vascular anomalies and, even when they do, such a situation would probably go unrecognized.

This report aims to prompt surgeons to test for and confirm this finding whenever possible, and urge anatomists to provide an embryological explanation for this condition.

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