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Review

Swallowing disorders after thyroidectomy: What we know and where we are. A systematic review

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HIGHLIGHTS

- Dysphagia and hoarseness can be observed in patients that underwent thyroidectomy.
- The current literature available on MEDLINE database, concerning the swallowing disorders appearing after the thyroidectomy was reviewed.
- Different diagnostic procedures could be used to study patient discomfort, as well as intraoperative nerve monitoring, fiber optic laryngoscopy, endoscopy, pH monitoring, esophageal manometry and videofluorography.
- The diagnostic procedures described can help to identify the mechanisms involved in swallowing disorders. More studies are needed for understanding the causes of the dysphagia appearing after thyroidectomy.

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ABSTRACT

Introduction: Dysphagia and hoarseness are possible complications that can be observed in patients undergoing thyroidectomy or other neck surgery procedures. These complaints are usually related to superior and inferior laryngeal nerves dysfunction, but these can appear even after uncomplicated surgical procedure.
Methods: We reviewed the current literature available on MEDLINE database, concerning the swallowing disorders appearing after the thyroidectomy. The articles included in the review reported pathophysiology and diagnostic concerns.
Results: Twenty articles were selected for inclusion in the review. Depends on the possible causes of the difficulty swallowing (related to nerve damage or appearing after uncomplicated thyroidectomy), different types of diagnostic procedures could be used to study patient discomfort, as well as intraoperative nerve monitoring, fiber optic laryngoscopy, endoscopy, pH monitoring, esophageal manometry and videofluorography. Among all these procedures, videofluorography is considered the gold standard to evaluate the entire swallowing process, since that allows a real-time study of all the three phases of swallowing: oral phase, pharyngeal phase and esophageal phase.
Conclusion: The diagnostic procedures described can help to identify the mechanisms involved in swallowing disorders, with the aim to choose the best therapeutic option. More studies are needed for understanding the causes of the dysphagia appearing after thyroidectomy.

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1. Introduction

Patients candidate to thyroidectomy or other neck procedures, such as parathyroidectomy, often complain voice and swallowing disorders [1,2].

The symptoms concerning the swallowing, also called aero-digestive symptoms, can occur not only after the surgical procedure, but often appear even before. They are reported as generic discomfort, tightness, lump, foreign body, difficulty or pain during swallowing and are often slight [2]. These are frequently complained by patients with thyroid diseases and considered a possible indication to surgery apart from thyroidectomy [3,4]. Otherwise, they can persist or appear after the thyroidectomy in the presence of complications, such as a laryngeal nerve damage (superior laryngeal nerve - SLN, or inferior laryngeal nerve - RLN) as well as after a thyroidectomy in which a postoperative SLN and/or a RLN damage can be excluded by means of an ORL evaluation performed just after the thyroidectomy [2,5–7]. Then, two main categories of swallowing changes should be distinguished: related to nerve damage or appearing after uncomplicated thyroidectomy.

The aim of this study is to revise the available literature for data concerning the swallowing complaints arising after thyroidectomy, with the aim of analysing its causes and pathophysiology, providing answers for questions regarding the management of these symptoms and, in particular, outlining the diagnostic exams actually available.

2. Methods

This work is fully compliant with PRISMA criteria [8]. According to these guidelines, selection of the studies to include in the review has been conducted as follow.

2.1. Literature search strategy

An electronic literature research was performed on PubMed and MEDLINE by two independent investigators (GS and CT) to identify articles in the English language investigating swallowing disorders after thyroidectomy. The search included papers published in the English language, available online, up to 2003 until February 2016.

The following medical subject headings (MeSH) and terms were used to achieve broad and specific searches: “swallowing” *and* “thyroidectomy” with the Boolean operators AND or OR.

Moreover, the research was expanded considering the related references cited by the above-mentioned paper or related subjects concerning relevant aspects emerging during the illustration of the diagnostic and surgical techniques on the discussion.

We also checked the most recent articles concerning the diagnostic procedures for the investigation of swallowing disorders. Finally, we reviewed the published data of our personal experience.

2.2. Selection criteria

We took into consideration clinical trials as well as reviews and meta-analyses that investigate about swallowing disorders appeared in patients that had previously undergone thyroid surgery.

We included articles that reported pathophysiology and diagnostic concerns.

Conference presentations were excluded.

2.3. Study selection

A total of 143 papers were found according to the search strategy.

In the first stage, of all search results, the titles and abstracts were read and selected based on the mentioned selection criteria.

In the second stage, full text was obtained for relevant papers, as well as any citations for which a decision could not be made from the abstract.

Final decision regarding inclusion was based after reading the full article, and a total of 20 papers was considered eligible for this review.

3. Results

The search process was performed as in Fig. 1.

A total of 143 abstracts and titles were reviewed for potential eligibility. One-hundred and thirteen abstracts were excluded after reading title or abstract based on the criteria for inclusion. A total of 29 articles were selected for further reading. Nine studies were excluded after full reading by several reasons (listed in Fig. 1). Finally 20 articles were selected for inclusion in this systematic review [1–5,7,9–22].

The data available from the selected papers suggested a classification of the post-thyroidectomy swallowing disorders on the base of the correlation with a neural damage (concerning the recurrent laryngeal nerve or the superior laryngeal nerve) identified with a direct laryngoscopy.

3.1. Swallowing disorders related to laryngeal nerve damage

The Thyroid surgery performed for benign diseases as well as for malignancies can be complicated with motor or sensory nerve injuries. The nerves that can be involved in the surgery lesions are branches of the vagus nerve. As a consequence, the patients can suffer from voice and swallowing symptoms [9,23–26]. A SLN palsy changes the pitch of the voice and causes an inability to make explosive sounds due to paralysis of the cricothyroid muscle. Both the SLN and the RLN are involved in swallowing mechanisms. The internal branch of the SLN provides sensitive innervation of the supraglottic space and vocal folds. Its lesion can determine, in some cases, dysphagia and aspiration [7] while the external branch (EB-SLN) provides the motility of the cricothyroid muscle, which improves the tension of the vocal folds but its damage is occasionally followed from various rates of swallowing symptoms [23,27]. As confirmed in animal models, the EB-SLN provides the laryngeal protective response so a damage of this branch can be involved in dysphagia [28]. The RLN, that arises from a contingent of fibers of the vagus nerve in the anterior mediastinum, anteriorly the aortic arch, innervates all the intrinsic laryngeal muscles except the cricothyroid one [1]. Its branches provide different groups of muscles: the anterior branch shows an intense response after stimulation during nerve monitoring [29]; the posterior branches are responsible for the motility of the cricopharyngeal muscle. It explains why the patients that underwent unilateral RLN paralysis suffer from swallowing impairment in about 30% of cases [3,25,26]. A RLN injury is associated with an incomplete glottis closure and, as a consequence, a swallowing dysfunction. The anatomy of the right RLN is different from the left one. The right RLN encompass the subclavian artery and emerges from the anterior superior mediastinum in a lateral position. Along a 6 cm-way it provides some sensitive branches to the esophagus thus entering into the larynx. Occasionally, owing to an abnormal embryologic development, concerning a major vascular abnormality in which the brachiocephalic artery does not exist, a right aberrant subclavian artery originates directly from the aortic arch. This vessel, also called “lusorian artery”, runs behind the esophagus. In this case, the right inferior laryngeal nerve originates directly from the cervical portion of the vagus nerve, so it assumes a non-recurrent course

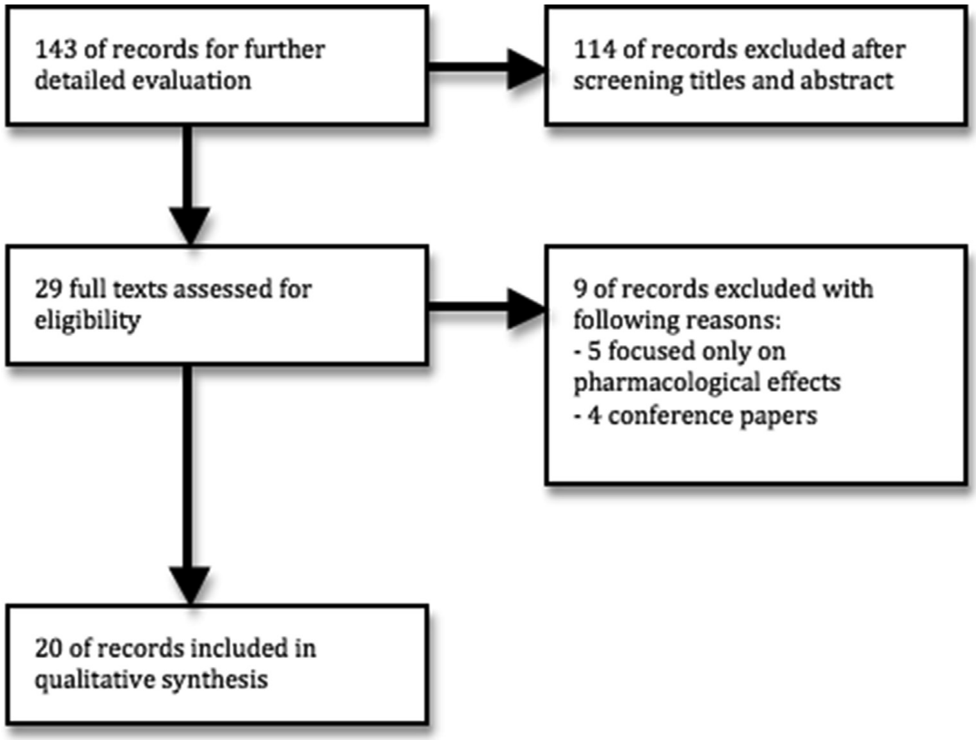

Fig. 1. Flowchart of the study selection process.

and reaches the larynx upright (Fig. 2). It happens since it is pulled down by the subclavian artery during its embryological descent [23]. The Left RLN encircles he aortic arch and, along a 12 cm-way in the trachea-esophageal groove (Fig. 3), it enters the larynx. Some small branches of the nerve, mainly sensitive, enter the esophagus. As previously described, both left and right RLNs provide sensitive posterior branches innervating the esophagus as far as the crico-pharyngeal muscle. It could explain the swallowing impairment after thyroidectomy complicated with RLN damage. The nerve palsies concerning the RLN are frequent during thyroid and parathyroid surgery with an incidence near to 10% and over 2% respectively for the transient and the definitive. Its incidence is higher in thyroidectomies plus lymph node dissection, especially of the 6th level (central neck dissection) [24,25,30–34]. Moreover, the incidence of the EB-SLN seems to be more frequent, with an incidence of up to 28% [10,11,35,36]. The transection of a nerve is a rare event: most frequently you may experience the stretching during the maneuvers of dislocation of the gland and/or during the use of ligation, positioning of clamps or clips too close to the nerve, its compression, suction, contusion, pressure, electrical or thermal injury, or devascularisation [33]. Concerning this, the use of energy-based surgical instruments or haemostatic agents seems to be safe, as showed in several studies [37–40]. The minimally invasive surgical approach seems to be safe in preventing laryngeal nerve palsies with results comparable to the conventional “open” thyroidectomy [41–44]. Finally, it would be better to associate the thyroidectomy in patients candidate to surgical parathyroidectomy procedure in the presence of suspected thyroid nodules. In this case the complications rate is similar to those of the thyroidectomy alone, then a comparison with the morbidity of the redo neck surgery should be done for making the decision [45]. These complications, resulting in swallowing as well as voice dysfunction, are feared after thyroid surgery. The routinary individuation of the nerves (RLN and, if possible, EB-SLN) during surgery reduced in recent years the incidence of surgical nerve injuries. The

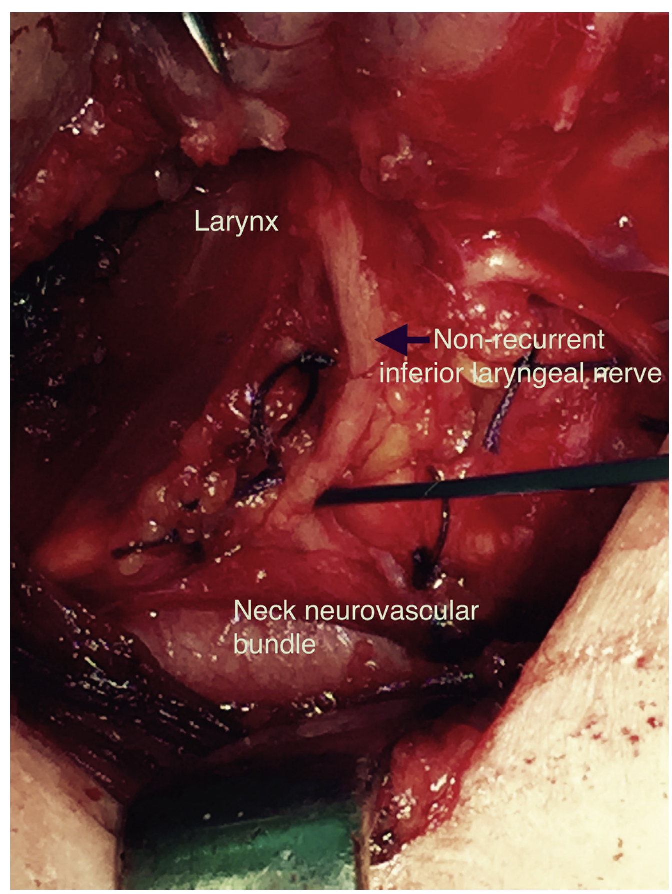

Fig. 2. Right thyroidal cavity. The inferior laryngeal nerve arises directly from the cervical vagus nerve and enters the larynx without showing the typical recurrent course. This is the so called “non-recurrent laryngeal nerve”.

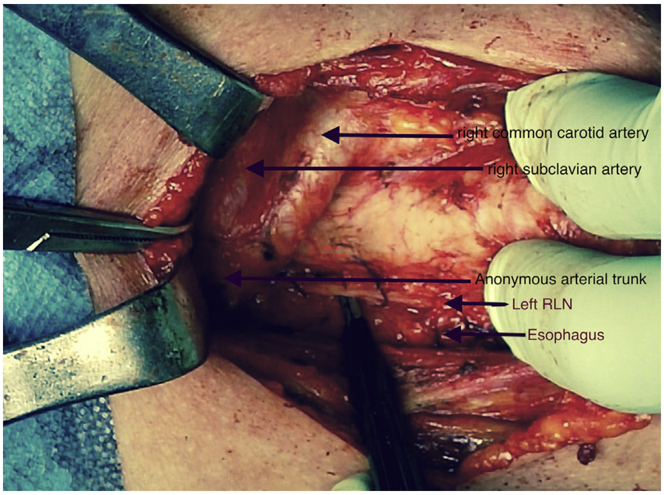

Fig. 3. Left recurrent laryngeal nerve along the tracheo-esophageal groove after its cross with the anonymous arterial tunk.

intraoperative nerve monitoring (IONM) has been introduced for this purpose, with the aim of further safety, but the results of the use of this intraoperative procedure are still controversial [46–48]. This practice seems to reduce the incidence of complications in some circumstances, such as aggressive cancers with invasion of surrounding tissues, extended and/or intrathoracic goitres, non-recurrent inferior laryngeal nerve, redo surgery and, generally, any difficult dissection. Although the IONM has a widespread utilisation in several referral thyroid surgery units, further data are needed to confirm its usefulness as well as the efficacy of its developments, such as the continuous nerve monitoring.

3.2. Swallowing disorders appearing after uncomplicated thyroidectomy

As previously affirmed, the aerodigestive disorders can appear after a neck (thyroid, parathyroid) surgical procedure even in the absence of clear surgery complications [2,5,49]. These complaints, with still unclear causes, are usually transient and occur early after the surgical procedure [49]. It has been reported that in some cases the discomfort persist long after the surgical procedure [5]. The causes invoked are orotracheal intubation, surgical manipulation, scar and adhesions of the skin flap with the superficial cervical fascia, psychological reaction to the surgery [1,5,49]. To date, the injuries to the extrinsic perithyroidal neural plexus, which innervates the pharynx are unevaluable with actual tools. The thin anastomoses connecting the RLN and the external branch of the SLN, or the sympathetic cervical chain with both the RLN and SLN, seem to be involved in swallowing disorders [1,12]. To date the literature concerning the swallowing complaints after neck surgery is poor [1,2,5,45]. The studies of Lombardi and coll [5,12]. Examined this association by means of questionnaires to assess voice and swallowing disorders (Voice Impairment Score – VIS, and Swallowing Impairment Score - SIS). A study matched the data of these questionnaires, commonly available in Literature, with the findings of esophageal functional tests obtained by means of the manometry, pH monitoring and videofluorography [2]. The preliminary study found two main changes in esophageal motility: the decrease in Upper Esophageal Sphyncter (UES) pressure, that was a constant change after total thyroidectomy, and the UES incoordination, that was not constant but, if present, associated to SIS impairment with a statistical significance [2]. The same group of study monitored these patients, that were examined once again in a long-term study that confirmed the role of upper esophageal motility changes in the origin of these aerodigestive disorders [13]. These changes are largely transient, but in some cases can persist along the time. The study concluded that the innervation of upper aerodigestive anatomical structures (larynx, pharynx, upper esophagus) and its possible undiagnosed damage during the surgical procedure should be the cause of the disorders. The role of proximal acid reflux, as cause of some symptoms has been hypothesized in another study in which the proton pump inhibitors were administered before the thyroidectomy [14]. These patients had less pain and swallowing disability early after thyroidectomy. The possible role of laryngeal mobility in the origin of swallowing disorders was evaluated in a prospective clinical study in which the mean laryngeal mobility significantly decreased in the post-thyroidectomy period among the patients enrolled [10]. Moreover, in these individuals the swallowing symptoms were considerable especially in the early postoperative period and showed themselves as a “foreign body sensation”, “more power needed for swallowing” or a “sense of obstacle while swallowing”. Nevertheless, these symptoms were present in the preoperative assessment. The authors concluded that the correlation between laryngeal mobility and swallowing disorders was not proved. Another study [15] evaluated a group of patients that underwent thyroidectomy with a laryngeal nasofibroscopy performed in the early post-operative period and later. Moreover, the patients that evolved with normal laryngeal mobility and abnormal laryngeal mobility were compared each other. The study confirmed that the dysphagia occurred in patients after thyroid surgery. It was characterized by stasis of food in the oro- and hypopharynx in the early post-operative period and persisted later in some cases. It could allow to affirm that swallowing impairment could be associated to supraglottic and pharyngeal functional changes. Some studies [16,17] enhanced the advantages of minimally invasive or non-cervical (robotic) approaches in containing the adhesions of the platysma muscle flap with the superficial cervical fascia. These adhesions could cause fixation of the different layers of the cervical wall and subsequent restriction of hyoid bone movements. The advantages of the subfascial approach to thyroidectomy in reducing the hyoid fixation confirm these findings [18]. Assuming that the adhesions between the different neck structures (laryngotracheal unit, strap muscles, platysma, skin flap) could influence the swallowing, some antiadhesive dressings have been used between the different layers, but the results are conflicting [19,20].

3.3. Diagnostic tools

Different diagnostic tools could help the clinicians for patients that presents swallowing disorders after neck surgery, that differ in that evaluate different structure or parameters and for the more or less invasiveness of the procedure. These tools that evaluate post-thyroidectomy clinical or subclinical swallowing problems will be systematically discussed. Stated that the principal origin of post-thyroidectomy swallowing impairment is a dysfunction of the nerves that provide the laryngeal motility, before this analysis we would briefly examine the strategies for prevention of nerve injuries. All things considered, the first step for setting a post-thyroidectomy swallowing disorder starts intra-operatively since the IONM technique has been introduced [48]. More recently, the same technique showed high sensitivity and specificity values in identifying the paralyses of the EB-SLN [50]. In the postoperative period both RLN and EB-SLN can be explored to identify, if possible, the cause of the swallowing complaints. The otolaryngology evaluation should be completed with a fiberoptic laryngoscopy. It allows the identification of vocal fold palsy with the remark of the ipsilateral RLN paralysis. The same technique is available for identifying the EB-SLN paralysis testified by a reduced tension of vocal folds [51,52]. When a paralysis of a laryngeal nerve is identified, a treatment can be established. If a lesion of the laryngeal nerves is not present, it is justified to investigate the different mechanisms illustrated before, so a diagnostic protocol can be performed for the identification of the possible causes of the swallowing impairment. Another technique that can be used for evaluating these patients is the endoscopic exploration of esophagus (EGDS), the pH monitoring, esophageal pH-impedance (MII-pH), esophageal manometry and the videofluorography.

3.3.1. Fiber optic laryngoscopy

This simple exam is routinely performed before the thyroidectomy has been scheduled, with the aim of verifying the normal motility of vocal folds [53–56]. Under the guidance of specific aerodigestive symptoms it gives some information concerning laryngeal changes, such as arytenoid or interarytenoid edema, vocal folds edema, ventricular bands edema, laryngeal edema. These changes can be related to the smoking alcohol intake or gastroesophageal reflux disease (GERD) [57].

3.3.2. Endoscopy

The EGDS is frequently non-conclusive concerning the esophageal disease. It can show the mucosal effects of the GERD, but in over the 50% of cases the endoscopic esophageal examination results normal [58]. Novel endoscopic technologies, such as wireless capsule endoscopy, confocal laser endomicroscopy, electronic chromoendoscopy, have been made with the aim of improving the detection of esophageal diseases, but its role seems actually limited to the more advanced mucosal alterations associated to the GERD, such as the Barrett's esophagus. More data concerning these diagnostic techniques are needed for validating the results in terms of diagnosis of GERD [59]. Narrow-band imaging, by using particular light filters, enhances visualization of the mucosal and vascular structures. The preliminary results encourage its use in both GERD and Barrett's Esophagus [60–62].

3.3.3. pH monitoring

The evaluation of acid esophageal reflux can be evaluated with the pH monitoring. The patient must discontinue any acid-suppressing medication, 5 days (H2 blockers) or 7 days (proton pump inhibitors) before the exam. The pH-meters are endowed with some probes placed along the esophageal course. It can be used a pH catheter equipped with 2 sensors spaced 15 cm apart. The pH monitoring is done by placing a pH probe 5 cm above the upper border of the Low Esophageal Sphyncter, that is determined with the manomertry [2]. A pH software analysis program is used to record, store, view, and analyze gastroesophageal pH data. The measurement criteria for evaluating the gastroesophageal reflux are stated with the DeMeester score, a mathematical formula that integrates the frequency of reflux episodes, the duration of reflux episodes, and the accumulated exposure time. This score system is reproducible and correlates with the degree of esophageal epithelial damage determined histologically [60]. Below the threshold of 14.7, the result is usually considered normal.

3.3.4. Esophageal impedance

The MII-pH is today considered the most reliable method for identifying gastro-esophageal reflux because it allows to recognize any episode and define its composition, duration, location and pH.

The MII-pH combines the measurement of pH and impedance into the esophageal lumen. The impedance is based on the repeated changes in ions concentrations which occur in the esophagus for the air (increased impedance) or liquid (impedance drop) transit. As in pH monitoring, a flexible tube of 1.5–2 mm in diameter is inserted through the nose and positioned distally in the esophagus in order to transfer data, for 24 h, to a portable recording instrument. The presence on the same tube of multiple (typically 7) metal rings (which form two by two an impedance channel) and 1 to 2 pH-metric electrodes allows to identify anything that passes into the esophagus (acid and non-acid materials, non-solid, gaseous or mixed), distinguishing, according to the progression of the impedance change, a swallowing by a reflux and specifying its duration and the proximal and distal extension. A reflux episode is defined in the presence of a retrograde flow (in practice from the esophagus distal to proximal) capable of varying, by convention, of at least 50% above the baseline value impedance in at least 3 consecutive rings (or 2 channels). The duration of the episode (bolus clearance time, or BCT) is determined, in a similar way, by the time required to return impedance to 50% of the initial value. The gaseous reflux is defined as the increase of higher impedance of 3000 Ω in 2 consecutive channels with a peak of more than 7000 Ω in a point. A mixed reflux combines the features of gas and liquid reflux. For the simultaneous presence of the electrode pH measurement, the reflux is classified as acid (if the pH is < 4), weakly acidic (pH between 4 and 7) or alkaline (pH > 7). Since the rings are placed at a distance between them of at least 1.5 cm, for the automatic recording of the reflux episode by impedance a bolus should measure at least 3 cm. The volume required for detecting the reflux episode with MII-pH is at least 0.5 ml [63].

3.3.5. Esophageal manometry

The measurement of the pressures of the whole esophageal body can be performed with a system of electrodes connected to a pneumo-hydraulic capillary infusion system. The probes are graduated at an interval of at least 1 cm each other, to allow the measurement of the distance and the length of the sphincter. In general, this diagnostic tool is used with the aim of defining esophageal motor function and identifying its abnormalities. It allows to evaluate the position, pressure, length, and relaxation of both Esophageal Sphyncter, the Upper (UES) and the Lower (LES) ones. The normal value of the LES pressure is considered in a range of 12–30 mm Hg. Moreover, the system evaluates the LES and UES relaxation as a response to swallowing and the esophageal body function. Nowadays, the conventional manometry is going to be supplanted by novel high resolution esophageal manometry systems (HREM). The HREM systems actually available have two different methods of measuring pressure. In the first one, a catheter is endowed with several pressure-sensitive segments and the pressure is calculated as the average pressure from these segments. In the other system, a catheter is endowed with a small ball filled with liquid and surrounded by a pressure sensor. Both systems of pressure measurements allow to obtain a number of informations concerning the esophageal motility and contractility. In particular, the HREM gives more informations concerning the relaxation pressure, the intrabolus pressures, the contractile front velocity, the distal latency. The functional gastro-esophageal junction can be better localized, both hyper-contractility and hypo-contractility can be better defined. Moreover, peristaltic velocity can be carefully assessed [2,16,64,65].

3.3.6. Videofluorography

Videofluorographic examination to date is the “gold standard” for a good evaluation of swallowing process, since that allows a real-time study of all the three phases of swallowing: oral phase, pharyngeal phase and esophageal phase [66,67], through the dynamic analysis of oro-pharyngeal region both as a whole and in detail the movements of the various structures involved, detecting any anatomical and/or functional alterations in both oropharyngeal and esophageal regions, defining eventually cause of dysphagia.

It presents, compared to other diagnostic investigations (endoscopy, manometry) that can be used to study swallowing disorder, some advantages related to ease of execution, to its panoramic views of the oro-pharyngeal-esophageal region and also to better acceptance by the patient given its non-invasiveness.

For this reason it is often used as primary diagnostic procedure in patients with dysphagia [60], even if, to our knowledge, few studies [2,21,22] of thyroidectomized patients that present swallowing disorder that have had instrumental evaluation of esophageal motility have been published.

Nevertheless, as previously said, videofluorography is absolutely the best tool to detect disorders in the swallow mechanism [2,59,60], and in these kind of patients could be underwent to identify all the possible cause of dysphagia related to alterations due to damage caused by clear or unclear surgery complications (such as SLN or RLN damage or eventual movement alterations due to the presence of adhesions between the different neck structures). It allows to study alteration in the oral and pharyngeal swallowing phase, vocal cord and soft palate dismotility, hyoid bone movement alteration, epiglottic tilting, alterations in esophagus motility with uncompleted esophageal clearing and gastroesophageal reflux, all alterations that can be detected in these patients.

Videofluoroscopy begins with a baseline evaluation (without contrast material) for the study of the vocal chords and soft palate motility. Then the study is conducted with the use of liquid barium contrast material, of different consistencies and amounts, which are chosen on a case-by-case basis, administrated in small bolus (between 5 and 10 cc), with the aim of simulating normal swallowing as closely as possible [66–69].

First it is asked to the patients to hold the bolus for several seconds in their mouth and to swallow at the operator's instructions. All phases of the process are recorded acquiring images and video first in the antero-posterior view (AP-view) and then in the latero-lateral view (LL-view), permitting the visualization of bolus flow in relation to structural movement throughout the upper aerodigestive tract in real-time.

In case of asymmetric tilting of the epiglottis, the AP-view is the best position to evaluate this alteration, as well as for the evaluation of bolus stasis in the valleculae and/or pyriform sinuses (Fig. 4); while on the lateral view is possible to study the base of the tongue and the soft palate, that close the oral cavity posteriorly to prevent spill of food into the open larynx, as well as the alteration of the hyoid bone movement that normally move in a cranial direction and lift the larynx. Alterations in these mechanisms are associated with alterations of the swallowing that sometimes could be associated with laryngeal penetration (contrast material seen entering the larynx) or aspiration (when the ingested bolus extends inferiorly through the true vocal cords into the proximal trachea) of contrast media, due to an insufficient closure of the larynx when it should be closed [70] (Fig. 5). Aspiration may occur before, during, or after the swallow and is the most threatening symptom of oropharyngeal dysphagia.

Fig. 4. Videofluorography AP-view, patient with dysmorphic epiglottis with asymmetrical tilting. Residue of the contrast medium in valleculae and pyriform sinuses.

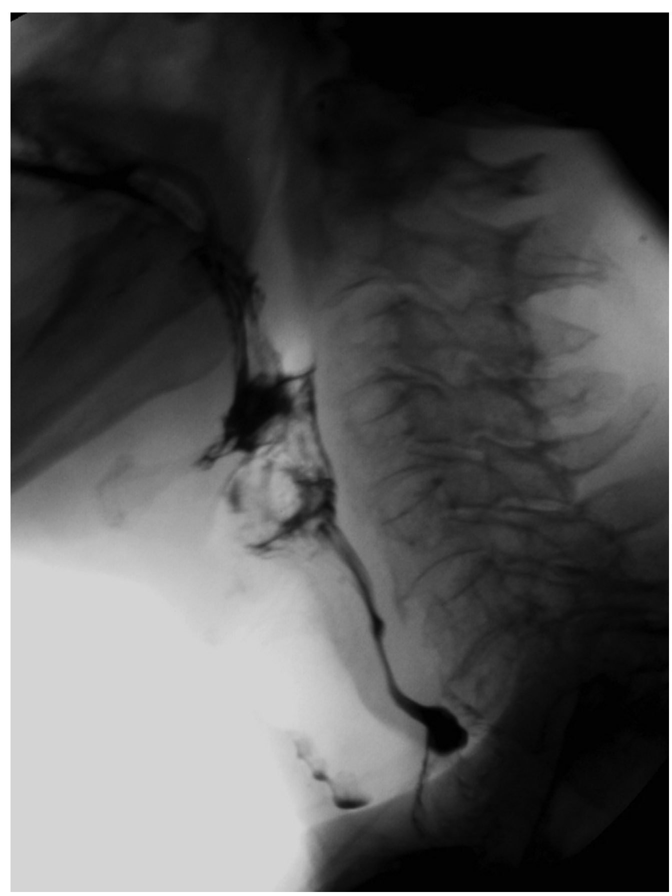

Fig. 5. Videofluorography LL-view, patient with transient sub-epiglottic penetration and subsequent aspiration with persistence of contrast media in the anterior wall of the trachea, in the absence of coughing.

The lateral view also allows the evaluation of the entire esophagus, to study its dysmotility during the passage of the bolus (caused for alteration in the innervation of the esophagus for nerve damage during the surgery) to detect causes of interrupted or altered passage. Even if is not possible to identify a specific motor pattern, as assessed in previous studies, the most frequent disorders identified in these kind of patients were esophageal dyskinesia and gastroesophageal reflux [2].

All the videofluorographic findings could help to direct through the most possible cause of the discomfort of the patients and possible swallowing disorder cause.

4. Discussion

All things considered, the swallowing disorders after thyroid surgery, that frequently appear in association with voice complaints, have a complex pathogenesis that involves the pharynx as well as the larynx, the laryngeal nerves, the perithyroidal neural plexus, the intrinsic laryngeal muscles and the neck wall (muscles, skin flap). Moreover, these aerodigestive disorders can be influenced by the gastro-esophageal reflux and other situations that occur during the surgical procedures, including the orotracheal intubation. Concerning the diagnostic procedures previously discussed, it seems to be clear that the swallowing dysfunction related to laryngeal nerves palsies need to be study in these patients. All the diagnostic procedures showed can help, in a different way, to identify the mechanisms involved in swallowing disorders, with the aim to choose the best therapeutic option according to the diagnosis [21,22,63–68,71,72].

5. Conclusion

In the presence of the dysphagia seeing a thyroidectomy, several exams are available for understanding the pathophysiologic changes involved in this complaint. Concerning the pathogenesis of these changes, none of the studies available to date discuss the problem with an overall view of the situation. The swallowing disorders correlated to a thyroidectomy complicated with a SLN or RLN palsy are well explained. On the contrary, the swallowing complaints seeing an uncomplicated thyroidectomy need further investigations to explain the mechanisms involved in the dysphagia.

Ethical approval

Since this article is a review, no ethical board approval is needed.

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Author contribution

G.S.: Partecipated substantially in conception, design, and interpretation of data; also partecipated substantially in the drafting, editing and revising of the manuscript.

C.T.: Partecipated substantially in conception, design, interpretation of data and drafting and revising the manuscript.

S.B.: Partecipated substantially in conception, design, interpretation of data and drafting the manuscript.

C.R.: Partecipated substantially in conception, design, and interpretation of data.

D.P.: Partecipated substantially in conception, design, and interpretation of data.

C.P.: Partecipated substantially in conception, design, and interpretation of data.

N.C.P.: Partecipated substantially in conception, design, and interpretation of data and revising the manuscript.

F.V.: Partecipated substantially in conception, design, and interpretation of data.

F.C.: Partecipated substantially in conception, design, and interpretation of data.

G.C.: Partecipated substantially in conception, design, interpretation of data and revising of the manuscript.

G.L.R.: Partecipated substantially in conception, design, and interpretation of data and revising of the manuscript.

G.G.: Partecipated substantially in conception, design, and interpretation of data; also partecipated substantially in the drafting, editing and revising of the manuscript.

G.S. and C. T. contributed equally to this work.

Conflict of interest statement

None.

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