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Review

Hoarseness after thyroidectomy: Blame the endocrine surgeon alone?

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ABSTRACT

OBJECTIVE: Hoarseness is a postoperative complication of thyroidectomy, mostly due to damage to the recurrent laryngeal nerve (RLN). Hoarseness may also be brought about via vocal cord dysfunction (VCD) due to injury of the vocal cords from manipulations during anesthesia, as well as from psychogenic disorders and respiratory and upper-GI related infections. We reviewed the literature aiming to explore these potential surgical and non-surgical causes of hoarseness beyond thyroidectomy and the role of the endocrine surgeon. Is he/she alone to blame? METHODS/MATERIAL: The MEDLINE/PubMed database was searched for publications with the medical subject heading "hoarseness" and keywords "thyroidectomy", "RLN", "VCD" or "intubation". We restricted our search till up to May 2013. RESULTS: In our final review we included 80 articles and abstracts that were accessible and available in English. We demonstrated the incidence of hoarseness stemming from surgical and non-surgical causes and also highlighted the role of intubation as a potential cause of injury-related VCD. CONCLUSIONS: Hoarseness is a relatively common complication of thyroidectomy, which can be attributed to many factors including surgeon's error or injuries during intubation as well as to other non-surgical causes. However, compared to procedures such as cervical spine surgery, mediastinal surgery, esophagectomy and endarterectomy, thyroidectomy would seem to be a procedure with a relatively low rate of recurrent laryngeal nerve palsies (RLNPs). It is often difficult to determine whether the degree of hoarseness after thyroidectomy should be attributed only the surgical procedure itself or to other causes, for example intubation and extubation maneuvers. The differential diagnosis of postoperative hoarseness requires the use of specific tools, such as stroboscopy and intra- and extralaryngeal electromyography, while methods like acoustic voice analysis, with estimation of maximum phonation time and phonation frequency range, can distinguish between objective and subjective deterioration in the voice. The importance of medical history should be also emphasized.

Key words: Hoarseness, Intubation, Recurrent laryngeal nerve (RLN), Thyroidectomy, Vocal cord dysfunction (VCD)

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INTRODUCTION

Hoarseness is one of the most common complications following an operative procedure of the thyroid gland. The recurrent laryngeal nerve (RLN) can be damaged by retraction, since it lies within the tracheoesophageal groove, as well as by thermal injury or dissection. These injuries can be the most devastating to the patient. Clinical manifestations range from mild symptoms of hoarseness, loss of effective cough mechanism and upper pharyngeal dysphagia with aspiration in cases of ipsilateral injury causing ipsilateral vocal cord dysfunction (VCD), to life-threatening airway obstruction from bilateral RLN injury. It is well known among endocrine surgeons that after thyroidectomy most patients complain of some voice and swallowing disturbances, even in the absence of objective laryngeal nerve injuries, diagnosed with videostrobolaryngoscopy (VSL).[1-4] This functional, "subjective" postthyroidectomy syndrome, which includes a broad spectrum of symptoms among patients, is of great concern since severe thyroid surgery complications may be connected with profound medicolegal implications.[1-5]

The aim of our study was to establish, via a search of the literature, whether hoarseness after thyroidectomy should be mostly attributed to surgical error rather than to other causes such as intubation maneuvers or to the patient's surgical and non-surgical medical history.

METHODS

Studies were identified by performing an electronic search of MEDLINE up till May 2013 with the key words "hoarseness", "thyroidectomy", "recurrent laryngeal nerve (RLN)", "vocal cord paresis dysfunction (VCD)" or "intubation".

In this review we included 80 articles and abstracts that were accessible and available in English. We demonstrated the incidence of hoarseness in other surgical and non-surgical causes while also highlighting the role of intubation as a potential cause of VCD.

RESULTS

Hoarseness due to RLN injury after thyroidectomy

Although the incidence of permanent RLN palsy has with time declined and is presently estimated to be less than 2%,[6] the morbidity and mortality associated with this complication make it the most frequent source of malpractice lawsuits in thyroid surgery.[7] While this problem may not exist to a great extent in units with only specialists in endocrine surgery operating, it still occurs at a frequency of 0.2–0.8% in academic or educational hospitals with a high admission of patients.[8] Numerous studies, with sometimes conflicting results, can be found in the literature regarding RLN injury in thyroidectomy. Steurer et al[9] showed that surgical dissection of the RLN did not increase the total risk of temporary and permanent palsy. A RLN paralysis rate of less than 2.5% was reported among patients who underwent more extensive thyroid operations for benign[10-14] and malignant[15,16] thyroid conditions and during thyroid reoperations.[10,17-19] Though there are numerous reports quoting high levels of safety during more extensive thyroid operations and reinterventions by experienced surgeons, thyroid cancer operations and secondary thyroidectomy are still associated with a higher complication rate and an increased risk of RLN injury.[20,21] In postoperative RLNP, recovery may be anticipated at a rate ranging from 50% to 88%,[6,20,22] the rates depending on the type of surgery (primary vs redo), thyroid disease (benign vs malignant), extent of surgery (lobectomy vs subtotal resection), formal identification of the RLN and surgical volume (high vs low).[23-25]

In another study,[26] it was found that the kind of dissection (total dissection, partial dissection or no dissection) had no significant influence on the rate of RLNP ($P=0.10$).[26] Only revision surgery was associated with higher rate of impairment of the RLN (6.2% vs 11.6%; $P=0.04$).[26] About 40% of these patients had impairment of vocal function that was more often attributed to vocal folds injury rather than to RLNP.[26] Studies with a large number of patients show prevalence for permanent paresis to be between 0% after primary surgery and 20% after revision surgery.[6,27]

The extent of RLN injury may vary in severity from neuropraxia to neurotmesis. In neuropraxia, spontaneous recovery of dysphonia after a period of time varying from 1 to 6 months should be expected.[25] After neurotmesis, there would be no such recovery. Therefore, most studies agree that a minimum

follow-up period of 12 months is needed to assess voice function after thyroidectomy if dysphonia is detected.[25] In summary, the incidence of RLN palsy varies from less than 1% to as high as 20%, depending on the type of disease (benign or malignant), the type of thyroid resection (first-time or reoperation) and the extent (subtotal or total thyroidectomy), the surgical technique (with or without routine RLN identification) and surgeon experience.[28]

Anesthesiologic causes of hoarseness

Hoarseness due to intubation

Although the literature is much more oriented to describing the risk of damaging the RLN during thyroidectomy, vocal cords can be injured during the intubation-extubation procedures as well. The end result of this injury-related vocal cord dysfunction is the same: hoarseness. In fact, it is fairly difficult to differentiate between the damage done by thyroid surgery and anesthesia in most cases. Injury to the vocal folds attributed to intubation or extubation was identified in 31% of the patients recruited into a recent study.[26] Compared with findings in older studies that found laryngeal injuries in 6.2% to 16.3% of the patients who underwent thyroid surgery, later data suggest a much higher rate for these complications.[29] However, another study demonstrated the frequency of intubation-related RLN palsy as a cause of hoarseness to be 1.4% transiently and 0.5% permanently.[30] Furthermore, when investigated one to two days after surgery, an even higher rate of complications (73%) was ascertained in the form of increased amount of visible blood vessels, bleeding into the vocal cords or the trachea and bruises at the vocal processes or the arytenoid cartilages.[31] The differential diagnosis of postoperative hoarseness requires the use of specific tools apart from simple laryngoscopy, including stroboscopy as well as intra- and extralaryngeal electromyography.[32,33] A partial palsy of the RLN due to intubation would be associated with severe dysphonia or aphonia and not with dyspnea because of the typical intermediate position of the paralyzed vocal folds with a normal electromyographic function of the cricothyroid muscle.[32] This rate of laryngeal injuries led Mencke et al[34-36] to conclude that thyroidectomy represents a minor risk to the larynx as compared with the intubation or extubation procedure, while similar findings were reported in a smaller group of patients.[37] In another study, Rahman et al[38] found that respiratory complications after thyroidectomy concern up to 7.6% of cases. Among these, 10% of them were attributed to difficult intubation, while 15% were due to RLNP.[38]

Risk factors for vocal fold injury caused by intubation are cuff pressure,[39] size of the tube, movement of the tube, physical trauma, intubation environment, duration of intubation, gastroesophageal reflux and mucociliary mechanism.[35] Kikura et al[40] demonstrated that the risk of VCD due to intubation increases three-fold in patients 50 years old or above, twice in patients intubated for 3-6 h, fifteen times in patients intubated for more than 6 h and twice in patients with a history of diabetes mellitus or hypertension.

It is thus not unreasonable to assume that in many cases of thyroidectomy, a large number of these risk factors are dealt with. In these cases, the contribution of the intubation procedure to hoarseness after thyroidectomy should be always taken into account.

As far as the drug used for relaxation is concerned, no significant influence has been detected in rapid-sequence induction nor in reduction in vocal fold injury using neuromuscular monitoring.[35,36] When intraoperative neuromonitoring (IONM) is applied, no increase in the incidence of laryngeal side effects and lesions was observed.[41] Meanwhile, inadequate muscle relaxation at the moment of tracheal intubation is another possible cause leading to laryngeal injuries,[42] while movement of the tube in the trachea was found to be related to an increased incidence of hoarseness.[43]

The results of intubation in other surgical approaches beyond thyroidectomy

General principles/mechanisms

Extensive data are available concerning the prevalence of hoarseness after thyroidectomy, as mentioned earlier.[36-46] On the other hand, there is a lack in the literature of sufficient data as to the correlation of intubation and hoarseness in other surgical approaches not in the head and neck. This information would be of great importance, since it could help identify the exact effect of intubation on the vocal cords and the mechanism by which intubation itself could cause hoarseness.

Nuutinen et al[37] demonstrated a bilateral VCD in a non-head and -neck-related surgery which was attributed to overextension of the neck during intubation. One possible pathophysiological explanation regarding this clinical presentation could be the compression of the nerve, specifically the anterior branch of RLN,[45] between an inflated endotracheal tube cuff and the overlying thyroid cartilage, especially at the junction of the vocal process of the arytenoid cartilage and the membranous true vocal cord, 6 to 10 mm below the level of the cord.[31] Another suggested mechanism includes a slipped upward endotracheal tube which brings the inflated cuff to rest against the vocal cords.[46] Additionally, a similar presentation can occur due to an overinflated cuff which has kept the vocal cords under constant pressure.[46] Both these conditions may also cause damage to the anterior branch of the RLN that innervates the lateral cricoarytenoid muscle.[46] Moreover, the nasogastric tube can be implicated in RLN palsy if positioned in the midline, a position which may lead to postcricoid inflammation, which in turn results in vocal cord immobility.[43] The underlying pathophysiological mechanism seems to be neuropraxia of the posterior branch of the RLN that innervates the posterior cricoarytenoid and interarytenoid muscles, or inflammatory spasm of the interarytenoid muscles themselves.[43]

Operation type and duration

A recent study showed a statistically significant difference in the incidence of sore throat among patients who underwent cesarean section and other gynecological patients, particularly when endotracheal tubes of sizes larger than 7.5mm ID ($p < 0.03$) were used.[47] This study indicates that the CO_2 pneumoperitoneum and Trendelenburg position used during laparoscopy increase endotracheal cuff pressure and may lead to discomfort during the postoperative phase. Measurement of endotracheal cuff pressure is a simple and inexpensive procedure and should be applied in patients undergoing laparoscopic surgery.[30] As regards the effect of duration of surgery on the incidence of hoarseness, study results in the literature are controversial. Jones et al[38] stated that increased duration of surgery led to an increased incidence of hoarseness, mainly because of mucosal damage caused by the endotracheal tube.[38] Yamanaka et al[48] concluded that prolonged intubation led to longer postoperative hoarseness. By contrast, Colton House et al[46] found that duration of intubation, type of endotracheal tube and size of endotracheal tube do not significantly correlate to the incidence of vocal fold mobility and degree of laryngeal injury noted after prolonged intubation. Intubation-related laryngeal injuries were seen to be present in up to 12% of patients with the use of neuromuscular blockade drugs for tracheal intubation[35,42,45] but have also been observed in 42% of patients without them.[35] In a study of Mencke et al,[36] the incidence of VCD, caused by bilateral thickening of the vocal folds (86%) reached 27%. More vocal fold injuries are detected in older patients, presumably due to a decrease in flexibility and atrophy of the vocal tissues.[26] Similarly to other studies,[35,36] the most common finding was thickening of the mucosa in the posterior parts of the vocal folds, followed by hematoma. Whether these alterations are caused by laceration or by gastroesophageal reflux remains unclear, but alterations in the posterior part of the vocal folds have been attributed to the tube or to adduction reaction of the vocal folds caused by anesthesia.[26] Laryngologic complications due to hematomas were most commonly located on the left side, very probably because the anesthesiologist was right-handed.[42] Granulations and thickening were primarily found bilaterally in the posterior part of the vocal folds, most likely as a result of chronic irritation by the endotracheal tube.

Hoarseness in non-thyroid surgery

Complications after cervical spine procedures demonstrated a rate of RLNP of nearly 25%, with 8% being clinically symptomatic and 15.9% detected via laryngoscopy.[49] Recently, Jung et al[50] demonstrated in a prospective study a significant decrease in hoarseness incidence in anterior cervical spine surgery, with a total rate of persisting symptomatic and asymptomatic RLN palsy of 1.3%.

The morbidity of RLN palsy is high during some thoracic operations.[51] The incidence is around 31% among patients undergoing left lung resection for cancer[52] and, as reported in Japan, can be as high as 80% among those undergoing esophagectomy with three-fold lymph node dissection for carcinoma.[53] In a recent study concerning esophagectomy with cervical

anastomosis,[54] the overall incidence of postoperative unilateral RLNP (URLNP) was 50% with 28.6% categorized as transient, 10.7% as permanent and the remaining 17.9% as of unknown clinical outcome due to absence of follow-up. Hoarseness is the most common postoperative complication of extended radical esophagectomy for thoracic esophageal cancer, with a rate of 45%, as reported by Nishimaki.[55] The rate of hoarseness after mediastinoscopy has been generally reported at less than 1%.[56] Widstrom[57] found that laryngoscopy before and after mediastinoscopy revealed VCD in 6% of patients.

As far as coronary bypass is concerned, transient hoarseness following open-heart surgery may be an ominous sign of RLN injury. Since this hoarseness cannot be attributed to intralaryngeal edema, several mechanisms of injury to RLN have been suggested: a) through central venous catheterization; b) by traction on the esophagus; c) by direct vocal cord damage or palsy from a traumatic endotracheal intubation; d) trauma by compression of the RLN or its anterior branch at the tracheoesophageal groove by an inappropriately sized endotracheal tube cuff; e) by a faulty insertion of a nasogastric tube; f) due to median sternotomy and/or sternal traction pulling laterally on both subclavian arteries; g) due to direct manipulation and retraction of the heart during open-heart procedures; h) from hypothermic injury with ice/slush. The incidence of hoarseness in open-heart surgery is 1-2%.[58]

AbuRahma and Choueiri[59] studied the incidence of hoarseness after carotid endarterectomy. Twenty-five cranial and/or cervical nerve injuries were identified in 19 out of 89 patients (21%), of which 6 involved the RLN (7%).[59] Of these injuries, 88% were transient with a complete healing time ranging from 2 weeks to 28 months, while the remaining 12% were permanent.[59] When the permanent nerve injuries were excluded, the average recovery time was 13.5 months for the RLN,[59] a longer healing time than other cranial nerve injuries. Fifteen patients (16.8%) experienced postoperative hoarseness or voice changes,[59] but during comprehensive examination, including fiberoptic laryngoscopy, only 11 (12.3%) of these were found to have injury to the vagal nerve or its branches. Four injuries (4.4%) were attributed to endotracheal intubation. Fourteen patients (15.7%) had preexisting RLNP, 8 (8.9%) of whom had previously undergone a surgical procedure with a nerve at risk (thyroid gland or transcervical approach to the spinal cord). The incidence of patients with recurrent carotid stenosis who require reoperation appears to be approximately 2% to 10%.[60,61]

Table 1 depicts the incidence of hoarseness in surgical procedures beyond thyroidectomy.

Hoarseness due to non-surgical causes

Psychogenic hoarseness

Psychogenic hoarseness is a condition described in the literature variably by such terms as “hysteric croup” and “emotional laryngeal wheezing”, suggesting psychological disorders as the cause for vocal cord adduction.[62,63] and can be as high as 80% among those undergoing esophagectomy with 3-fold lymph node dissection for carcinoma in Japan. Other disorders such as depression, factitious disorder, conversion disorder and somatoform disorder are referred to as being associated with hoarseness.[64-66] The common denominator in all these diagnoses was the presence of significant emotional stress. Husein et al[67] found that emotional stress was the inciting factor in the absence of any obvious psychiatric disorder. Depression has been a common underlying psychiatric diagnosis in many patients with hoarseness affecting up to 33% to 40% of patients with VCD.[64] Neri et al[68] in a retrospective research observed that out of 15 thyroidectomized patients with postoperative hoarseness, 7 (46.6%) had a nerve lesion, while 8 (55.3%) did not, a result that was attributed to psychogenic causes. Baker[69] described a case of psychogenic dysphonia following a modified thyroplasty for a unilateral vocal fold paresis.

One interesting manifestation that should be highlighted is postthyroidectomy bilateral abductor vocal cord paralysis (BAVCP), which is a potentially life-threatening syndrome strongly connected with serious psychiatric manifestations as well as by voice, airway, hypothyroid and hypoparathyroid symptoms. Around one third of the patients (35.2%) with the syndrome had psychiatric complications, with 16.4% having pre-existing psychiatric symptoms exacerbated by the syndrome, 12.5% presenting with psychiatric symptoms initiated by the syndrome and 4.7% of them

Table 1. Incidence of hoarseness in surgical procedures beyond thyroidectomy

Procedure	Author	Incidence of hoarseness	Mechanism of injury	Method of identification of hoarseness	Study category
Carotid endarterectomy	AbuRahma et al[59] Ballotta et al[60] Schauber et al[61] Morris[64]	7% 2-10% in restenosis surgery	Local trauma to the nerve by means of retraction, stretching, clamping and transection. However, most of the clinical injuries occur during retraction	Clinical examination and direct laryngoscopy	Prospective LOE II-2
Open heart surgery	Hamdan et al[58]	1-2%	Several mechanisms	Direct laryngoscopy	Review article LOE III
Lung cancer	Filaire et al[52] Zhao et al[36]	31%	Surgical injury, tumor invasion	Fiber optic laryngeal examination	Prospective LOE II-2
Esophagectomy	Isono et al[53] Nishimaki et al[55] Pertl et al[54]	45-80%	Cervical access and lymphadenectomy	Clinical examination and direct laryngoscopy	Prospective LOE II-2
Cervical spine surgery	Jung et al[49,50]	1,3-25%	Endotracheal cuff pressure, retraction	Indirect laryngoscopy	Prospective LOE II-2
Intubation or extubation	Kambic et al[42] Zimmert et al[29] Mencke et al[35,36] Echternach et al[26]	6.2-31%	Arytenoid trauma, surgical trauma, modification of the vascular supply and venous drainage of the larynx, etc.	Videoendoscopy and videostrobolaryngoscopy	Randomized controlled trial LOE I
Mediastinoscopy	Roberts et al[40]	1-6%	Traction in the anterior mediastinum	Intraoperative neuromonitoring	Prospective LOE II-2

LOE= Level of evidence according to US Preventive Services Task Force (USPSTF).

having psychiatric symptoms etiologically distinct from the syndrome.[70]

VCD and asthma

Differentiating asthma and VCD can sometimes be difficult.[71] The literature reports cases of hoarseness misdiagnosed as asthma for extended periods of time.[72] Approximately one third of patients with VCD were diagnosed with asthma prior to the correct diagnosis of VCD.[71] Morris et al[64] found that, of 11% of patients with VCD who had bronchoprovocation testing, only 29% were reactive. O'Connell et al[73] reported coexistent asthma in 35% of patients with VCD. The current literature lacks prospective studies that adequately define the relationship between VCD and asthma or uses multiple measures to define airway hyperreactivity.[64]

VCD and Gastroesophageal Reflux Disease (GERD)

Although not implicated as a causative factor, 18% of patients with VCD are reported to have underlying GERD.[64] Twenty-two adolescent patients with VCD had posterior laryngeal changes of arytenoid and interarytenoid edema with pachyderma typically seen in GERD.[74] Cases of patients with VCD when GERD symptoms are present should prompt evaluation and consideration for treatment with proton pump inhibitors.[64]

Hoarseness and environmental exposure

Studies indicate that many persons present hoarseness caused by environmental factors. Perkner et al[75] found that patients exposed to smoke, dust, fumes, gas or vapors had VCD symptoms within 24 h of a single exposure. Moreover, Andrianopoulos et al[76] reported that hoarseness was triggered in patients by stimuli including foods, perfumed products, air pollutants and chemical agents. Chlorine gas inhalation can also exert a wide array of effects on the entire airway, ranging from mucous membrane irritation to acute respiratory distress syndrome (ARDS).[77] The extent and location of damage is determined mainly by the duration of exposure and quantity of gas released.[77]

Reactive airways dysfunction and nonspecific bronchial hyper-responsiveness are commonly reported as sequelae to chlorine exposure.[77]

DISCUSSION

It is presumed that hoarseness is a surgical complication after thyroidectomy when no preoperative laryngologic examination is undertaken. This emphasizes the need for preoperative laryngoscopy before thyroidectomy, at least for medicolegal reasons, especially since laryngeal complications caused by injury to the vocal folds occur much more frequently than impairment of the RLN.[2,3,78] Discordance between objective and subjective deterioration of voice is observed in about one third of symptomatic patients.[2,3] With regard to objective alterations, it has been demonstrated that patients who undergo total thyroidectomy may show significant objective variations of acoustic voice analysis (AVA), with decrease in maximum phonation time (MPT)[3,5] and phonational frequency range[2,3] in the absence of any laryngeal nerves injury. On the other hand, it is shown[1,4] that most patients complain of vocal symptoms in the absence of any objective alteration of AVA.[1,4] Caregivers should be aware of these subjective discomforts that commonly occur after thyroid surgery. Furthermore, patients should be fully informed pre-operatively about these symptoms that can persist after thyroidectomy. They should also be reassured about the complete reversibility of such symptoms, in the absence of any objective nerve injury, as for example the slow decline in pre-operative compressive symptoms after surgery.[79] Most studies agree that a minimum follow-up period of 12 months is needed to assess voice function after thyroidectomy if dysphonia is detected.[25]

Several studies in the literature report symptoms of hoarseness that precede thyroidectomy. Rosato et al[78] emphasize that, preoperatively, more than one third of patients already show phonation and deglutition problems: 8% are due to damage to the RLN (6% cord hypomobility, 2% monoplegia), 3% are due to deficit of the superior laryngeal nerve (hypotonia) and 16% are associated with problems in the physiology of swallowing. In their study, postoperatively, around one third of patients complained about the onset of phonation and swallowing problems that were previously absent: 7% were due to RLN damage (3% cord hypomobility, 4% monoplegia), 6% were due to a deficit of the superior laryngeal nerve (SLN) (hypotonia) and 21% were due to scarring and adhesion formation.[78] Several causes have been proposed to interpret these symptoms. They have been attributed to arytenoid trauma after endotracheal intubation,[3] surgical trauma, modification of the vascular supply and venous drainage of the larynx,[1] local pain in the neck, cricothyroid dysfunction,[1-3] strap muscle malfunction or lesion of the perithyroidal neural plexus,[4] intra-operative injury of the fine anastomotic branches connecting the inferior laryngeal nerve (ILN) and the external branch of superior laryngeal nerve (EBSLN) and/or one of their anastomosis with the sympathetic cervical chain,[1] laryngotracheal fixation with impairment of vertical movement[2,4] and psychologic reaction to the operation.[1]

In a large study of 1333 patients, only 8 (0.6%) demonstrated preoperative unilateral VCP, which was found in 4 of the 1219 patients (0.3%) who underwent a primary thyroid operation and in 4 of the 114 patients with recurrent disease (3.5%).[26] Unilateral VCP was due to compression of the nerve by an enlarged thyroid gland or to surgical injury during the first thyroid operation in all patients with recurrent disease. The rate of vocal fold injury was estimated at 31.3%.[26] It was not clear whether these rates of complications should be attributed to surgical maneuvers alone. For the 1365 nerves at risk, the rate of recurrent nerve palsy was 6.6%. No significant difference was noted in the rate of RLNP associated with malignant lesions (P=0.13) or age (P=0.23).

As stated, a partial palsy of the recurrent laryngeal nerve due to intubation would be associated with severe dysphonia or aphonia and not with dyspnea because of the typical intermediate position of the paralyzed vocal folds with a normal electromyographic function of the cricothyroid muscle. The use of these methods to identify the nature of postoperative hoarseness is recommended in cases of regular IONM but postoperatively impaired function of the vocal cords.[32] Even endotracheal intubation could be considered safe in operations under general anesthesia; rarely, it could cause hoarseness as a complication. As recorded in the literature, a possible reason for hoarseness is compression of anterior branches of the RLN in the

larynx between the posteromedial part of the thyroid cartilage and the cuff of the tube. In the literature, unilateral VCD due to endotracheal intubation is mentioned as occurring more frequently in comparison to bilateral VCD. These types of palsies usually totally resolve in approximately 6 months.[80]

Table 2 summarizes the clinical presentation of both unilateral and bilateral VCD.

CONCLUSIONS

Hoarseness is a common complication of thyroidectomy which can be attributed to many factors including surgical error, intubation injury and non-surgical causes, such as psychological reasons. Furthermore, many patients have pre-existing hoarseness that may either improve or persist after surgery. As compared with procedures such as cervical spine surgery, mediastinum surgery, esophagectomy and endarterectomy, thyroidectomy appears to be a procedure with a relatively low risk for hoarseness.

It is difficult to determine whether the full percentage of hoarseness after thyroidectomy should be attributed to surgical procedures alone or also to intubation maneuvers, which are additionally a proven and well established cause. The connection of intubation with the clinical outcome of hoarseness should be reconsidered due to interesting and constantly increasing literature establishing and explaining the pathophysiology and incidence of laryngeal injury during and after endotracheal intubation as well as in other surgical procedures not in the head and neck region.

Currently available data justify the assumption that not every case of RNL palsy following thyroid surgery should be attributed to the operation itself. Nevertheless, the damage caused by intubation may only account for a minority of these cases. The differential diagnosis of postoperative hoarseness requires the use of specific tools which go beyond simple laryngoscopy and include stroboscopy as well as intra- and extralaryngeal electromyography. Finally, we should highlight the value of an extensive and adequate medical history in order to disclose previous surgical procedures that may result in subclinical forms of RLN injuries or non-surgical causes (psychological or environmental causes) that can lead to VCD and hoarseness post-thyroidectomy.

Table 2. Clinical presentation of VCD

	Unilateral VCD	**Bilateral VCD**
Presentation of symptoms[6-80]	Days	Hours to days
Time of diagnosis[6-80]	Days following extubation	Hours following extubation
Voice characters[32]	Breathy, hoarse, weak	Normal or weak. Both cords generally lie within 2 to 3 mm of the midline, and the voice is of good quality but of limited intensity
Cough[32]	Usually inefficient	Inefficient (paramedian position) Efficient (median position)
Breathing[32]	Normal	Insufficient
Choking[32]	Present	Present (paramedian) Absent (median)
Laryngoscopic examination after intubation[35-36]	Hematomas, mucosal thickening	Mucosal thickening, granulations
Frequency[6]	About 85% of the cases	Less frequent. Almost 15% of the cases.
Swallowing dysfunction[6]	Especially noticeable when drinking liquids	Much more noisy presentation. Correlated with insufficient breathing
Airway[32]	Airway is usually not obstructed because the normal cord abducts sufficiently	The airway is inadequate, resulting in stridor and dyspnea with moderate exertion as each cord is drawn to the midline glottis by an inspiratory Bernoulli effect. Aspiration is also a danger

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