ARCHIVES OF HEAD AND NECK SURGERY
ISSN 2595-2544

MISCELLANEOUS

LITERATURE REVIEW

Dysphagia and head and neck cancer: how tumors and their treatments impact swallowing

Mariana Gonçalves Rodrigues[1]*, Eliézia Helena de Lima Alvarenga[1], Leonardo Haddad[1]

Abstract

Introduction: Dysphagia manifests in various ways in patients with head and neck cancer. It can be an initial symptom of the oncological disease or a consequence of the treatment received. **Objective**: This study aims to review the impact of dysphagia on the different sites where head and neck cancer occurs, including the mouth, pharynx, larynx, and thyroid. **Methods:** A comprehensive search was conducted in the PubMed database using the following terms: "dysphagia and oral cancer"; "dysphagia and oropharyngeal cancer"; "dysphagia and laryngeal or hypopharyngeal cancer"; "dysphagia and larynx cancer"; "dysphagia and thyroid", and "dysphagia and neck dissection". **Results**: The changes in swallowing physiology resulting from head and neck cancer or its treatments were analyzed by anatomical subsite. Outcomes were also evaluated separately based on the treatment modality, either surgical or non-surgical. **Conclusion:** Dysphagia affects not only the quality of life but also contributes to the deterioration of physical health.

Keywords: cancer symptoms; deglutition disorders; head and neck neoplasms; quality of life; thyroid neoplasms.

How to cite: Rodrigues MG, Alvarenga EHL, Haddad L. Dysphagia and head and neck cancer: how tumors and their treatments impact swallowing. Arch Head Neck Surg. 2023;52:e20230009. https://doi.org/10.4322/ahns.2023.0009

[1]Universidade Federal de São Paulo (UNIFESP), Escola Paulista de Medicina, Departamento de Otorrinolaringologia e Cirurgia de Cabeça e Pescoço, São Paulo, SP, Brasil

Financial support: None.
Conflicts of interest: No conflicts of interest declared concerning the publication of this article.
Submitted: June 06, 2023.
Accepted: July 10, 2023.

The study was carried out at the Departamento de Otorrinolaringologia e Cirurgia de Cabeça e Pescoço, Escola Paulista de Medicina, Universidade Federal de São Paulo (UNIFESP), São Paulo, SP, Brasil.

This study was presented as a scholarship Term Paper (*Trabalho de Conclusão de Curso - TCC*) by Mariana Gonçalves Rodrigues in March 2023.

Introduction

Patients with head and neck cancer (HNC) may experience dysphagia as an initial symptom of the oncological disease or after HNC treatment. Dysphagia refers to difficulty in swallowing[1] food and managing one's own secretions, from oral containment, its passage through the oral cavity, the pharynx, and the esophagus, until in the stomach[2-4]. This difficulty can result from an anatomical-functional abnormalities or neuromuscular deficiencies of the involved structures, leading to nutritional intake and hydration. Moreover, it impacts airway safety and the individual's quality of life (QoL).

It is essential to highlight the phases of adult swallowing to understand the impact of HNC based on its various subsites. Deglutition can be divided into four phases: pre-oral, oral, pharyngeal, and esophageal[6].

The pre-oral phase occurs before placing food in the mouth, and it is triggered by olfactory and visual sensory stimulation, which leads to salivation[7].

The oral phase is voluntary, comprising preparatory and propulsive stages in which the food becomes a bolus. This phase involves mastication through muscular activity and teeth, bolus preparation, enzymatic action by saliva, and superior tongue movement. Oral containment involves facial muscles (orbicularis oris, buccinator, risorius, and depressors and elevators of the lips) innervated by the facial nerve. Sensory-motor responses are regulated by the brainstem through the nuclei of the trigeminal, facial, glossopharyngeal, vagus, and hypoglossal nerves; peripheral cervical nerves (C1-C3), and the cerebral cortex[3].

The propulsive phase occurs through lingual movement from front to back, increasing bolus pressure against the hard palate by elevating the tongue, directing it to the pharynx, followed by muscle contraction and repositioning of the tongue via its posterior elevation. Subsequently, the glossopalatal junction opens, the soft palate rises to close the nasopharynx, preventing nasal reflux.

The pharyngeal phase is involuntary[3,6] and reflexive, characterized by propelling the food bolus to the esophagus through coordinated muscular movements (mylohyoid muscle; anterior digastric muscles; geniohyoid, stylohyoid, and styloglossus muscles; the posterior portion of the tongue; superior, medium, and inferior pharyngeal constrictor muscles; palatoglossus and palatopharyngeus muscles)[3].These movements, characterized by contraction and relaxation, are initiated through the stimulation of the superior laryngeal nerve, a branch of the vagus nerve[2,3]. The swallowing reflex relies on the integrity of the mucosa of the hypopharynx and larynx to trigger sensory stimulation[3]. Afferent sensory input sending information of mechanical, chemical, and thermal receptors about the properties of the bolus from the oral cavity, the base of the tongue, oropharyngeal and hypopharyngeal mucosa, through the glossopharyngeal and vagus nerves (internal branch)[3]. At this stage of deglutition, there is an intertwining of sensory information and oral and pharyngeal motor response, making it difficult to distinguish between these phases, which are collectively termed the oropharyngeal phase. The swallowing reflex can be triggered before the bolus reaches the upper third of the epiglottis or contacts the valleculae and pyriform sinuses in the pharynx[3]. For swallowing safety, the aerodigestive tract is reconfigured, coordinating breathing with swallowing apnea[8]. This apnea arises because of the closure of the upper airway, with the elevation and forward movement of the larynx driven by the traction of the suprahyoid muscles and reflex adduction of the vocal and vestibular folds. This is followed by the retroflexion of the epiglottis, closure of the vocal folds, and the inward movement of the arytenoids, which come close to the base of the epiglottis, which descends to close the supraglottic vestibule. Subsequently, the upper esophageal sphincter opens, leading to the pharyngeal clearance of the food and repositioning of the larynx[2,3,6].

The involuntary esophageal phase begins with the opening of the upper esophageal sphincter, followed by reflex primary peristalsis until the opening of the lower esophageal sphincter, moving the bolus to the stomach.

Dysphagia can be the initial manifestation of some HNCs, either due to their presence, affecting the swallowing system, or due to anatomical-functional changes or neuromuscular impairment of the involved structures, as discussed in the initial paragraphs.

Some HNC patients need surgical treatment, which may increase anatomical changes that will lead to functional compensations by the remaining structures. Adjuvant or primary combined chemoradiotherapy is also an option in many cases. However, it causes deleterious effects on different phases of swallowing, even when the organ is preserved. In this sense, dysphagia can be a consequence of the treatment administered.

The heterogeneity of HNC manifestations, the timing of swallowing assessment, and the different therapeutic approaches challenge the study of dysphagia's prevalence, justifying the wide variability of dysphagia in this group, from 16 to 100%[9] Up to two-thirds of patients exhibit dysphagia at the time of HNC diagnosis, but this manifestation can increase to up to 75% after treatment[11].

This study aimed to review the impact of dysphagia on different HNC sites. The mouth, pharynx, larynx, and thyroid were studied.

Material and methods

A search was conducted on the PubMed database on January 5th, 2023, using the following terms: "dysphagia and oral cancer"; "dysphagia and oropharyngeal cancer"; "dysphagia and laryngeal or hypopharyngeal cancer"; "dysphagia and larynx cancer"; "dysphagia and thyroid", and "dysphagia and neck dissection". The following filters were used: "Meta-Analysis", "Review", "Systematic Review", and "in the past 10 years". In total, excluding texts in duplicate, 40 scientific articles were retrieved.

Results

Mouth

Oral tumors are preferably treated surgically[12,13], and dysphagia affects 66 to 88% of the operated patients[14]. Chemoradiotherapy [(C)RT] are considered adjuvant treatments in most cases or are indicated for patients who are unable to undergo surgery, or for inoperable tumors. The presence of bone structures, the air-tissue transition, and involuntary mobility reduce the effectiveness of radiotherapy alone for neoplasms of this site[12]. The surgical treatment of oral cancer includes not only the resection of the tumor but also reconstruction of the site, which often leads to feeding difficulties for the patient. There is significant variability in the assessment of dysphagia in patients treated for oral cancer in the literature[15], which hampers the interpretation of the results. QoL questionnaires, tracheostomy use, duration of alternative feeding methods, and instrumental swallowing assessments (videofluoroscopic swallow study - VFSS and Fiberoptic Endoscopic Evaluation of swallowing- FEES) are the most mentioned methods in studies[15]. Another limitation in interpreting these results is the variability of tumor locations within the mouth, where cancers of the lips, tongue, floor of the mouth, and gums are studied together.

Another relevant bias refers to tumoral staging, since studies include T1 to T4 tumors in the same analysis. Despite the limitations, some conclusions can be drawn adjuvant radiotherapy worsens the results of QoL questionnaires. Among the late complications related to radiotherapy that could explain the deterioration of swallowing quality are subcutaneous fibrosis, trismus, and sialadenitis with xerostomia[15], which impact the oral phase of swallowing. In this context, it is recommended that T1 and T2 patients without criteria for adjuvant indication are indeed spared from radiotherapy. It is worth noting that the classic criteria for adjuvant radiotherapy indication for oral tumors include presence of multiple compromised lymph nodes, a single compromised lymph node >3 cm, presence of perineural or vascular invasion, T4a tumors or positive lymph node in levels IV and/or V, and oral tongue tumors with an invasion depth >4 mm[12].

Larger resections, such as those involving the oral tongue in conjunction with the base of the tongue, are associated with increased pharyngeal transit time, penetration, and aspiration[15]. The larger the volume resected of the oral tongue, the worse the functionality of the postoperative oropharyngeal phase of swallowing because of impairment in the lingual driving force against the palate during bolus transfer[13], the hypopharyngeal suction pump. When glossectomy is combined with anterior mandibulectomy and/or resection of floor muscles, the patient loses the ability to elevate and to anteriorize the hyoid and larynx, impairing the opening of the upper esophageal sphincter and placing residue in the pyriform sinuses[16].

When compared to primary closure, microsurgical reconstructions are associated with better postoperative swallowing outcomes, especially in larger tumors[15].

In the early postoperative period, dysphagia is exacerbated by oral and pharyngeal edema, fatigue, and the presence of a protective tracheostomy[13].

Changes in taste are significant complications in HNC patients, especially when the tumor occurs in the oral cavity. The tumor itself and its extensive surgical resection combined with reconstruction techniques affect taste perception. Preserving more than 50% of the base of the tongue is associated with better gustatory recovery as it better preserves the glossopharyngeal nerve. Dysgeusia can occur because of damage to the oral mucosa due to the cytotoxicity and neurotoxicity of (C)RT[17]. It is estimated that up to 76% of HNC patients undergoing (C)RT experience taste alteration symptoms, which are worse between the fourth and eighth weeks of treatment and in smokers[17]. Changes in taste significantly impact the oral phase of swallowing.

Multidisciplinary care is crucial to patient rehabilitation. Swallowing rehabilitation with speech therapists is essential. Oral exercises, oral sensory stimulation, compensatory strategies, and airway protection maneuvers improve swallowing function and patient QoL in the early post-operative period[14,15]. Dental care is also fundamental to prevent complications after surgery and/or radiotherapy. Treating oral infections and poorly preserved teeth, as well as oral hygiene advice before surgery and radiotherapy positively impact patient health. Furthermore, complications like mucositis,

osteoradionecrosis, and secondary infections should be covered by multiple professionals[18].

Regarding changes in swallowing physiology after (C)RT, muscular fibrosis is the main cause of injury, and the oropharyngeal phase is the most affected one[19]. There is reduced laryngeal excursion, base of the tongue dysfunction, decreased contact between the base of the tongue and the posterior wall of the pharynx, reduced pharyngeal contraction, reduced epiglottic deflection, and laryngeal vestibule closure impairment[19]. In the oral phase of deglutition, the reduced lingual strength observed after (C)RT also contributes to dysphagia. Regarding the esophageal phase, there is a delay in the opening of the upper esophageal sphincter[19]. Oral mucositis, pain, nausea, and loss of appetite are some of the immediate toxicities of (C)RT that impact the patient's swallowing[20]. Xerostomia and dysgeusia also affect swallowing but are late complications of systemic therapies[20]. All these complications not only impact the individual's QoL but also cause weight loss and malnutrition[20].

Oropharynx

Oropharynx squamous cell carcinoma (OPSCC) manifests in two forms: related to the human papillomavirus (HPV) and to smoking and alcohol consumption[12]. Early diagnosis of OPSCC seldom occurs due to the paucity of symptoms in initial stages. The palatine tonsil is the most affected site of the oropharynx[12]. One of the main challenges for the surgical treatment of OPSCC is surgical access. The transoral approach is preferably in T1 and T2 tumors, but it is not always sufficient to ensure resection with appropriate margins with the surgical instruments used. More recently, the transoral robotic surgery (TORS) was introduced as an alternative for OPSCC cases, but this technique is limited to cases with the following characteristics: tumors ≤4 cm, patients with mouth openings >3 cm, tumors not invading the parapharyngeal space, unilateral base-of-tongue tumors, tumors extending up to a third of the soft palate, and absence of retropharyngeal internal carotid[12]. Compared to traditional open surgery, there seems to be a trend towards a shorter duration of alternative feeding methods in patients operated on robotically; however, the evidence is low[21]. TORS also seems to be superior to non-surgical treatments in terms of dysphagia, as it does not have late cytotoxic effects on the swallowing anatomy[22].

(C)RT can replace surgical resection and is considered a good treatment. Comparisons of functional and oncological outcomes between patients treated with or without surgery come from non-randomized retrospective studies that often result in contradictory conclusions. In this regard, decision-making should be individualized and prioritize multidisciplinary discussion[12], where physicians from different specialties can discuss the best therapeutic option for each patient. When swallowing functional outcomes are studied in the literature, only a minority of the studies, 30.2%, use instrumental swallowing assessments such as VFSS and FEES[23]. Instrumental swallowing assessment allows objective evaluation of a patient's swallowing, so when not used, indirect criteria are applied in the evaluation of swallowing like questionnaires, interviews, and clinical outcomes. A systematic literature review on the post-treatment QoL of OPSCC patients showed that eating is

the most impacted domain[24], with issues related to dry mouth, dysphagia, and difficulty chewing. One possible explanation for deglutition disorders caused by pharyngectomies is the decreased contact between the base of the tongue and the posterior pharyngeal wall, leading to reduced pressure against the food bolus and delayed swallowing reflex. These swallowing changes increase the risk of aspiration and residue accumulation[25]. Combined resections of the tongue and palate also alter the food bolus transit from the mouth to the pharynx and can lead to velopharyngeal sphincter incompetence and nasal escape[25]. Non-surgical treatments for OPSCC are associated with worse QoL indices. Considering only radiotherapy, the literature shows that intensity-modulated radiotherapy (IMRT) is associated with better QoL[26] outcomes compared with conventional radiotherapy, as it minimizes radiation effects on tissues adjacent to the neoplasm[26].

All the systematic reviews included in this study mention that their conclusions are limited as a result of the methodological variability in assessing the oncological and functional outcomes for OPSCC patients.

Larynx and hypopharynx

Dysphagia can be the first symptom of laryngeal cancer, especially when the neoplasm is located at the supraglottic level. The hypopharynx and larynx share a close anatomical relationship, which facilitates the progression of oncological disease between the two structures in more advanced cancer stages. The surgical treatment for T3 and T4a stages of laryngeal cancer usually involves partial or total excision of the hypopharynx to ensure appropriate surgical margins. In patients undergoing total laryngectomy, swallowing dynamics are altered since the contraction of the base of the tongue against the pharyngeal wall must overcome the resting pressure of the closed pharynx for the food bolus to enter the esophagus. These physiological changes slow food transit or foster residue accumulation in the neopharynx, being even more prevalent in patients who also underwent (C)RT[27]. Another common complication of total laryngectomy is pharyngocutaneous fistula[27,28], which delays oral feeding rehabilitation and demands prolonged maintenance of an alternative diet through a nasoenteral tube or gastrostomy. Even in cases where total laryngectomy is uncomplicated, the frequency of oropharyngeal dysphagia described in the literature ranges between 10 and 60%[28], either after instrumental swallowing assessment or after QoL questionnaires for treated patients. The main dysphagic symptoms reported by patients undergoing total laryngectomy, with or without adjuvant treatment, include regurgitation, food "sticking to the throat", globus sensation, or prolonged meals[28]. The main findings from instrumental swallowing assessments included impaired pharyngeal propulsion, increased resistance to pharyngeal flow, pharyngeal muscle weakness, pharyngoesophageal dysfunction, pharyngeal spasm, and nasopharyngeal reflux[28]. The primary method used for instrumental assessment was VFSS[28]. The most frequent complications of pharyngeal reconstruction were stenosis, pseudodiverticulum formation, fistulization, and tumor recurrence[27,28], affecting the pharyngeal and esophageal stages of swallowing. The formation of a pseudodiverticulum seems to depend on

the type of pharyngeal closure, being more frequent after vertical closure compared to "T"-shaped reconstructions[27,28].

Partial horizontal supracricoid laryngectomy (PHSL) is a surgical treatment option for glottic, transglottic, or supraglottic tumors in stages T1b, T2, or T3; selected T4 tumors (without invasion of the external perichondrium of the thyroid cartilage, for example); or as salvage surgery following failed radiotherapy[29]. By principle, PHSL sacrifices the entire glottic level, the thyroid cartilage, and the vestibular bands, but should spare at least one arytenoid cartilage. For this therapeutic approach, there are two closure options: cricohyoidoepiglottopexy (CHEP) and cricohyoidopexy (CHP). Swallowing rehabilitation is one of the outcomes studied in both reconstruction techniques. Studies comparing both techniques concluded that there is a slight advantage in terms of nasoenteral tube duration and aspiration incidence in the CHEP group compared with the CHP group. However, this conclusion is not unanimous in the literature, with several other studies showing no inferiority of one technique over the other[30]. Patients who receive advice and speech therapy training on postural maneuvers for swallowing pre- and post-surgical treatment they started oral intake before, early remove the nasoenteral tube or gastrostomy compared with those who were advised only postoperatively[30]. Research shows that, despite the high incidence of dysphagia in the early postoperative period, there is a complete recovery of the swallowing function and a low incidence of late complications, such as aspiration pneumonia[30].

Laryngopharyngeal reflux (LPR)—considered a risk factor for dysphagia–has been the subject of studies regarding its causality with laryngeal cancer[31,32]. There is a lack of definitive evidence for a causal relationship between reflux and laryngeal cancer. One of the main difficulties in establishing causality is the high association between smoking/alcohol consumption and reflux. Additionally, there is a lack of solid studies that adequately differentiate between gastroesophageal reflux disease and LPR.

Non-surgical therapies, like (C)RT, also cause dysphagia, as they induce fibrosis of the swallowing musculature and xerostomia. The anatomical and functional mechanisms involved in post-radiotherapy dysphagia are detailed in the General Considerations section.

Dysphagia is one of the initial symptoms of hypopharyngeal cancer, which, unfortunately, is often diagnosed in advanced stages. The location of squamous cell carcinoma in the hypopharynx is, by itself, a risk factor both for pharyngocutaneous fistula after pharyngolaryngectomy (incidence 20 and 25%)[33] and for late dysphagia in patients treated with (C)RT exclusive[34]. Resection of hypopharyngeal cancer can result in dysphagia as it alters muscle contractility, causing residue accumulation and a risk of penetration and aspiration[25].

Initial stage tumors can be treated with exclusive radiotherapy or partial or total pharyngolaryngectomy; however, there is still much room for discussion regarding the best therapeutic option in stages III and IV[12,35]. A study comparing oncological and functional outcomes among patients treated with induction chemotherapy followed by combined chemoradiotherapy,

definitive radiotherapy, and primarily surgical treatment concluded there were no significant differences among the outcomes, and that patient QoL should be prioritized when choosing the treatment modality[34]. To assess dysphagia after treatment, that study examined the duration of gastrostomy use after the main treatment and found that the difference between the periods in which the alternative method was used was not significant[36].

A systematic review that compared oncological and functional outcomes of patients treated with TORS and transoral endoscopic approaches concluded there was no significant difference in swallowing disorders after both studied modalities. Dependency on a definitive alternative method for nutritional support, occurrence of aspiration pneumonia, and the functionality scale (Functional Oral Intake Scale, FOIS) are among the criteria mentioned for evaluating post-treatment dysphagia[37].

Thyroid

Dysphagia is not usually a symptom of early thyroid cancer. When advanced, thyroid tumors can invade adjacent structures, such as the inferior laryngeal nerve (a branch of the vagus nerve) and the esophagus, and in these situations, they manifest with dysphagia. Benign diseases, such as bulky or substernal goiter, can manifest with dysphagia, due to esophageal deviation and compression[38]. Nodules located in the left lobe and more posteriorly are also more likely to cause esophageal dysphagia because of their closer proximity to the esophagus, which is naturally and slightly shifted to the left in the cervical topography.

Dysphagia is a frequently neglected complication of total thyroidectomy, with or without neck dissection[39-42]. Patients undergoing thyroidectomy for malignant or benign thyroid diseases may complain of dysphagia preoperatively in 34.6% of cases. In the first two weeks after surgery, the complaint reaches 46.5%, then progressively regresses to 22.2% of patients after 2 to 3 months, and finally manifests in 5% of individuals after 1 year[40]. Up to 45% of patients undergoing total thyroidectomy may present with some swallowing disorder manifested as a "sensation of strangulation and difficulty swallowing"[41]. The dysphagia symptoms reported by patients are due to the surgical trauma of the complex laryngopharyngeal innervation. Even if the inferior and superior laryngeal nerves are preserved, it seems to interfere with the pharyngeal phase of swallowing. Because these symptoms do not result in a decline in the patient's QoL, they tend to be neglected and resolve within a short time[41]. Patients with swallowing difficulties after uncomplicated thyroidectomies may exhibit incoordination or reduced contractility of the upper esophageal sphincter, as well as decreased laryngeal mobility and restriction to hyoid movement[43]. More rarely, vocal cord paralysis due to injury to the inferior laryngeal nerves can cause laryngeal closure insufficiency during swallowing, increasing the risk of aspiration[41,43]. Neurophysiological monitoring of laryngeal and vagus nerves during thyroidectomy is recommended to avoid bilateral nerve injury. Once a signal loss is detected on the first operated cervical side, the surgery is usually interrupted[41]. There might be an advantage to endoscopic or robotic access to prevent dysphagia after thyroidectomy since

the strap muscles would not be dissected. However, there is not sufficient literature support to defend this hypothesis[42].

The adjuvant treatment for intermediate or high-risk well-differentiated thyroid cancers is radioiodine therapy, which can also lead to oral phase dysphagia, as it may cause xerostomia, sialadenitis, dysgeusia, and dental cavity[42].

General considerations

All review studies retrieved through the search at the PubMed database report various limitations to interpret the results due to the heterogeneity of the included papers. Differences regarding how dysphagia is assessed, such as instrumental methods, QoL questionnaires, and the use of alternative feeding methods show that there is no standardization for the study of swallowing disorders, jeopardizing conclusions, and comparisons.

Most of the accessed studies address dysphagia in HNC patients without distinguishing the tumor site. The following considerations were formulated based on HNC studies that did not specify a particular tumor site.

Regarding changes in swallowing physiology after (C)RT muscular fibrosis is one of the main causes of disturbances, and the oropharyngeal phase is the most affected one[19]. There is a sensitive reduction in the hyolaryngeal complex elevation, weakness of the base of the tongue, decreased contact between the base of the tongue and the posterior pharyngeal wall, pharyngeal constrictor muscles dysmotility, reduced epiglottis deflection, laryngeal vestibule closing impairment[19]. Studies that assessed deglutition using VFSS and FEES showed that, in the oral phase of swallowing, tongue strength decrease, observed after (C)RT, also contributes to dysphagia. In the esophageal phase, there is a delay in the upper esophageal sphincter opening[19]. Oral mucositis, pain, nausea, and loss of appetite are some of the immediate toxicities of (C)RT affecting patient swallowing[20]. Xerostomia and dysgeusia also impact swallowing but are late complications of systemic therapies[20]. Xerostomia is a common consequence of radiation treatments since salivary glands receive high radiation doses, leading to changes in saliva composition and reduced secretion[20]. Patients who underwent IMRT report fewer symptoms related to xerostomia compared with those who received conventional radiotherapy[20].

Dysphagia may be the most significant side effect of HNC and its treatment. The high occurrence of dysphagia in patients can have serious consequences such as malnutrition, dehydration, high risk of aspiration, and death. Early detection and management of dysphagia are essential to prevent or mitigate its negative outcomes[43].

Three months after oncological treatment, there is a peak in swallowing disorders, and this phase can last up to the sixth month post-treatment[19,44]. Functional outcomes show significant improvement one year after treatment, likely due to the patient's adaptation to their new condition, and not because of an improvement from the toxic effects of (C)RT[19].

A multidisciplinary approach is crucial for managing dysphagia in HNC patients. Affective aspects, such as patient depression and anxiety, can impact dysphagia[9], especially in the oral phase of swallowing, which is voluntary.

Exercises to stimulate swallowing and reduce trismus, both pre- and post-treatment, assist in improving patient functional outcomes[45]. Patients should have their swallowing assessed before, during, and after cancer treatment[46], preferably using instrumental methods such as VFSS and FEES, in addition to QoL questionnaires. While surgical procedures cause anatomical/neurological changes at specific sites, (C)RT leads to functional changes mainly because of muscle weakness and swallowing incoordination[46]. Radiotherapeutic protocols aimed at preserving structures at risk for aspiration in dysphagia show improvement in deglutition outcomes after treatment[47,48]. Whenever possible, these protocols aim to spare key structures like the base of the tongue, pharyngeal constrictor muscles, glottis, supraglottis, upper esophageal sphincter, oral cavity, cricopharyngeal muscle, and cervical esophagus during radiotherapy planning[47,48]. The radiation dose on the pharyngeal constrictor muscles seems to be the main factor associated with late swallowing disorders, especially in glottic and supraglottic tumors. Applying the lowest possible radiation dose on structures involved in swallowing is recommended, but extreme care must be taken not to use a sub-dose[47,48].

Dysphagia treatment in oncology patients should promote QoL, reduce aspiration, and improve swallowing, ensuring proper nutrition and hydration[46]. It is advocated that swallowing exercises should continue even during periods when the patient relies exclusively on alternative feeding methods[46].

Tracheostomy is very common in patients with HNC, either due to respiratory failure caused by tumor growth or as a means of protecting the airway after extensive surgical procedures. There is much debate about the implications of placing a tracheostomy tube on swallowing quality and safety. A systematic literature review[49] addressing the changes resulting from tracheostomy could not conclusively determine if the presence of the tube indeed impacts swallowing physiology. However, this review did not include HNC patients, and its authors discuss that methodological heterogeneity is a significant limitation.

Dysphagia is an independent risk factor for the occurrence of aspiration pneumonia in HNC patients[50]. Other independent risk factors for the development of pneumonia in these patients include male sex, alcohol consumption, poor oral hygiene prior to treatment, pre-treatment dysphagia, tumors of the hypopharynx or nasopharynx, (C)RT compared with surgical treatment only, re-irradiation, neck dissection, prolonged use of tracheostomy, and the use of sedatives to induce sleep[50]. The authors of the meta-analysis addressing pneumonia in HNC patients argue that tumor location in the hypopharynx would be more associated with pneumonia because its anatomical proximity to the pharyngeal constrictor muscles, whereas patients with nasopharyngeal neoplasms would suffer more from the late effects of radiotherapy, as their survival rate is higher[50].

Final remarks

Dysphagia is frequent in patients with HNC, whether as a symptom of the oncological disease or because of the treatment. This swallowing disorder has a significant impact not only on the QoL of patients but also on the

worsening of their physical health outcomes, such as pneumonia, weight loss, malnutrition, among other complications. Early diagnosis and multidisciplinary rehabilitation are fundamental for proper care of patients with HNC.

References

1. Lindgren S, Janzon L. Prevalence of swallowing complaints and clinical findings among 50–79-year-old men and women in an urban population. Dysphagia. 1991;6(4):187-92. PMid:1778094.
2. Reddy SS, Priyadharshini R. Oropharyngeal dysphagia: understanding the etiology. Otolaryngol Res. 2017;1:115.
3. Sasegbon A, Hamdy S. The anatomy and physiology of normal and abnormal swallowing in oropharyngeal dysphagia. Neurogastroenterol Motil. 2017;29(11):e13100. **http://dx.doi.org/10.1111/nmo.13100** PMid:28547793.
4. Roden DF, Altman KW. Causes of dysphagia among different age groups: a systematic review of the literature. Vol. 46. Otolaryngol Clin North Am. 2013;46(6):965-87. **http://dx.doi.org/10.1016/j.otc.2013.08.008**. PMid:24262954.
5. Smith PA. Nutrition, hydration, and dysphagia in long-term care: differing opinions on the effects of aspiration. J Am Med Dir Assoc. 2006;7(9):545-9. **http://dx.doi.org/10.1016/j.jamda.2006.03.008**. PMid:17095418.
6. Jean A. Brain stem control of swallowing: neuronal network and cellular mechanisms. Physiol Rev. 2001;81(2):929-69. **http://dx.doi.org/10.1152/physrev.2001.81.2.929**. PMid:11274347.
7. Leopold NA, Kagel MC. Dysphagia—ingestion or deglutition?: A proposed paradigm. Dysphagia. 1997;12(4):202-6. **http://dx.doi.org/10.1007/PL00009537** PMid:9294940.
8. Martin BJ, Logemann JA, Shaker R, Dodds WJ. Coordination between respiration and swallowing: respiratory phase relationships and temporal integration. J Appl Physiol. 1994;76(2):714-23. **http://dx.doi.org/10.1152/jappl.1994.76.2.714** PMid:8175582.
9. Krebbers I, Pilz W, Vanbelle S, Verdonschot RJCG, Baijens LWJ. Affective symptoms and oropharyngeal dysphagia in head-and-neck cancer patients: a systematic review. Dysphagia. 2023;38(1):127-44. **http://dx.doi.org/10.1007/s00455-022-10484-8**. PMid:35796877.
10. Russi EG, Corvo R, Merlotti A, Alterio D, Franco P, Pergolizzi S, De Sanctis V, Ruo Redda MG, Ricardi U, Paiar F, Bonomo P, Merlano MC, Zurlo V, Chiesa F, Sanguineti G, Bernier J. Swallowing dysfunction in head and neck cancer patients treated by radiotherapy: Review and recommendations of the supportive task group of the Italian Association of Radiation Oncology. Cancer Treat Rev. 2012;38(8):1033-49. **http://dx.doi.org/10.1016/j.ctrv.2012.04.002**. PMid:22542950.
11. Dwivedi RC, St Rose S, Chisholm EJ, Georgalas C, Bisase B, Amen F, Kerawala CJ, Clarke PM, Nutting CM, Rhys-Evans PH, Harrington KJ, Kazi R. Evaluation of swallowing by Sydney Swallow Questionnaire (SSQ) in oral and oropharyngeal cancer patients treated with primary surgery. Dysphagia. 2012;27(4):491-7. **http://dx.doi.org/10.1007/s00455-012-9395-z**. PMid:22350113.

12. Chaves ALF, Marta GN, Kowalski LP. Manual de oncologia em cabeça e pescoço. São Paulo: Âmbito; 2021

13. Dawson C, Al-Qamachi L, Martin T. Speech and swallowing outcomes following oral cavity reconstruction. Curr Opin Otolaryngol Head Neck Surg. 2017;25(3):200-4. **http://dx.doi.org/10.1097/MOO.0000000000000359**. PMid:28459758.

14. Zhang J, Li Q, Wu HY, Yang Y. A Systematic review of swallowing training measures for postoperative oral cancer patients. Dysphagia. 2022;37(6):1839-50. **http://dx.doi.org/10.1007/s00455-022-10445-1**. PMid:35435477.

15. Kao SS, Peters MD, Krishnan SG, Ooi EH. Swallowing outcomes following primary surgical resection and primary free flap reconstruction for oral and oropharyngeal squamous cell carcinomas: a systematic review. Laryngoscope. 2016;126(7):1572-80. **http://dx.doi.org/10.1002/lary.25894**. PMid:26865034.

16. Giannitto C, Preda L, Zurlo V, Funicelli L, Ansarin M, Di Pietro S, Bellomi M. Swallowing disorders after oral cavity and pharyngolaryngeal surgery and role of imaging. Gastroenterol Res Pract. 2017;2017:7592034. **http://dx.doi.org/10.1155/2017/7592034**. PMid:28496456.

17. Togni L, Mascitti M, Vignigni A, Alia S, Sartini D, Barlattani A, Emanuelli M, Santarelli A. Treatment-related dysgeusia in oral and oropharyngeal cancer: a comprehensive review. Nutrients. 2021;13(10):3325. **http://dx.doi.org/10.3390/nu13103325**. PMid:34684326.

18. Levi LE, Lalla RV. Dental treatment planning for the patient with oral cancer. Dent Clin North Am. 2018;62(1):121-30. **http://dx.doi.org/10.1016/j.cden.2017.08.009**. PMid:29126489.

19. Wall LR, Ward EC, Cartmill B, Hill AJ. Physiological changes to the swallowing mechanism following (chemo)radiotherapy for head and neck cancer: a systematic review. Dysphagia. 2013;28(4):481-93. **http://dx.doi.org/10.1007/s00455-013-9491-8**. PMid:24078216.

20. Bressan V, Stevanin S, Bianchi M, Aleo G, Bagnasco A, Sasso L. The effects of swallowing disorders, dysgeusia, oral mucositis and xerostomia on nutritional status, oral intake and weight loss in head and neck cancer patients: a systematic review. Cancer Treat Rev. 2016;45:105-19. **http://dx.doi.org/10.1016/j.ctrv.2016.03.006**. PMid:27010487.

21. Anakapu K, Wilson M, Findlay M, Brown T, Bauer J. Nutritional outcomes in patients undergoing transoral robotic surgery for head and neck cancers compared to conventional open surgery. Systematic review. Head Neck. 2022;44(1):238-53. **http://dx.doi.org/10.1002/hed.26913**. PMid:34724253.

22. Hutcheson KA, Holsinger FC, Kupferman ME, Lewin JS. Functional outcomes after TORS for oropharyngeal cancer: a systematic review. Functional outcomes after TORS for oropharyngeal cancer: a systematic review. Eur Arch Otorhinolaryngol. 2015;272(2):463-71. **http://dx.doi.org/10.1007/s00405-014-2985-7** PMid:24643851.

23. Li P, Constantinescu GC, Nguyen NA, Jeffery CC. Trends in reporting of swallowing outcomes in oropharyngeal cancer studies: a systematic review. Dysphagia. 2020;35(1):18-23. **http://dx.doi.org/10.1007/s00455-019-09996-7**. PMid:30847548.

24. Høxbroe Michaelsen S, Grønhøj C, Høxbroe Michaelsen J, Friborg J, von Buchwald C. Quality of life in survivors of oropharyngeal cancer: a systematic review and meta-analysis of 1366 patients. Eur J Cancer. 2017;78:91-102. **http://dx.doi.org/10.1016/j.ejca.2017.03.006** PMid:28431302.

25. Giannitto C, Preda L, Zurlo V, Funicelli L, Ansarin M, Di Pietro S, Bellomi M. Swallowing disorders after oral cavity and pharyngolaryngeal surgery and role of imaging. Gastroenterol Res Pract. 2017;2017:7592034. **http://dx.doi.org/10.1155/2017/7592034**. PMid:28496456.

26. Roets E, Tukanova K, Govarts A, Specenier P. Quality of life in oropharyngeal cancer: a structured review of the literature. Support Care Cancer. 2018;26(8):2511-8. **http://dx.doi.org/10.1007/s00520-018-4227-9** PMid:29725802.

27. Zenga J, Goldsmith T, Bunting G, Deschler DG. State of the art: rehabilitation of speech and swallowing after total laryngectomy. Oral Oncol. 2018;86:38-47. **http://dx.doi.org/10.1016/j.oraloncology.2018.08.023**. PMid:30409318.

28. Terlingen LT, Pilz W, Kuijer M, Kremer B, Baijens LW. Diagnosis and treatment of oropharyngeal dysphagia after total laryngectomy with or without pharyngoesophageal reconstruction: systematic review. Head Neck. 2018;40(12):2733-48. **http://dx.doi.org/10.1002/hed.25508**. PMid:30478930.

29. Chawla S, Carney AS. Organ preservation surgery for laryngeal cancer. Head Neck Oncol. 2009;1(1):12. **http://dx.doi.org/10.1186/1758-3284-1-12**. PMid:19442314.

30. Lips M, Speyer R, Zumach A, Kross KW, Kremer B. Supracricoid laryngectomy and dysphagia: a systematic literature review. Laryngoscope. 2015;125(9):2143-56. **http://dx.doi.org/10.1002/lary.25341**. PMid:26013745.

31. Coca-Pelaz A, Rodrigo JP, Takes RP, Silver CE, Paccagnella D, Rinaldo A, Hinni ML, Ferlito A. Relationship between reflux and laryngeal cancer. Head Neck. 2013;35(12):1814-8. **http://dx.doi.org/10.1002/hed.23208**. PMid:23794281.

32. Zhang D, Zhou J, Chen B, Zhou L, Tao L. Gastroesophageal reflux and carcinoma of larynx or pharynx: a meta-analysis. Acta Otolaryngol. 2014;134(10):982-9. **http://dx.doi.org/10.3109/00016489.2014.927592**. PMid:25131391.

33. Dedivitis RA, Aires FT, Cernea CR, Brandão LG. Pharyngocutaneous fistula after total laryngectomy: systematic review of risk factors. Head Neck. 2015;37(11):1691-7. **http://dx.doi.org/10.1002/hed.23804**. PMid:24958209.

34. Jiang N, Zhang LJ, Li LY, Zhao Y, Eisele DW. Risk factors for late dysphagia after (chemo)radiotherapy for head and neck cancer: A systematic methodological review. Head Neck. 2016;38(5):792-800. **http://dx.doi.org/10.1002/hed.23963**. PMid:25532723.

35. Takes RP, Strojan P, Silver CE, Bradley PJ, Haigentz M Jr, Wolf GT, Shaha AR, Hartl DM, Olofsson J, Langendijk JA, Rinaldo A, Ferlito A. Current trends in initial management of hypopharyngeal cancer: the declining use of open surgery. Head Neck. 2012;34(2):270-81. **http://dx.doi.org/10.1002/hed.21613**. PMid:22228621.

36. Chung EJ, Jeong WJ, Jung YH, Kwon SK, Kwon TK, Ahn SH, Sung MW, Keam B, Heo DS, Kim JH, Wu HG, Lee KW, Eom KY, Rho YS. Long-term oncological and functional outcomes of induction chemotherapy followed by (chemo)radiotherapy vs definitive chemoradiotherapy vs surgery-based therapy in locally advanced stage III/IV hypopharyngeal cancer: Multicenter review of 266 cases. Oral Oncol. 2019;89:84-94. **http://dx.doi.org/10.1016/j.oraloncology.2018.12.015**. PMid:30732965.

37. Lai KWK, Lai R, Lorincz BB, Wang CC, Chan JYK, Yeung DCM. Oncological and functional outcomes of transoral robotic surgery and endoscopic laryngopharyngeal surgery for hypopharyngeal cancer: a systematic review. Front Surg. 2022;8:810581. **http://dx.doi.org/10.3389/fsurg.2021.810581**. PMid:35464886.

38. Sorensen JR, Bonnema SJ, Godballe C, Hegedüs L. The impact of goiter and thyroid surgery on goiter related esophageal dysfunction. a systematic review. Front Endocrinol. 2018;9:679. **http://dx.doi.org/10.3389/fendo.2018.00679**. PMid:30524374.

39. Haugen BR, Alexander EK, Bible KC, Doherty GM, Mandel SJ, Nikiforov YE, Pacini F, Randolph GW, Sawka AM, Schlumberger M, Schuff KG, Sherman SI, Sosa JA, Steward DL, Tuttle RM, Wartofsky L. American Thyroid Association management guidelines for adult patients with thyroid nodules and differentiated thyroid cancer: the American Thyroid Association guidelines task force on thyroid nodules and differentiated thyroid cancer. Thyroid. 2016;26(1):1-133. **http://dx.doi.org/10.1089/thy.2015.0020** PMid:26462967.

40. Galluzzi F, Garavello W. Dysphagia following uncomplicated thyroidectomy: a systematic review. Eur Arch Otorhinolaryngol. 2019;276(10):2661-71. **http://dx.doi.org/10.1007/s00405-019-05599-y** PMid:31414222.

41. Minuto MN, Reina S, Monti E, Ansaldo GL, Varaldo E. Morbidity following thyroid surgery: acceptable rates and how to manage complicated patients. J Endocrinol Invest. 2019;42(11):1291-7. **http://dx.doi.org/10.1007/s40618-019-01064-z**. PMid:31124043.

42. Vardaxi C, Tsetsos N, Koliastasi A, Poutoglidis A, Sapalidis K, Triaridis S, Printza A. Swallowing disorders after thyroidectomy: a systematic review and meta-analysis. Eur Arch Otorhinolaryngol. 2022;279(9):4213-27. **http://dx.doi.org/10.1007/s00405-022-07386-8** PMid:35438344.

43. Heijnen BJ, Speyer R, Kertscher B, Cordier R, Koetsenruijter KW, Swan K, Bogaardt H. Dysphagia, speech, voice, and trismus following radiotherapy and/or chemotherapy in patients with head and neck carcinoma: review of the literature. BioMed Res Int. 2016;2016:6086894. **http://dx.doi.org/10.1155/2016/6086894**. PMid:27722170.

44. Porto de Toledo I, Pantoja LLQ, Luchesi KF, Assad DX, De Luca Canto G, Guerra ENS. Deglutition disorders as a consequence of head and neck cancer therapies: a systematic review and meta-analysis. Support Care Cancer. 2019;27(10):3681-700. **http://dx.doi.org/10.1007/s00520-019-04920-z** PMid:31230120.

***Correspondence**
Mariana Gonçalves Rodrigues
Universidade Federal de São Paulo (UNIFESP), Escola Paulista de Medicina, Departamento de Otorrinolaringologia e Cirurgia de Cabeça e Pescoço
Rua Borges Lagoa, 783, Vila Clementino
CEP 4083-001, São Paulo (SP), Brasil
Tel.: +55 (11) 5576-4848
E-mail: mariana.g.rodrigues100@gmail.com

Authors information
MGR - Head and Neck surgeon, Hospital das Clínicas, Faculdade de Medicina da Universidade de São Paulo (HC-FMUSP); Escola Paulista de Medicina, Universidade Federal de São Paulo (UNIFESP). EHLA - MD, PhD (otorhinolaryngology), Universidade Federal de São Paulo (UNIFESP).
LH - Ph.D. in Sciences, Universidade Federal de São Paulo (UNIFESP).

45. Cousins N, MacAulay F, Lang H, MacGillivray S, Wells M. A systematic review of interventions for eating and drinking problems following treatment for head and neck cancer suggests a need to look beyond swallowing and trismus. Oral Oncol. 2013;49(5):387-400. **http://dx.doi.org/10.1016/j.oraloncology.2012.12.002**. PMid:23291294.

46. Kraaijenga SA, van der Molen L, van den Brekel MW, Hilgers FJ. Current assessment and treatment strategies of dysphagia in head and neck cancer patients: a systematic review of the 2012/13 literature. Curr Opin Support Palliat Care. 2014;8(2):152-63. **http://dx.doi.org/10.1097/SPC.0000000000000050**. PMid:24743298.

47. Hutchison AR, Cartmill B, Wall LR, Ward EC. Dysphagia optimized radiotherapy to reduce swallowing dysfunction severity in patients undergoing treatment for head and neck cancer: a systematized scoping review. Head Neck. 2019;41(6):2024-33. **http://dx.doi.org/10.1002/hed.25688**. PMid:30723986.

48. Duprez F, Madani I, De Potter B, Boterberg T, De Neve W. Systematic review of dose--volume correlates for structures related to late swallowing disturbances after radiotherapy for head and neck cancer. Dysphagia. 2013;28(3):337-49. **http://dx.doi.org/10.1007/s00455-013-9452-2**. PMid:23429941.

49. Skoretz SA, Anger N, Wellman L, Takai O, Empey A. A systematic review of tracheostomy modifications and swallowing in adults. Dysphagia. 2020;35(6):935-47. **http://dx.doi.org/10.1007/s00455-020-10115-0**. PMid:32377977.

50. Reddy PD, Yan F, Nguyen SA, Nathan CO. Factors influencing the development of pneumonia in patients with head and neck cancer: a meta-analysis. Otolaryngol Head Neck Surg. 2021;164(2):234-43. **http://dx.doi.org/10.1177/0194599820938011**. PMid:32660345.