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HEAD AND NECK

Prevalence and associated factors of aspiration and severe dysphagia in asymptomatic patients in the late period after open partial laryngectomy: a videofluoroscopic evaluation

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Abstract

Purpose This study aimed to evaluate late and asymptomatic patients after open partial horizontal laryngectomy (OPHL), investigating the clinical–surgical and socio-demographic factors associated with aspiration and severe dysphagia.

Methods One-thousand videofluoroscopic swallowing studies were performed in 100 asymptomatic patients in the late period after OPHL(median 6.5 years). Aspiration and severe dysphagia were, respectively, assessed by the Penetration-Aspiration scale (PAS) and by the Dynamic Imaging Grade of Swallowing Toxicity (DIGEST) classification. Associated factors were investigated by multivariate logistic regressions.

Results 34% (95% CI 24.3–47.6%) of patients presented aspiration and 23% (95% CI 15.3–34.6%) had severe or life-threatening dysphagia (DIGEST grades 3–4). On logistic regression, the presence of aspiration was associated with lower preoperative serum albumin (odds ratio [OR]: 0.22; 95% CI 0.07–0.64; $p=0.005$, for each 1 g/dL increment); a greater weight loss in early postoperative period (OR: 1.19, 95% CI 1.05–1.35; $p=0.008$, for each 1 kg loss); older age at surgery (OR: 1.08; 95% CI 1.01–1.17, for each 1-year older); and with the presence of diabetes (OR: 5.16; 95% CI 1.09–27.47; $p=0.039$).

Conclusion Deglutition abnormalities are frequent in asymptomatic patients later after OPHL. Older patients, with lower preoperative serum albumin levels, with greater postoperative weight loss, and with diabetes compose the clinical profile at risk for having worse swallowing function in the late period after OPHL.

Keywords Head and neck cancer · Laryngectomy · Deglutition · Swallowing disorders · Dysphagia · Fluoroscopy

Introduction

In the past decades, the development of new protocols for the treatment of laryngeal cancer has directed therapeutic objectives not only to cure cancer but also to preserve the larynx and its functions [1]. Along with chemo-radiotherapy protocols, partial laryngectomies are indicated for the treatment of intermediate or moderately advanced laryngeal tumors; being also a viable alternative for rescue procedures, providing good oncological and functional results [2]. The Open Partial Horizontal Laryngectomy (OPHL) is a type of horizontal resection indicated for selected T2–T4 (moderately advanced) tumors that was developed in the 1950s, becoming one of the main procedures for intermediate and advanced horizontal resections [3, 4]. Simultaneously, transoral laser microsurgery has largely replaced vertical partial laryngectomies, although this technique is traditionally used for early tumors [5]. OPHL consists of resection of the glottic and supraglottic area, above the cricoid cartilage, preserving at least one cricoarytenoid unit, which will give rise to a neoglottis together with the epiglottis by reconstruction with cricohyoidoepiglottopexy (CHEP), whose main objective is to maintain the sphincter function of the larynx [3, 4].

The main advantage of OPHL over total laryngectomy is the preservation of voice and swallowing and breathing functions, without the need for a permanent tracheostomy

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[3]. However, reconstruction does not evolve to a complete glottal occlusion mechanism, resulting in penetration and aspiration, characterizing chronic dysphagia [6, 7]. The incidence of dysphagia borders 100% immediately after surgery, and it is the main limitation of the procedure. Its clinical management deserves a multidisciplinary team in the postoperative period, and functional results vary widely depending on the referral center and the team's expertise [6–10]. After swallowing rehabilitation, usually lasting 3–4 months, the patient is expected to recover full swallowing function and be discharged from therapy [11]. Nevertheless, few previous studies [6–9, 11] had objectively assessed the functional aspects of swallowing in patients after OPHL by videofluoroscopy, the gold-standard method [12]. Moreover, all studies were performed in the early period after OPHL. In the late period, most patients do not have clear complaints of dysphagia [8] but may have chronic silent aspiration [7, 11]; and, as far as we know, there were no previous studies that assess the prevalence of deglutition abnormalities in these individuals by videofluoroscopy. Furthermore, there may be clinical factors that are associated with more severe dysphagia [13, 14], and its determination can help to identify those individuals at higher risks of aspiration/severe dysphagia and, hence, to improve the management of these patients after OPHL [14, 15].

Therefore, this study aimed to evaluate, by videofluoroscopic swallowing studies (VFSS), the prevalence of aspiration and severe dysphagia by applying two validated scales, the Penetration-Aspiration scale (PAS) [16] and the Dynamic Imaging Grade of Swallowing Toxicity (DIGEST) classification [17]; and its association with socio-demographic and clinical–surgical factors, in patients in the late period after OPHL. Additionally, we evaluated the intra- and inter-examiners agreement in scoring the PAS and DIGEST.

Materials and methods

Patients

This is a cross-sectional study with 100 patients with laryngeal cancer, treated with OPHL and reconstructed with CHEP, enrolled in the Head and Neck Cancer Surgery Section of the Brazilian National Cancer Institute between 2015 and 2019. The study protocol was approved by the Institution's Teaching and Research Ethics Committee (number 26331314.2.0000.5274), and all patients gave written informed consent. The inclusion criteria covered adult patients (≥ 18 years old) who were treated surgically by a single surgical team performing the technique described by Laccorreye [18], without active disease (local recurrence or distant metastases), and with an interval of at least 6 months after the last oncologic treatment. Patients who had previous or complementary radiotherapy were not excluded. Patients were enrolled if they had attended and had been discharged from speech therapy, presented no current complaints of swallowing, had a functional adaptation of it for nutrition and hydration, and had no tracheostomies or feeding tubes. We excluded patients with cognitive–linguistic impairments and those who had another type of surgical intervention in the head and neck region before or after the OPHL. All patients were identified during routine medical outpatient visits and underwent speech–language screenings to confirm their eligibility. Socio-demographic and current clinical data were directly collected by individual interviews and past clinical–surgical data were collected from medical records. For clinical–oncologic staging, the TNM classification based on the 8th edition of the American Joint Committee on Cancer (AJCC) [19] was used.

Swallowing assessments

All patients had their deglutition objectively evaluated by VFSS. The VFSS exams were performed in the Radiology Department of the Institute according to the protocol routinely used in the institution and previously described by Logemann [20]. An Axiom Remote Control Icons MD X-ray machine (Siemens AG, Germany) was used to perform the exams. All video segments were recorded in a side view/lateral plane with an image capture rate of 30 frames per second and stored in a Picture Archiving and Communication Systems (PACS) for later review and analysis.

The protocol was as follows: the contrast was offered in a glass, using dilutions of barium sulfate (BS, 100% Bariogel®), mineral water, and Thicken Up Clear®. Four consistencies were given: (1) liquid in 5 ml (2.5 ml water + 2.5 ml BS), 10 ml (5 ml water + 5 ml BS) and 20 ml (10 ml water + 10 ml BS); (2) thickened-liquid in 5 ml of BS, 10 ml of BS and 20 ml of BS; (3) pure in 5 ml (5 ml of BS + 1.2 g of Thickener), 10 ml (10 ml of BS + 2.4 g of Thickener) and 20 ml (20 ml of BS + 3.6 g of Thickener); (4) solid on a moistened cookie/cracker in BS; hence, totaling ten swallowings per patient. During the examination, all subjects were positioned in lateral view, as close as possible to the tabletop and the enhancer, to avoid distortions of the fluoroscopic image. The examination was performed with the instruction that the patient should ingest the contrast of each specific consistency/amount exactly as he/she would eat at home. Since all patients had already been discharged from speech therapy, all maintained a neutral posture during swallowing and none of them used any maneuvers for airway protection. All patients performed the ten scheduled swallowings with a median time of 5 min between each swallowing.

The Penetration-Aspiration Scale (PAS) [16] and the Dynamic Imaging Grade of Swallowing Toxicity (DIGEST)

[17] scales were used to analyze the VFSS. As originally described by Rosenbek et al. [16], the PAS defined penetration as the passage of the bolus to the level of the larynx without passing below the vocal folds (2–5 point scores), and aspiration as the passage of material below the level of the vocal folds (6–8 point scores). After OPHL, there is no glottic level per se due to resection of the vocal folds, which is the reference site of the PAS. The neoglottis has the arytenoid(s) as the last barrier to aspiration; thus, bolus stasis at the level of this remaining structure(s) was considered as penetration, and passage of bolus below the arytenoid(s) was considered as aspiration [21] (Fig. 1). For analysis of the PAS, we dichotomized the scale into presence/absence of aspiration [21].

The DIGEST [17] is a validated staging tool to assess the severity of pharyngeal dysphagia based on VFSS. It presented excellent reliability for a population of head and neck cancer (weighted kappa: intra-rater 0.82–0.84 and inter-raters 0.67–0.81). The scale has two component scores: (1) safety rating and (2) efficiency rating. To classify safety, the evaluator assigns the maximum PAS score observed during the swallowing of different bolus consistencies. To classify the efficiency rating, the evaluator assigns the maximum percentage of pharyngeal residue on an ordinal scale (< 10%; 10–49%; 50–90%; and > 90%), according to different bolus consistencies. Finally, the DIGEST gives an ordinal summary of 5 grades by correlating the parameters of safety and efficiency of swallowing: grade 0 = without dysphagia; 1 = mild; 2 = moderate; 3 = severe; and 4 = life-threatening dysphagia [17]. Both scales' application was initially standardized by discussion among five specialists (1 radiologist, 2 head and neck surgeons, and 2 speech–language pathologists) to determine the functional patterns to be considered. After reaching a consensus, one of the speech–language pathologists (AF), blinded to other patients' data, independently performed all VFSS analyses and gradings. The second speech–language pathologist (CF) independently analyzed a set of VFSS from 32 randomly selected patients (320 swallowings) to assess inter-examiner agreement. The first speech–language pathologist also re-analyzed these same VFSS examinations, at least 6 months after the first evaluation, to assess intra-examiner reproducibility.

Statistical analysis

The intra- and inter-examiner agreements on PAS and DIGEST assignments—both as an ordinal scale and dichotomized as presence/absence of aspiration (PAS), and as more/less severe dysphagia (DIGEST)—were assessed by weighted kappa coefficients and overall proportions of agreement. The descriptive analysis of the distribution of the socio-demographic and clinical–surgical characteristics of the study population was presented as proportions for categorical variables and as measures of central tendency (means or medians) and dispersion (standard deviations or interquartile ranges) for quantitative variables, depending on having normal or asymmetric distributions. For continuous variables, patients with/without aspiration on PAS were compared by independent t tests or Mann–Whitney tests, whereas patients at different stages of DIGEST were compared by ANOVA or Kruskal–Wallis tests, when appropriate. For categorical values, patients were compared by the chi-squared or Fisher's exact tests. For assessing the variables independently associated with the presence of aspiration on PAS and with the more severe dysphagia grades on DIGEST (grades 3–4), multiple logistic regressions were performed. The candidate variables to enter the logistic models were all socio-demographic and clinical–surgical variables, regardless of their significance on bivariate comparisons. A forward selection procedure was performed, with a p value < 0.10 as the criterion to enter and to remain into the logistic models. Some continuous variables (serum albumin, hemoglobin, and time with tracheostomy and feeding tube) had less than 10% of missing values, and these values were multiple imputed by chained equations. All statistical

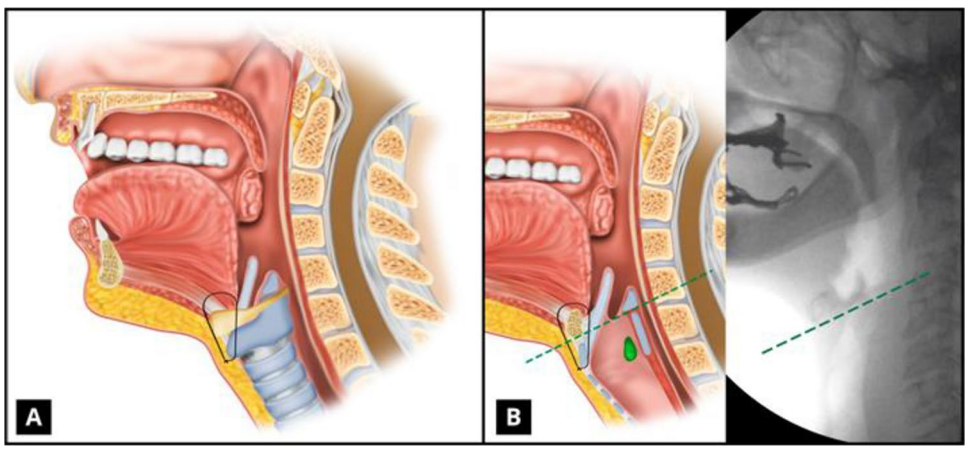

Fig. 1 **A** Model of anatomical outcome after open partial horizontal laryngectomy reconstructed with cricohyoidoepiglottopexy. **B** Radiological model and actual image exemplifying the area considered the reference for transition from penetration to aspiration

analyses were performed by the IBM SPSS version 19 package, and a significance level of 0.05 was adopted.

Results

Intra- and inter-examiners agreement on PAS and DIGEST scales

Intra- and inter-examiners agreement was evaluated in 32 randomly selected patients (320 videofluoroscopic swallowings). Table 1 shows the results of the agreement analyses. Agreement varied from moderate (for intra-examiner dichotomical DIGEST grading, kappa: 0.53) to nearly perfect (for inter-examiner dichotomical PAS and DIGEST scales, kappa: 1.0). Overall, intra- and inter-examiners agreement was substantial for both scales.

Baseline characteristics of patients and presence of aspiration and severe dysphagia

One thousand videofluoroscopic swallowings from 100 asymptomatic patients at later postoperative period of OPHL (median of 6.5 years) were evaluated by the PAS and DIGEST scales. Table 2 presents the socio-demographic and clinical–surgical characteristics of all individuals, and of those divided according to having or not aspiration on PAS (7–8 vs. 1–6 point scores) and according to DIGEST classification (stages 1, 2 and 3–4). Patients were predominantly elderly males, past or current smokers and alcohol drinkers. Most were in oncologic stages 3–4 and had good preoperative performance status. In 57% of them, both arytenoids were preserved and bilateral linfadenectomy was performed in 83%. Patients lost a median of 8.4 kg in the first 3 months after surgery. Overall, 34 patients had aspiration on PAS (prevalence rate 34%, 95% CI 24.3–47.6%) and 23 were at 3–4 stages of DIGEST (i.e., with severe or life-threatening dysphagia, prevalence rate 23%, 95% CI 15.3–34.6%), and none were at zero stage (normal deglutition). Patients with aspiration on PAS and at worse stages on DIGEST were older and lost more weight in early postoperative period than their counterparts without aspiration and at better DIGEST stages. Furthermore, patients with aspiration had lower preoperative serum albumin than those without aspiration.

Factors associated with aspiration on PAS and severe dysphagia on DIGEST

Table 3 outlines the factors independently associated with the presence of aspiration on PAS. A lower preoperative serum albumin, a greater weight loss on early (3 months) postoperative period, older age at surgery and the presence of diabetes were the variables associated with aspiration, whereas being non-married was marginally associated. Serum albumin and weight loss were the strongest variables associated with aspiration: a 1 g/dl higher serum albumin was associated with a 78% lower chance of having aspiration, whereas each 1-kg weight loss was associated with nearly 20% greater odds of having aspiration.

Table 4 shows the factors independently associated with severest stages of dysphagia (3–4) according to the DIGEST classification. Older age at surgery and greater weight loss in early postoperative period were the variables associated with severe to life-threatening dysphagia. A 1-year older age and 1-kg weight loss were, respectively, associated with a 10% and 18% higher likelihoods of having more severe dysphagia on DIGEST.

Discussion

To the best of our knowledge, this study is the first to evaluate deglutition by VFSS in patients at a later period after OPHL. It has 2 main findings with potential clinical

Table 1 Intra- and inter-examiners agreement analysis of the PAS and DIGEST scales in 32 patients (320 videofluoroscopic swallowing) after open partial laryngectomy

Scales	Intra-examiners			Inter-examiners		
	Weighted kappa*	*p*-value	Agreement %	Weighted kappa*	*p*-value	Agreement %
PAS						
Ordinal (1–8 points)	0.60	< 0.001	65.6	0.95	< 0.001	87.5
Dichotomical (7–8 vs. 1–6)	0.69	< 0.001	84.4	1.00	< 0.001	100
DIGEST						
Ordinal (0–4 stages)	0.76	< 0.001	65.6	0.94	< 0.001	84.4
Dichotomical (3–4 vs. 0–2)	0.53	0.001	75.0	1.00	< 0.001	100

*Quadratic weighted kappa coefficient

Table 2 Baseline characteristics of all 100 patients after open partial laryngectomy and divided according of having or not aspiration on Penetration-Aspiration Scale (PAS) and divided according to the Dynamic Imaging Grade of Swallowing Toxicity (DIGEST) classification, as diagnosed by video-fluoroscopic swallowing studies (VFSS)

Characteristics	All patients ($n=100$)	Penetration-Aspiration Scale (PAS)			DIGEST classification			
		Patients without aspiration ($n=66$)	Patients with aspiration ($n=34$)	p-value	Stage 1 ($n=31$)	Stage 2 ($n=46$)	Stage 3/4 ($n=23$)	p-value
Age at VFSS exam (years)	68.9 (9.5)	67.8 (10.1)	70.9 (8.0)	0.13	68.8 (12.1)	67.6 (8.2)	71.6 (7.9)	0.26
Age at surgery (years)	61.4 (9.5)	60.5 (9.8)	63.3 (8.9)	0.16	61.5 (10.5)	59.7 (8.9)	64.8 (8.9)	0.10
Male sex, %	96	97.0	94.1	0.60	96.8	97.8	91.3	0.41
Marital status, % married	71	74.2	64.7	0.32	74.2	76.1	56.5	0.21
Education, % up to 8 years	64	63.6	64.7	0.92	58.1	69.6	60.9	0.55
Smoking, % current/past	84	87.9	76.5	0.14	83.9	89.1	73.9	0.27
Alcohol intake, %	78	75.8	82.4	0.45	67.7	82.6	82.6	0.25
Diabetes, %	15	15.2	14.7	0.95	19.4	15.2	8.7	0.55
Cardiovascular diseases*, %	35	39.4	26.5	0.20	35.5	39.1	26.1	0.56
Surgical aspects								
Staging % I	8	7.6	8.8	0.50	9.7	6.5	8.7	0.93
II	34	30.3	41.2		29.0	34.8	39.1	
III–IV	58	62.1	50.0		61.3	58.7	52.2	
Performance status, % zero	69	72.7	61.8	0.26	67.7	71.7	65.2	0.84
Preoperative serum albumin, g/dl	4.4 (0.7)	4.5 (0.7)	4.2 (0.4)	0.085	4.4 (0.3)	4.4 (0.9)	4.3 (0.4)	0.95
Preoperative serum hemoglobin, g/dl	14.1 (1.5)	13.9 (1.6)	14.3 (1.0)	0.12	13.7 (1.6)	14.2 (1.5)	14.4 (0.9)	0.20
Two preserved arytenoids, %	57	56.1	58.8	0.79	54.8	56.5	60.9	0.90
Bilateral linfadenectomy, %	83	80.3	88.2	0.32	83.9	82.6	82.6	0.98
Radiotherapy, %	31	30.3	32.4	0.83	25.8	34.8	30.4	0.70
Surgical complications†, %	17	16.7	17.6	0.90	12.9	19.6	17.4	0.75
Days with tracheostomy	36 (20–54)	34 (20–53)	36 (20–55)	0.95	38 (19–60)	34 (20–50)	39 (16–86)	0.46
Days with feeding tube	38 (27–64)	36 (24–63)	40 (29–70)	0.43	42 (33–80)	32 (21–54)	43 (29–86)	0.036
Weight loss over the first 3 months after surgery, kg	8.4 (6.0–11.5)	8.3 (5.0–10.4)	10.3 (6.5–12.1)	0.059	8.5 (5.9–12.1)	8.3 (5.0–10.3)	9.3 (6.9–12.0)	0.14
Time interval between surgery and VFSS exam, months	78 (36–129)	66 (24–120)	96 (36–144)	0.44	84 (36–144)	78 (24–123)	60 (36–132)	0.96

Values are means (SDs), medians (interquartile ranges) or proportions

*Includes arterial hypertension, cardiac and cerebrovascular diseases

†Includes hemorrhage, fistula and infection

Table 3 Multiple logistic regression analysis for the independent covariates associated with the presence of aspiration evaluated by the penetration-aspiration scale (PAS) applied to video-fluoroscopic swallowing study (VFSS) examinations of 100 patients after open partial laryngectomy

Independent covariates	Odds ratio	95% confidence intervals	*p*-value
Preoperative serum albumin (1 g/dl increase)	0.22	0.07–0.64	0.005
Weight lost over the first 3 months after surgery (1 kg decrease in weight)	1.19	1.05–1.35	0.008
Age at surgery (1 year increase)	1.08	1.01–1.17	0.030
Presence of diabetes (yes vs. no)	5.16	1.09–27.47	0.039
Marital status (non-married vs. married)	2.67	0.86–8.30	0.090

Logistic analysis was further adjusted for sex and time-interval between surgery and VFSS examination. Candidate variables to enter the final model were those shown in Table 2

Table 4 Multiple logistic regression analysis for the independent covariates associated with grades 3 or 4 in the Dynamic Imaging Grade of Swallowing Toxicity (DIGEST) classification applied to video-fluoroscopic swallowing study (VFSS) examinations of 100 patients after open partial laryngectomy

Independent covariates	Odds ratio	95% confidence intervals	*p*-value
Age at surgery (1 year increase)	1.10	1.01–1.21	0.032
Weight lost over the first 3 months after surgery (1 kg decrease in weight)	1.18	1.01–1.37	0.034

Logistic analysis was further adjusted for sex and time-interval between surgery and VFSS examination. Candidate variables to enter the final model were those shown in Table 2

relevance. First, it demonstrated that late asymptomatic patients after OPHL had a relatively high prevalence of hazardous swallowing abnormalities, 34% had aspiration, and 23% presented severe or life-threatening dysphagia when evaluated by the PAS and DIGEST scales, respectively. Second, it demonstrated that the clinical factors associated with higher likelihoods of having later severe swallowing disturbances were lower preoperative serum albumin level, which probably reflects a poorer preoperative nutritional status, a greater early postoperative weight loss, older age at surgery, and the presence of diabetes. These clinical characteristics may help to identify those individuals submitted to OPHL who are at a higher risk profile to develop late severe dysphagia and for whom a closer follow-up and prolonged speech therapy might be recommended. Additionally, we confirmed the good intra- and inter-observer agreement of the recently proposed DIGEST scale [17] for assessing dysphagia severity in post-OPHL patients.

OPHL is a surgical procedure indicated mainly for the treatment of moderately advanced laryngeal cancers, aiming to preserve organ function. However, this functional preservation may be partial and there may be chronic sequelae due to resection of parts of the laryngeal structure [3]. Abnormalities of the valvar mechanism of the larynx significantly alter the dynamics of deglutition; and, indeed, dysphagia is the main complication of OPHL [6–9]. In general, after a few months of swallowing rehabilitation therapy, a functional improvement that permits adequate oral nutrition is observed [22]. Nevertheless, most previous studies that evaluated dysphagia after OPHL had small samples and used poorly effective methods of assessing deglutition abnormalities. Most used either questionnaires or clinical scales that are ineffective to detect dysphagia after OPHL [23–27] or used the evolution of oral intake to mistakenly assume deglutition safety and efficiency [28–31]. Few previous studies used objective methods of assessing deglutition abnormalities after OPHL, particularly the VFSS, which is the gold standard one to detect aspiration and hazardous dysphagia [8, 11, 25, 32–35]. Considering these studies, the prevalence of dysphagia after OPHL ranged from 17 to 74% [8, 11, 33, 35, 36], with the highest rates mainly observed within the 1st year after OPHL. Indeed, in the early postoperative period, the prevalence rates of dysphagia ranged from 67 to 100% [8, 11, 33, 37, 38]. On the other hand, few studies evaluated swallowing function in the late period after OPHL, when patients had already been discharged from swallowing rehabilitation therapy and were mostly asymptomatic; and most of them used non-objective methods of deglutition assessment. The few ones that used VFSS had small samples and poorly described the VFSS parameters used to grade the severity of dysphagia [8, 23, 24, 30]. In these studies, the prevalence of aspiration ranged from 12.9 to 67.3%. Our study provided, as far as we know, the first standardized evaluation of deglutition abnormalities severity, using VFSS, in a moderately large sample of asymptomatic patients, several years (median of 6.5 years) after OPHL. We showed a relatively high prevalence of silent aspiration (34%) and of severe/life-threatening dysphagia (23%) evaluated by applying standard scales (the PAS and DIGEST) on VFSS findings.

The identification of factors associated with a higher likelihood of having deglutition abnormalities in patients after OPHL is pivotal for clinical management, because chronic silent broncho-aspiration may lead to severe pulmonary complications [6–10, 25, 31, 35, 36]. Since most of the studies that evaluated the associated factors

of dysphagia in OPHL patients were performed in the early postoperative period, they mainly focused on perioperative clinical–surgical factors, such as more advanced tumor staging [8, 11, 33, 37, 38], need of complementary treatments (as radiotherapy) [1, 31], arytenoid resection [6, 7, 9, 24, 33, 39, 40], and longer permanence with tracheostomy or feeding tube [7, 8, 28–30] as the main factors associated with early dysphagia. Probably because we assessed aspiration and severe dysphagia in asymptomatic individuals in the late period after OPHL, we only identified the preoperative serum albumin and the extent of weight loss in the first 3 months after surgery as the perioperative factors associated with late dysphagia. These variables possibly may reflect the higher risk of dysphagia associated with poor nutrition status, but they might also be the consequence of more advanced oncological disease, which in general needs greater resections and complementary treatments. Moreover, the presence of diabetes was also associated with higher odds of having late aspiration, reflecting the importance of patients' comorbidities.

We found that older age was associated with both late aspiration and severe/life-threatening dysphagia, with higher odds of 8–10% for each 1-year increase in age at surgery. Older age is a well-known risk factor for laryngeal cancers [41], and in general, it is also associated with progressive deglutition abnormalities in elderly populations [42, 43]. Indeed, aging may affect deglutition ('presbyphagia') not only by frailty, sarcopenia, and muscle weakness but also by its associated comorbidities and hospitalizations [23, 43, 44]. Hence, it is not unexpected that the adverse effects of aging on deglutition may add up to the effects of OPHL itself. Some previous studies had already reported the association between older age and more severe dysphagia in patients after OPHL [36, 45].

This study has some limitations that are important to note. First, it has a cross-sectional design; hence, no cause-and-effect inference can be made but only speculated. Second, the eligibility criterion determined a wide range (up to 20 years) of postoperative period, which might have increased the heterogeneity of the sample. However, all patients were strictly asymptomatic and were evaluated under the same standardized protocol. Third, although our sample was one of the largest uni-center samples of patients in the late period after OPHL, it may still have been small to show some subtle associations. Hence, our findings shall be confirmed by larger, possibly multicenter, studies. Otherwise, this study has some particular strengths: the use of VFSS, which constitutes the current gold standard method of objectively assessing functional aspects of deglutition, but is still underused; and also the use of the recently proposed DIGEST scale for grading dysphagia severity.

Conclusion

This cross-sectional analysis of 100 asymptomatic patients at a late period after OPHL demonstrated a relatively high prevalence of silent aspiration (34%) and of severe/life-threatening dysphagia (23%) by VFSS. It also revealed that older patients, with lower preoperative serum albumin levels, greater postoperative weight loss, and diabetes compose the clinical profile at higher risk for having severe deglutition abnormalities in the late post-OPHL period. Prospective studies assessing the progression of dysphagia in these patients and the influence of presbyphagia, frailty, and sarcopenia in this population are necessary.

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Data availability The data that support the findings of this study are available from the corresponding author, ASF, upon reasonable request.

Declarations

Conflict of interests The authors have no relevant financial or non-financial interests to disclose.

Ethics approval and compliance with ethical standards The study protocol was approved by the Institution's Teaching and Research Ethics Committee (number 26331314.2.0000.5274), and all patients gave written informed consent. The study was performed in line with the principles of the Declaration of Helsinki.

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