BMC Cancer

RESEARCH Open Access

Dysphagia, nutritional status, and quality of life in patients with head and neck cancer undergoing radiotherapy alone or combined with chemotherapy: an observational study

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Abstract

Introduction Radiotherapy (RT) is the most common nonsurgical treatment for head and neck cancer (HNC) and may or may not be combined with chemotherapy (CT). Dysphagia, characterized by impaired swallowing function, is one of the most common side effects of RT, occurring during and after RT, and may persist long after treatment.

Objective To compare the evolution of dysphagia, nutritional status, and quality of life (QoL) in the periods immediately before and after RT for HNC in individuals who received only RT or combined RT/CT.

Methods Prospective longitudinal observational study performed in a hospital of the Brazilian public health system. The individuals were allocated into two groups: RG ($n=20$), consisting of patients who received only RT for HNC, and RCG ($n=27$), who received RT plus CT. The patients were evaluated before and after RT to identify and classify dysphagia (PARD protocol), anthropometric variables (BMI, triceps skinfold thickness, arm and calf circumferences, and manual dynamometry), and QoL (QLC-30 and H&N-35 questionnaires).

Results The groups were homogeneous in demographic characteristics and tumor stage. RCG showed a higher proportion of worsening dysphagia severity ($p<0.01$) and worsening of anthropometric assessment ($p<0.05$). A negative correlation was observed between the initial–final change in dysphagia and the change in BMI for the total sample (*rho*=-0.379, $p<0.05$). QoL worsened in most domains evaluated, but RCG showed additional worsening in the domains of global health and nausea and vomiting ($p<0.05$).

Conclusion RT for HNC leads to the early development of dysphagia, which can adversely affect nutritional status and QoL. Including CT in the RT regimen leads to a more accentuated worsening of the evaluated parameters.

Keywords Head and neck cancer, Radiotherapy, Chemotherapy, Dysphagia, Quality of life

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Introduction

Head and neck cancer (HNC) is the sixth most prevalent type of malignant tumor in men and the tenth in women, affecting approximately 800,000 individuals every year [1, 2]. Among the treatments for HNC, radiotherapy (RT) is used in the vast majority of cases and may be combined with chemotherapy (CT), called chemoradiotherapy, and surgical procedures are also common [3]. HNC grows invasively with destruction of adjacent anatomical structures, significantly lowering the quality of life (QoL), as it can cause problems in swallowing, chewing, phonation, and breathing, among others [4]. The treatment, in addition to inevitably contributing to a significant deterioration of these functions, also brings other side effects, such as mucositis, oral infections, and decreased salivation [5, 6].

Dysphagia, characterized by dysfunction in swallowing food and liquids, can be classified as mechanical or neurogenic based on its etiology. Cancer and the side effects of its treatment can affect any of the stages of swallowing: oral, pharyngeal, or esophageal [7]. This condition is usually associated with other symptoms, such as malnutrition, dehydration, weight loss, chronic aspiration, and even aspiration pneumonia. Such complications are directly related to physical and psychosocial disorders with a great impact on QoL [8, 9]. Dysphagia affects patients with HNC due to both the tissue involvement of the tumor and the treatment used, especially RT [4, 8]. Dysphagia is usually observed in a more acute form during treatment of HNC and can persist long after treatment, becoming even irreversible in more severe cases [9]. Its prevalence is estimated to reach approximately 60% of patients after treatment for HNC [8].

HNC's invasive growth negatively impacts vital functions by damaging adjacent anatomical structures, notably affecting the ability to swallow. Dysphagia can occur as a result of various treatment modalities for HNC, such as surgery, radiation, and systemic therapy, whether used individually or in combination, can derive from inflammation or tissue fibrosis due to irradiation of regions of the orofacial and cervical muscles, xerostomia, tooth deterioration, laryngeal edema, tongue base, and laryngeal elevation, and odynophagia of local inflammatory origin, such as oral mucositis [8, 10]. Nerves involved in the motor function of the pharyngeal muscles may also play a role in the development of RT-related dysphagia [11]. Even taste changes resulting from cancer treatment, especially those involving CT, may be associated with dysphagia [8].

Dysphagia development during HNC treatment can negatively impact nutritional status, hinder treatment adherence, and ultimately reduce survival rates [12]. While previous studies have reported the incidence of dysphagia—both transient and permanent—following HNC treatment, there remains a critical gap in understanding the distinct and isolated impacts of RT and CT on the acute development of dysphagia. Most studies analyze dysphagia as a general consequence of HNC treatment, without distinguishing between the contributions of RT alone versus combined RT/CT [10, 13].

This study aims to address this gap by specifically comparing the evolution of dysphagia, nutritional status, and QoL in individuals undergoing RT alone versus those receiving RT combined with CT. By assessing these parameters immediately before and after treatment, we seek to provide a clearer understanding of how each treatment modality contributes to dysphagia onset. Additionally, we investigate the association between dysphagia and nutritional status through anthropometric assessment, offering clinically relevant insights for optimizing patient care.

Methods

Study sample and design

This was an observational, prospective, longitudinal study conducted at the outpatient clinic supporting cancer patients at the Mário Penna Institute (Belo Horizonte, Minas Gerais, Brazil) from January to December 2022. The study included patients over 18 years old with histopathologically confirmed squamous cell carcinoma of the oral cavity, larynx, pharynx, maxillary sinus, or salivary glands, who were recommended to receive radiotherapy (with or without chemotherapy) as the initial treatment for head and neck cancer. We excluded patients who had undergone tumor resection surgery before RT, as such procedures often lead to significant swallowing alterations that could compromise the accuracy of our dysphagia assessment protocol. Likewise, patients unable to open their mouths or swallow, including those dependent on nasogastric tubes or parenteral nutrition, were also excluded.

A total of 79 patients were included, of whom 47 completed all stages of the study (Fig. 1). Before starting RT, the patients underwent a clinical evaluation of the oral cavity and a structured interview for the characterization of demographic data, smoking habits, and associated comorbidities. A structured questionnaire was used to collect this data, which can be accessed in supplementary material.

The study consisted of evaluating the patients in two distinct stages: the initial stage and the final stage. In both stages, the patients answered the QoL questionnaires QLQ-C30 and H&N-35, underwent a clinical assessment of the risk and/or classification of the degree of dysphagia, and underwent an examination to collect anthropometric data. The initial stage was the day of the first RT session, and the final stage was the day of the last RT session.

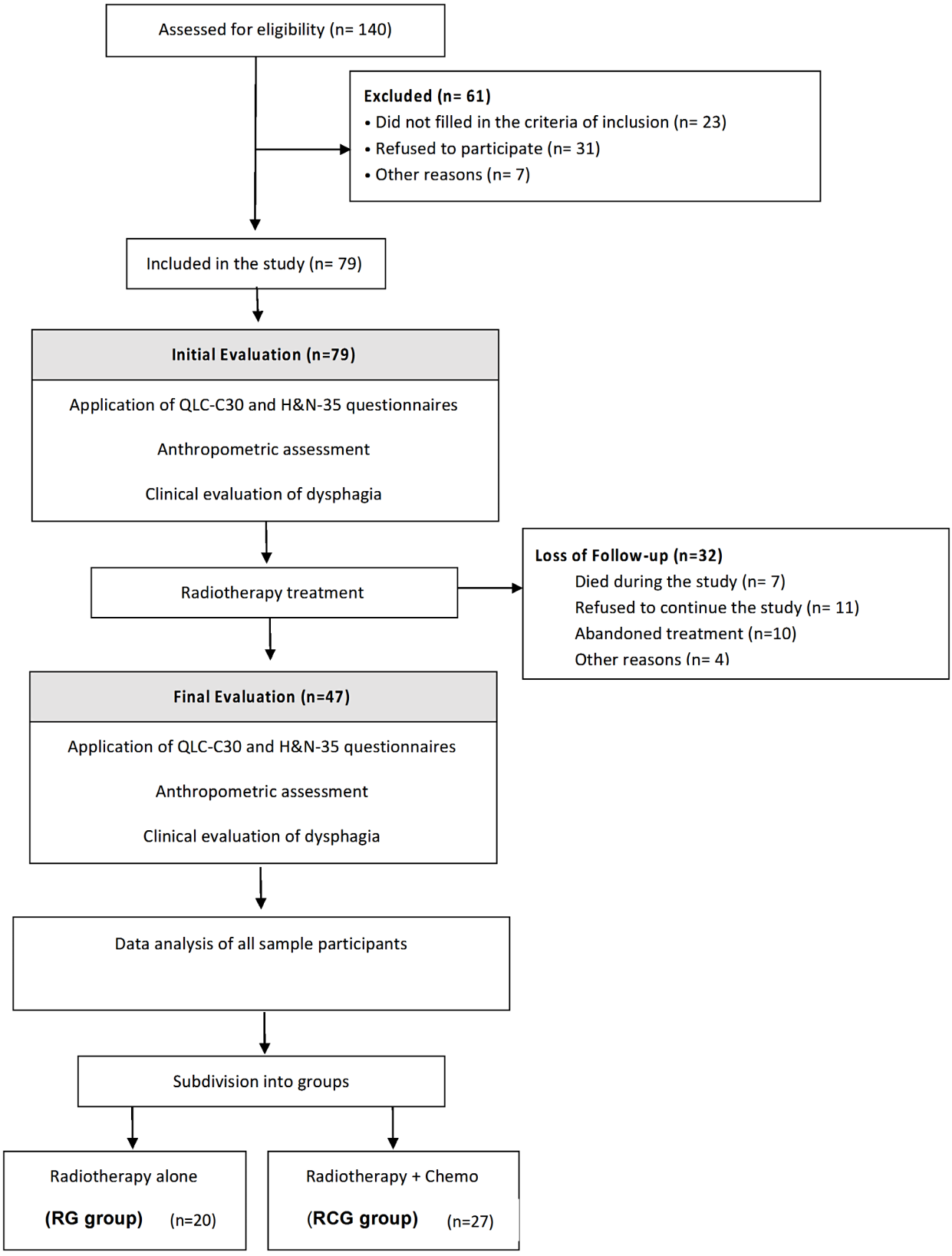

Fig. 1 Flowchart of the study phases and group design

After collecting data, the patients were divided into two groups: patients who received only the RT treatment proposed by the medical team (RT group, RG) and patients who received RT plus chemotherapy (RCG) (Fig. 1). The results of the groups were compared with each other.

All RCG patients received an intravenous platinum-based regimen combined with fluoropyrimidine. We emphasized that the use of cetuximab in HNC was reviewed by the National Commission for the Incorporation of Technologies in the Brazilian Unified Health System (SUS), with a negative decision. Cisplatin was administered intravenously at a dose of 100 mg/m² every three weeks, while 5-Fluorouracil (5-FU) was delivered as a continuous intravenous infusion at a dose of 1,000 mg/m² per day for four days, with the regimen repeated every three weeks. Patients in both groups received the same radiotherapy protocol, which consisted of the administration of 5 weekly fractions of 1.8–2.0 Gy, with a total of 66–70 Gy for 6 – 7 weeks.

Assessment of quality of life

Two questionnaires from the European Organization for Research and Treatment of Cancer (EORTC), the QLQ-C30 (version 3.0) and the QLQ-H&N35 module validated for Portuguese, were used to assess QoL [14, 15] The first assesses the symptoms and QoL of cancer patients in general. Its 30 items are distributed in scales that measure symptoms and functional aspects commonly related to cancer. A higher symptom scale score represents more/worse symptoms, but higher scores in the functional scales represent a higher QoL or level of functioning ("better") [16]. The QLQ-H&N35 is a specific module intended for patients with HNC and is applied after the QLQ-C30 questionnaire [15]. This module allows the evaluation of seven specific domains of HNC, namely, pain, swallowing, senses (taste and smell), speech, social eating, social contact, and sexuality. In addition, there are 11 specific items on problems such as dental problems, trismus, xerostomia, thick saliva, cough, malaise, consumption of analgesics, nutritional supplements, feeding tube use, and weight loss or gain. Most of the items are rated on a 4-point Likert scale (i.e., no = 1 point, a little = 2 points, moderate = 3 points, and a lot = 4 points). The QLQ-C30 questionnaire also has two items on the perception of QoL and health scored on a 7-point scale, where 1 = very bad and 7 = excellent. All scales in both questionnaires are represented as a score ranging from 0 to 100.

Risk assessment protocol for dysphagia

The Protocol for Risk Assessment for Dysphagia (PARD) was used to assess dysphagia. The PARD protocol has been validated for research in Brazil and consists of a noninvasive observational evaluation in which the speech therapist evaluates parameters related to the swallowing of liquid and soft foods [17]. The participant is offered water (5 ml volume) and then a soft food (sugar-free pudding), and the following swallowing parameters are observed: anterior oral leakage, oral transit time, nasal reflux, evaluation of the number of swallows, and elevation of the larynx during swallowing. Cervical auscultation is done with the aid of a stethoscope and should be performed before, during, and after swallowing, providing additional clues about the presence or absence of residues in the pharynx or larynx. If coughing and/or choking are observed during evaluation, these are also recorded. This evaluation was performed at both times of the study by a single speech-language pathologist experienced in the technique.

Based on the PARD protocol, we gave each patient a dysphagia severity score that ranged from Level I to Level VII, with Level I considered normal swallowing and Level VII considered severe oropharyngeal dysphagia [18]. This scale guides the treatment to be adopted [18].

Evaluation of anthropometry and manual dynamometry

Anthropometric measurements were evaluated in the study as direct indicators of nutritional status: changes in body weight, arm, and calf circumference, and triceps skinfold thickness [19]. BMI was calculated according to World Health Organization Guidelines [20]. Hand dynamometry was also done to estimate muscle strength as proposed by Schlussel et al. 2008 [21]. These measurements were performed by a single trained nutritionist.

Clinical data and habit investigation

The patients responded to a structured questionnaire designed and administered by the researchers to assess their clinical and sociodemographic conditions and habits, such as smoking. In addition, the medical records of the patients were analyzed to collect information related to general health, preexisting pathologies, tumor staging and location, and RT and CT protocols used.

Ethical aspects of research

This study was approved by the Research Ethics Committee of the School of Medical Sciences of Minas Gerais and the Mario Penna Institute (protocol: CAAE 38381720.5.3001.5121, Opinion: 4,532,121). All participants signed the free and informed consent form before the beginning of their participation in the study.

Statistical analysis

Exploratory statistical techniques were used for data analysis to better visualize the general characteristics of the data. The data are presented in frequency tables with their raw numbers and their respective percentages, as well as the descriptive measures (mean and standard

Table 1 Sociodemographic characteristics, pathologies, and habits of the study groups

Variables	RCG (*n* = 27)	RG (*n* = 20)	p-value
Sex			
Female	6 (22.2%)	7 (35%)	0.549[Q]
Male	21(77.8%)	13 (65%)	
Age (years) (mean ± SD)			
	60.0 ± 7.9	59.7 ± 12.9	0.876[t]
Comorbidities			
Diabetes	3 (11.1%)	1 (5%)	0.465 [Q]
Hypertension	10 (37.0%)	7 (35%)	0.878 [Q]
Respiratory Disease	1 (3.7%)	1 (5%)	0.984 [Q]
Gastrointestinal Disease	3 (11.1%)	0(0%)	0.134 [Q]
Neurological Disease	4 (14.81)	2 (10%)	0.567[Q]
Rheumatic Disease	1 (3.7%)	0 (0%)	0.876 [Q]
Smoker			
No	5 (18.51%)	3 (15%)	0.450[M]
Yes	7 (25.9%)	5 (35%)	
Former	15 (55.6%)	12 (60%)	
Smoking time			
0–10 years	7 (25.9%)	6 (30%)	0.365[M]
20–30 years	3 (11.1%)	3 (15%)	
30–40 years	8 (29.6%)	3 (15%)	
40–50 years	5 (18.51%)	4 (20%)	
> 50 years	4 (14.81)	4 (20%)	

[t] Student's t-test; [Q] chi-squared test, [M] Monte Carlo simulation. RCG: group that received concomitant RT and CT; RG: group that received RT only. Data are raw numbers and percentages relative to the size of each group

deviation of the mean) for the quantitative data. Comparisons were mainly performed by the Student's t-test and the paired t-test. The quantitative variables were tested for normality by the Kolmogorov–Smirnov test. As the continuous variables related to the QoL questionnaires did not have a normal distribution, a nonparametric test was used to compare them (Wilcoxon test). The categorical variables.

were compared using the chi-squared test, and when they presented expected frequencies lower than 5, Monte Carlo simulation was used for more than two response categories. The McNemar test was used to evaluate paired categorical data (initial and final evaluation). Spearman's correlation was used to assess the association between BMI and dysphagia.

In all tests, the significance level adopted was 5%; therefore, comparisons whose p-value was less than or equal to 5% were considered significant. The software used for the analyses was SPSS version 25.0.

Results

The total sample of this study was 47 patients, 70.2% of whom were males. The mean age was 59.9 years (± 9.9), ranging from 32 to 82 years. Hypertension was the most reported comorbidity (31.2%). Table 1 shows that most were former smokers (53.2%). When we stratified the entire sample into RCG and RG, we did not observe differences between any of the variables analyzed.

Table 2 Tumor characteristics and number of RT sessions in the study groups

Variable	RCG (*n*-27)	RG (*n* = 20)	*p*-value
Location of the primary tumor			
Oral cavity	10 (37.0%)	8 (40.0%)	0.345[Q]
Pharynx	10 (37.0%)	7 (35.0%)	0.576[Q]
Salivary gland	0 (0%)	3 (15.0%)	0.076[Q]
Glandular	0 (0%)	1 (5.0%)	0.145[Q]
Larynx	3 (11.1%)	2 (10.0%)	0.543[Q]
Maxillary sinus	2 (7.4%)	1 (5.0%)	0.423[Q]
Uncertain	2 (7.4%)	2 (10.0%)	0.413[Q]
Clinical stage			
Initial (0, I, II)	4 (15.2%)	3 (15.0%)	0.432[Q]
Advanced (III, VAT, IVB, CVI)	23 (81.1%)	17 (85.0%)	
Irradiated as adjunctive treatment	4 (15.2%)	3 (15.0%)	0.432[Q]
No. of RT sessions (mean ± SD)	31.2 ± 1.39	33.4 ± 2.78	0.876[t]

[t] Student's t-test; [Q] chi-squared test. RCG: group that received RT and CT concomitantly; RG: group that received RT only

Table 2 describes the variables characterizing the tumors and the average number of RT sessions used to complete the treatment regimen. For all groups, the most frequent location of the tumor was the oral cavity, and most cancers were in advanced stages. The median number of RT sessions was 32 (Table 2). There were no significant differences in any of the variables in table 2 between RG and RCG

Evaluating the groups on the worsening of dysphagia, in RG there was no significant difference in the level of dysphagia from the beginning to the end of the study. There was a significant worsening in RCG, i.e., these patients had a higher proportion of moderate-severe dysphagia at the final compared to the initial stage of the study ($p < 0.01$) (Table 3).

Table 4 shows the anthropometric evaluation data. There was a significant difference for all measurements in RCG ($p < 0.05$), except for the triceps skinfold thickness. For RG, however, only the calf circumference and weight measurements were different between the two study times ($p < 0.05$). A negative correlation was observed between the initial–final change in dysphagia and initial–final change in BMI when entire sample was analyzed (rho=-0.379, $p < 0.05$), i.e., the worse the dysphagia, the greater the reduction in BMI (Fig. 2).

Table 5 represents the QoL of the patients, which showed a significant difference in loss of appetite domains ($p < 0.05$) in both groups between the two evaluation times of the study, according to QLQ-C30. Only in RCG global health was significantly reduced ($p < 0.05$). RCG showed worsening in nausea and vomiting and fatigue ($p < 0.05$).

When assessing QoL by the H&N-35 questionnaire, we observed similar results for both groups, with worsening

Table 3 Comparison of dysphagia at the initial and final time points

Assessment of Dysphagia									
RCG					**RG**				
Initial		**Final**	***n***	***p* value[m]**	**Initial**		**Final**	***n***	***p*-value[m]**
Functional/Mild	→	Functional/Mild	7	**0.004**	Functional/Mild	→	Functional/Mild	9	0.131
Functional/Mild	→	Moderate/Severe	10		Functional/Mild	→	Moderate/Severe	6	
Moderate/Severe	→	Functional/Mild	0		Moderate/Severe	→	Functional/Mild	1	
Moderate/Severe	→	Moderate/Severe	7		Moderate/Severe	→	Moderate/Severe	3	
Total			24		Total			19	

[m] McNemar test. RCG: group that received RT and CT concomitantly; RG: group that received RT only. Three participants from the RGC group and one from the RG group had missing data and were excluded from the analysis

Table 4 Anthropometric data of the study groups

Anthropometric variables	**RCG**			**RG**		
	Initial (*n* = 27)	**Final (*n* = 27)**	**p-value**	**Initial (*n* = 20)**	**Final (*n* = 20)**	**p-value**
	Mean (SD)	**Mean (SD)**		**Mean (SD)**	**Mean (SD)**	
Arm Circumference (cm)	25.4 (3.6)	23.6 (3.4)	**< 0.001**[t]	27.5 (4.1)	26.8 (3.4)	0.235[t]
Calf circumference (cm)	32.0 (3.7)	30.4 (3.3)	**< 0.001**[t]	35.1 (4)	33.1 (5.1)	**0.017**[t]
Right Dynamometry (kg)	23.6 (10.3)	21.9 (9.5)	**< 0.001**[t]	23.2 (38.4)	22.8 (9.2)	0.342[w]
Left Dynamometry (kg)	24.0 (6.8)	20.1 (7.5)	**< 0.001**[t]	25.0 (7.1)	24.2 (5.6)	0.959[w]
Weight (kg)	58.4 (11.2)	52.9 (9.1)	**< 0.001**[t]	68.4 (14.1)	66.6 (13.7)	**0.012**[t]
Triceps skinfold (mm)	12.6 (8.9)	10.1 (4.6)	0.061[w]	17.3 (10.9)	14.5 (7.4)	0.765[w]
BMI (kg/m^2)	21.35 (7.2)	19.65 (6.9)	**< 0.001**[t]	22.9 (5.6)	22.0 (3.4)	0.735[w]

[t] paired t-test; [w] Wilcoxon test. RCG: group that received RT and CT concomitantly; RG: group that received RT only. Data are expressed as mean (SD)

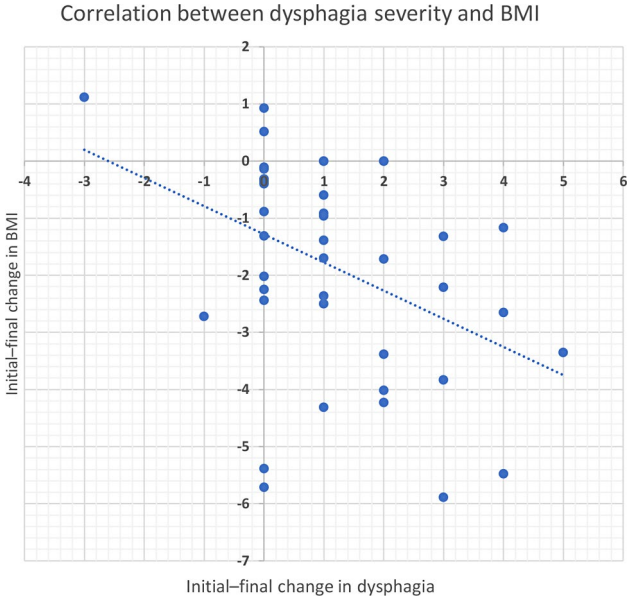

Fig. 2 Scatter diagram of the initial–final changes in dysphagia and BMI for the entire sample (*n* = 47)

in swallowing, pain, weight changes, problems eating socially, dry mouth, sensory problems, thick saliva, and greater use of nutritional supplements ($p < 0.05$). In addition, RG showed changes in the feeling bad domain ($p < 0.05$).

Discussion

Our findings show that dysphagia develops during RT for HNC and confirm our hypothesis that the severity of dysphagia tends to be worse when chemotherapy is instituted concomitantly with RT. To the best of our knowledge, this is the first study to compare the impact of RT alone or in combination with chemotherapy on the development of dysphagia, as well as its association with nutritional impairment and QoL.

When stratifying the sample into RG and RCG, we did not observe significant differences in the variables related to demographic data, habits, pathologies, or the characteristics of the tumor. The homogeneity of the groups in these variables is important because it reduces the possible bias related to the association of these variables with the results obtained. Regarding the characterization of the sample, we observed that more than 80% of the patients were considered smokers or former smokers, in line with the main epidemiological studies that indicate smoking as the main risk factor for HNC [22, 23]. Most patients included in the study had more advanced stages of HNC, which suggests that some would start palliative or neoadjuvant RT. Unlike other studies that investigated the impact of RT and CT, alone or in combination, on the perpetuation of dysphagia for months after treatment for HNC [8, 9, 24], our study aimed to analyze the individual impact of RT alone or with CT on the development of dysphagia during the RT.

To assess the progression of dysphagia, we assessed its severity using the PARD protocol at both study times.

Table 5 Quality of life assessed by QLQ-C30 and H&N-35

Domain	RCG					RG				
	Initial (*n* = 27)	Final (*n* = 27)	Effect Size (Cohen´s d)	CI 95% for mean difference	*p*-value	Initial (*n* = 20)	Final (*n* = 20)	Effect Size (Cohen´s d)	CI 95% for mean difference	*p*-value
QLQ-C30										
Scales										
global health	81.5 (19.1)	71.5 (22.1)	0.5	[-18.06; -1.95]	**0.046**	72.9 (17.3)	70.4 (12.5)	0.1	[-12.13; 7,15]	0.667
Functional	78.3 (15.9)	77.1 (17.7)	0.1	[-5.73; 8.03]	0.146	73.6 (20.1)	64.9 (26.5)	0.3	[-1.97; 19,31]	0.105
Symptoms	24.5 (16.8)	29.5 (13.9)	0.3	[-11.54; 1.56]	0.853	20 (18.1)	29.2 (17.5)	0.4	[-19,82; 1.36]	0.084
Symptoms										
Constipation	12.9 (27.9)	28.2 (35.4)	0.4	[-31.73; 1.16]	0.092	16.7 (31.5)	30.0 (38.8)	0.3	[-33.20;6,5]	0.064
Performance of activities	85.8 (28.0)	77.8 (31.0)	0.3	[-3.18; 19.15]	0.178	75.8 (38.4)	53.3 (43.1)	0.5	[1.73; 43.25]	**0.035**
Diarrhea	10.2 (25.8)	10.2 (25.8)	0.01	[-10.31;10.37]	0.916	15.0 (33.3)	5.0 (12.2)	0.3	[-6.08; 26.08]	0.292
Financial difficulty	40.7 (44.7)	34.6 (41.8)	0.2	[-5.55; 17.64]	0.823	33.3 (40.5)	38.3 (46.2)	0.1	[-21.22; 11.22]	0.527
Dyspnea	7.8 (23.2)	6.7 (16.1)	0.1	[-6.67; 8.83]	0.999	18.3 (33.3)	20 (33.2)	0.1	[-11.10; 7.76]	0.752
Pain	48.2 (33.7)	40.7 (28.6)	0.2	[-7.82; 22.83]	0.476	27.5 (36.8)	25.8 (28.3)	0.01	[-17.26; 20.58]	0.999
Fatigue	24.7 (25.7)	37.9 (23.0)	0.6	[-22.53; -3.83]	**0.011**	25.6 (24.5)	46.1 (36.8)	0.6	[-37.70; -3.40]	**0.033**
Cognitive function	88.3 (22.5)	86.2 (23.2)	0.1	[-8,78; 12.97]	0.969	80.0 (33.6)	77.5 (30.2)	0.1	[-13.36; 18.36]	0.894
Emotional function	58.4 (33.5)	60.9 (31.7)	0.1	[-15.85; 11.01]	0.808	57.5 (36.3)	51.2 (39.3)	0.2	[-10.91; 23.41]	0.522
Physical function	83.3 (13.9)	79.0 (18.2)	0.3	[-2.23; 10.88]	0.242	79.0 (31.3)	68.3 (31.7)	0.4	[-2.07; 23.41]	0.062
Social function	87.8 (27.2)	93.4 (15.4)	0.2	[-17.25; 6.16]	0.504	83.3 (19.5)	82.5 (27.3)	0.01	[-14.65; 16.32]	0.752
Insomnia	30.6 (40.2)	25.7 (35.0)	0.1	[-12.94; 22.67]	0.678	25 (38.8)	25.0 (37.3)	0.01	[-25.80; 25.80]	0.969
Nausea and vomiting	9.5 (22.3)	19.9 (24.5)	0.3	[-23.94; 3.20]	**0.049**	7.5 (23.2)	20.0 (31.8)	0.3	[-32.41; 7.40]	0.141
Loss of appetite	26.5 (34.7)	55.9 (47.0)	0.5	[-52.30; -6.43]	**0.035**	5.0 (22.4)	35.1 (43.7)	0.5	[-55.45; -4.20]	**0.041**
H&N-35										
Tube feeding	22.7 (42.2)	30.6 (46.2)	0.2	[-23.07; 7.36]	0.322	5.0 (22.4)	10.0 (30.8)	0.2	[-15.46; 5.46]	0.999
Change in teeth	19.4 (35.9)	12.1 (23.7)	0.2	[-6.57; 25.22]	0.231	15.8 (34.0)	14.8 (30.7)	0.01	[-20.51; 24.21]	0.915
Low Sexuality	43.7 (46.1)	45.3 (43.1)	0.01	[-21.48; 21.81]	0.999	27.8 (41.6)	35.8 (42.3)	0.1	[-26.44; 15.33	0.671
Dry Mouth	24.3 (37.6)	48.8 (44.6)	0.4	[-46.65; -2.42]	**0.042**	28.3 (41.0)	61.7 (45.1)	0.6	[-60,11; -6.55]	**0.036**
Swallowing	26.4 (27.5)	49.2 (27.1)	0.7	[-36.19; -9,34]	**0.003**	12.5 (16.0)	34.6 (32.1)	0.9	[-34.17; -9.99]	**0.004**
Pain	25.1(26.9)	44.8 (27.7)	0.6	[-31.78; -7.59]	**0.004**	12.5 (18.1)	40.8 (26.5)	1.2	[-39.39; -17.27]	**< 0.001**
Weight Gain	30.6 (46.2)	7.9 (26.7)	0.5	[5.99; 39.37]	**0.015**	35.0 (49.0)	20.0 (41.2)	0.3	[-12.48; 42.48]	**0.049**
Weight Loss	61.4 (48.7)	88.2 (32.0)	0.5	[-47.55; -6.16]	**0.02**	45.0 (51.0)	70.0 (47.1)	0.5	[-50.74; 0.74]	**0.043**
Problem eating socially	13.7 (18.8)	30.0 (21.2)	0.7	[-25.06; -7.41]	**0.002**	7.0 (14.0)	35.5 (31.2)	0.8	[-45.30; -11.71]	**0.002**
Problem with social contact	15.8 (23.1)	12.1 (17.4)	0.1	[-6.99; 14.28]	0.812	10.7 (21.1)	14.7 (19.2)	0.2	[-13.99; 5.99]	0.291
Speech Problems	27.9 (35.6)	27.2 (34.1)	0.01	[-15.00; 16.31]	0.917	36.1 (34.0)	41.5 (37.4)	0.2	[22.53; 9.66]	0.27
Sensory Problems	8.4 (19.2)	38.5 (32.3)	0.9	[-43.76; -16.38]	**< 0.001**	12.5 (26.2)	42.5 (38.8)	0.6	[-52.72; -7.28]	**0.024**
Thick saliva	39.7 (44.4)	83.3 (32.4)	0.9	[-62.17; -25.04]	**< 0.001**	35.0 (42.5)	78.3 (37.9)	0.7	[-70.63; -16.03]	**0.008**
Feeling bad	43.0 (46.1)	26.5 (37.6)	0.3	[-5.25; 38.22]	0.116	11.7 (27.1)	40.0 (42.7)	0.5	[-52.75; -3.91]	**0.039**
Cough	18.2 (28.1)	26.0 (32.5)	0.2	[-25.02; 9.52]	0.116	33.3 (42.3)	43.3 (39.1)	0.3	[-25.26; 5.27]	0.469
Trismus	30.5 (40.3)	35.6 (41.3)	0.1	[-24.08; 13.70]	0.116	11.7 (22.0)	21.7 (40.9)	0.2	[-29.0; 9.0]	0.32
Use of Nutritional Supplement	26.9 (44.4)	76.9 (42.1)	0.8	[24.77–75.05]	**0.016**	15.0 (37.4)	55.0 (51.0)	0.7	[12.0–67.99]	**0.013**
Use of analgesics	80.0 (39.6)	74.6 (42.2)	0.1	[-13.92; 24.63]	0.116	35.0 (49.1)	60.0 (50.3)	0.5	[-50.74; -0.74]	0.073

[w] Wilcoxon test. RCG: group that received concomitant RT and CT; RG: group that received RT only. Data are expressed as mean (SD)

In this way, even if there were patients who manifested some degree of dysphagia in the initial evaluation, it would be possible to evaluate its progression during RT treatment. We observed that patients tended to progress to more severe stages of dysphagia by the end of RT. However, the deterioration was not significant for RG, unlike RCG, suggesting that the combination of CT with the RT protocol is a predictive factor for the severity of the dysphagia during treatment. Because we did not find a significant difference in the worsening of dysphagia severity at the end of RT in the RG patients, our data do not allow us to evaluate aspects related to the perpetuation of dysphagia after RT, as evaluated by Silveira et al. (2015) [24].

Both CT and RT for HNC lead to nutritional deficiency, with a profound impact on the physical conditions of patients, which is strongly implicated in treatment outcomes [25, 26]. Dysphagia caused by the treatment of HNC is believed to be one of the main factors related to the nutritional deficiency that develops during nonsurgical treatment of HNC, as it has a profound impact on the diet of these patients [27–29]. We sought to evaluate the anthropometric changes throughout the treatment used, as well as a possible association between nutritional status and degree of dysphagia. Although all groups showed a reduction in the anthropometric measures evaluated and consequently in the muscle strength measured by dynamometry, the impact was again greater in RCG, where all the evaluated functions were significantly impaired. This was expected because we know that CT induces nutritional impairment due to its classic side effects, such as nausea, anorexia, and diarrhea [30]. We observed an increase in the degree of dysphagia in RCG patients, which may also have contributed to the results observed. Żmijewska-Tomczak et al., also found a greater decrease in the BMI of patients who received chemoradiotherapy compared to patients who received only RT for the treatment of HNC [31]. Cross-sectional studies have shown important anthropometric changes, especially in BMI, at the end of CT for HNC [25, 32]. Importantly, all patients in the present study received nutritional support when supplementation was indicated to minimize the physical deterioration during treatment and included individualized dietary assessments, caloric and protein supplementation as needed, and periodic monitoring by a multidisciplinary team to prevent severe malnutrition. We could have seen even worse results if there had been no nutritional support since it is well known that oral nutritional supplements effectively mitigate weight loss and preserve body composition in HNC patients undergoing chemoradiotherapy [33].

The variation in BMI is one of the main direct indicators of the nutritional status of patients undergoing cancer treatment [34, 35]. Thus, we investigated its association with the degree of severity of dysphagia. We observed a negative correlation between the change in the degree of dysphagia and the change in BMI, meaning that worsening dysphagia was associated with a decrease in BMI. Thus, we can infer that the changes in nutritional status observed in our study may be partly due to swallowing changes triggered by nonsurgical treatment of HNC. Nutritional support during cancer therapy is essential for optimizing treatment response, enhancing quality of life, and improving survival rates [36–38]. In our study, we observed a clear association between dysphagia severity and worsening anthropometric indicators. This highlights the importance of early identification of dysphagia or its risk factors in patients undergoing HNC treatment, enabling the timely implementation of targeted nutritional interventions to mitigate its impact as suggested by Cocuzza et al. (2024) [39]. While this support aimed to mitigate treatment-related physical deterioration, future studies should explore the efficacy of different nutritional interventions in preserving muscle mass, minimizing weight loss, and improving overall treatment tolerance. Further research on optimizing the timing, frequency, and composition of nutritional interventions could help establish more effective clinical guidelines for patients undergoing CT and RT for HNC.

QoL is usually assessed in studies that investigate the consequences of cancer treatment, whether RT, CT, or surgery [34]. We investigated QoL using the QLQ-C30 inventory that assesses the general quality of life of cancer patients, and we evaluated specific aspects of QoL in HNC patients using the H&N-35 module [15]. Although we observed a worsening in most of the domains of the questionnaires in both studied groups, a few specific differences were observed between the groups and deserve to be highlighted. RCG showed worsening of the nausea and vomiting domain, which would be expected due to the side effects of CT. This may be related to the worsening of nutritional status observed in this group. Also, in RCG, we observed worsening global health, reinforcing the impact of combined treatment on the QoL of patients. Most studies investigated QoL in a specific manner after RT for cancer. However, we found studies such as the one by Citak & Tulek (2013), who also evaluated the worsening of QoL during RT treatment using the same instruments in a combined sample of patients undergoing RT with or without chemotherapy for the treatment of HNC. These authors showed results similar to ours, with worsening, especially in the functional and social scales and in the domains of loss of appetite, fatigue, weight loss, dry mouth, and swallowing [40]. These authors also evaluated the QoL at the end of RT with or without chemotherapy and showed a worsening in the QoL scores among the patients after chemoradiotherapy treatment. However, in the latter evaluation,

these authors only showed the score at the end of RT, so it is not possible to assess the degree of deterioration of the domains between the beginning and the end of treatment. Other, larger studies showed worsening in all domains of QoL at the end of RT treatment for HNC but did not distinguish between patients who received only RT or RT + CT [31, 41]. The cross-sectional study by Oliveira Faria et al. (2022) also found QoL results similar to those found in our study at the end of RT and showed that intensive nutritional care can minimize the worsening of the most affected domains [42].

Study limitations

This study has some limitations such as the restricted number of participants due to the difficulty finding patients who were undergoing RT for HNC without concomitant chemotherapy, the lack of information about the nature of the surgical procedure conducted, and regarding nutritional support during the treatment. Another limitation of this study is the use of the Protocol for Risk Assessment for Dysphagia (PARD), which has inherent subjectivity in clinical evaluation, limited sensitivity and specificity, and inability to detect silent aspiration without instrumental assessments which could lead to misclassification of dysphagia severity [17]. Videofluoroscopy, the gold standard for dysphagia evaluation [43], was not available at the institution where this study was conducted, which may have impacted the accuracy of dysphagia assessment.

Future research should address these limitations by using larger sample sizes to improve statistical power and generalizability. Including diverse patient populations with varying dysphagia severity diagnosed by advanced tools, and treatment regimens will offer a more comprehensive understanding of its impact and management. Longitudinal studies with follow-up assessments can help track dysphagia progression and refine rehabilitation strategies. Additionally, evaluating multidisciplinary care-integrating speech therapists, dietitians, oncologists, dentists, and physical therapists could enhance patient outcomes through individualized nutritional and swallowing rehabilitation protocols. Furthermore, future studies could incorporate the collection of patient insights and experiences to complement quantitative assessments, providing a more holistic understanding of the challenges faced by HNC patients. By tackling these aspects, future studies can provide stronger evidence to guide clinical decisions and improve the quality of life for HNC patients.

Conclusion

RT for HNC leads to the early development of dysphagia, with consequent nutritional impairment and lowering of QoL. These parameters become worse when CT is added to RT. This study opens perspectives for the creation of differentiated follow-up protocols, especially involving speech-language pathology and anthropometric monitoring, for patients undergoing combined therapy involving CT and RT.

Abbreviations

RCG	Chemotherapy plus radiotherapy group
RG	Radiotherapy group
HNC	Head and neck cancer
QoL	Quality of life
CT	Chemotherapy
RT	Radiotherapy

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12885-025-13695-y.

Supplementary Material 1

Acknowledgements

The authors thank Aleida Nazareth Soares for supporting the statistical analysis.

Author contributions

MCMFG: Conceptualization, investigation, data curation, formal analysis, writing, and editing of the original draft. PMVF, ACSMA, and JSC: Data curation, methodological supporting, and revision of the original draft. APDL: Conceptualization, formal analysis, Investigation, methodological supporting, project administration, supervision, validation, and revision of the original draft. TJA, AM, MHSN, RBS, RFN, JMBS, PMA and LPM: methodological supporting, project administration and revision of the original draft. BAR: Conceptualization, formal analysis, statistical analysis, investigation, methodological supporting, project administration, supervision, validation and revision of the original draft. All authors read and approved the final manuscript.

Funding

The author ACSMA received a scientific initiation student grant from FELUMA (Fundação Educacional Lucas Machado). There was no other funding source for this project, therefore, the decision to publish and all aspects of this manuscript are the responsibility of the authors alone.

Data availability

The dataset analyzed during the current study is available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This project was approved by the Research Ethics Committee of the School of Medical Sciences of Minas Gerais and the Mario Penna Institute (protocol: CAAE 38381720.5.3001.5121, Opinion: 4.532.121). All study participants signed an informed consent form, after being informed about the project, understanding the terms, and clarifying possible questions about the research. The Helsinki Declaration of 1975, updated in 2013 was followed.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 4 November 2024 / Accepted: 10 February 2025
Published online: 07 March 2025

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