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ORIGINAL ARTICLE

Swallowing Skills and Aspiration Risk Following Treatment of Head and Neck Cancers

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Abstract

Surgical resection and chemoradiation are common modalities of treatment in head and neck cancers. Dysphagia is one of the common complications following these interventions. The severity of dysphagia depends on various factors, site and extent of resection, and radiation therapy to highlight a few. Thirty-five head and neck cancer patients treated with surgical and/or chemoradiation were assessed for parameters of swallowing. Extent of resection was statistically associated with swallowing symptoms phase wise. The results revealed a strong association between the presence of aspiration with resection of the tongue base and radiation therapy ($p < 0.01$). Oral preparatory and oral phase abnormalities were present in all the cases with varying severity especially in cases where the mandible and body of tongue were compromised ($p < 0.05$). These findings provide a specific profile which has high clinical utility.

Keywords Dysphagia · Radiation therapy · Aspiration risk · Surgical resection

Introduction

Swallowing is a complex mechanism which takes place in four stages, namely oral preparatory, oral transit, pharyngeal, and esophageal. Structures actively involved in the act of swallowing include the lips, mandible, tongue, velopharynx, muscle of mastication, and facial expressions. Head and neck cancers are one of the commonest causes of all cancers in India owing to tobacco and pan chewing. Primary treatment modalities in these patients include surgical resection, radiation therapy, and chemotherapy, which may directly or indirectly affect the dysphagia and aspiration-related structures (DARS). Resection of the mandible, body and base of the tongue, and palate leads to anatomical defect, thereby hampering swallowing functions. Acute and late swallowing abnormalities as a result of fibrosis have also been reported in patients who receive chemoradiation therapy due to physiological alterations during swallowing [1]. These anatomical and physiological alterations make patients with head and neck cancers susceptible to a high risk of aspiration and malnutrition. Literature reveals that pattern of swallowing abnormalities depends on the site and extent of resection, and type and nature of reconstruction [2, 3]. However, very few studies have correlated extent of resection with the phase-wise swallowing characteristics. Hence, a need arises to study the specific swallowing problems according to the site and extent of resection.

Objective

The present study aimed at exploring the correlation between the site and extent of resection with the swallowing abnormalities.

Methodology

The present study was prospective, cross-sectional, and observational in nature.

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Participant Details

A total of 35 patients (21 males and 14 females) with head and neck cancer who had undergone surgical and/or radiation therapy intervention were included in the present study. These patients were assessed between 3 and 6 months following the intervention. Age range was between 32 and 66 years.

Details of Primary Intervention

Among the 35 patients, 31 underwent surgical resection of the tumor along with reconstruction while 4 patients underwent radiation therapy alone. Fourteen patients among the 35 underwent radiation therapy at some point in time. The operative notes were reviewed in detail and discussed with the surgeons. The data was classified with respect to site of resection (resection of the jaw, the tongue, and base of the tongue).

Swallowing Assessment

All the patients underwent a detailed swallowing assessment following management (3 to 6 months). Swallowing assessment was done using an instrumental assessment of swallowing. Modified Barium Swallow (MBS) was performed using thin barium, paste barium, and barium-coated cookie. The recordings were reviewed by two speech language pathologists for the presence of swallowing abnormalities. The parameters studied in the present study are listed in Table 1.

Fisher's exact test was administered to examine the association between the independent variables (site and extent of resection) and dependent variables (oral preparatory, oral, and pharyngeal phase abnormalities).

Table 1 Phase-wise swallowing characteristics

Phase	Parameters
Oral preparatory	Drooling
	Mastication
	Reduced bolus formation
Oral transit	Reduced lingua velar contact
	Delayed oral transit
	Post-swallow residue
Pharyngeal phase	Delayed swallow reflex
	Penetration/aspiration
	Pharyngeal residue

Results

The following Table 2 reveals the occurrence of phase-wise swallowing dysfunction among head and neck cancer patients:

Among 35 patients, oral/oral preparatory phase was affected in all the patients with respect to bolus preparation or manipulation. However, signs of abnormal pharyngeal phase were seen in 21 patients (60%) while penetration and/aspiration were observed among 11 patients (31%). It was observed that the oral preparatory phase was most affected by the resection of the mandible while oral transit was directly influenced by resection of the tongue. Pharyngeal phase abnormalities were seen in individuals in complete resection of the tongue (involving the base of the tongue) and in those who have undergone radiation therapy.

Further, the data was subjected to Fisher's exact test in order to establish statistical association between the extents of resection/radiation therapy with the presence of dysphagia symptoms. Table 3 reveals the results of Fisher's test.

Results revealed that resection of the mandible significantly affected mastication, dribbling of food from the oral cavity ($p < 0.01$), and delayed oral transit ($p < 0.05$). Oral preparation and oral transit were significantly affected due to resection of the body of the tongue. The parameters most significantly affected were poor bolus formation, presence of penetration/aspiration ($p < 0.05$), reduced lingua palatal contact, delayed oral transit, and post-swallow residue ($p < 0.01$). Resection of the tongue base significantly affected reduced lingua palatal, delayed swallow reflex, pharyngeal residue and presence of penetration aspiration ($p < 0.05$), and premature spillage ($p < 0.01$). Radiation therapy had strong association with premature spillage, delayed swallow reflex, pharyngeal residue, and presence of aspiration ($p < 0.01$). Among patients who underwent radiation therapy, 7 patients presented with silent aspiration.

Discussions

The present study was aimed at highlighting specific swallowing abnormalities following surgeries of head and neck. A specific phase-wise pattern was observed depending on the site of resection for swallowing functions following oral cancers.

Resection of the mandible influenced oral preparation. Poor mastication, dribbling of food from the oral cavity, and poor oral transit were significantly associated with resection of the mandible. This could be attributed to the fact that loss of mandible and dentition leads to difficulty in chewing. Muscles at the floor of the mouth (geniohyoid and mylohyoid) play an important role in oral transit of bolus which further explains the delay in oral transit due to its resection. Poor bolus preparation and delayed oral transit of bolus have been seen in

Table 2 Occurrence of phase-wise swallowing dysfunction across head and neck cancer patients

Type of surgery		ASM	HG	HM	HGHM	TG	RT
Number of individuals (*n*)		3	7	11	7	3	4
Phase	Parameters						
Oral preparatory	Drooling	100%	14%	100%	100%	–	–
	Mastication	100%	–	100%	100%	–	50%
	Reduced bolus formation	100%	57%	100%	100%	100%	25%
Oral	Reduced lingua-velar contact	–	86%	–	100%	100%	50%
	Post swallow residue	33%	86%	18%	100%	100%	–
	Delayed oral transit	66%	100%	64%	100%	100%	50%
Pharyngeal phase	Delayed swallow reflex	33%	71%	27%	71%	100%	100%
	Penetration/aspiration	–	29%	–	29%	100%	100%
	Pharyngeal residue	33%	14%	–	–	100%	100%

ASM, anterior segmental mandibulectomy; *HGHM*, hemi-glossectomy with hemi-mandibulectomy; *HG*, hemi-glossectomy; *TG*, total glossectomy; *HM*, hemi-mandibulectomy; *RT*, radiation therapy

patients who have undergone anterior floor of the mouth resection especially seen in anterior segmental mandibulectomy [4]. Trismus, poor lip closure, and reduced mastication have been reported following mandibulectomy [5], which is in accordance with the findings of the present study.

Resection of the tongue affected the oral phase significantly. It was observed that the oral phase was evidenced by reduced bolus formation and manipulation in the oral cavity, poor tongue coordination and control, poor lingua velar contact, delayed oral transit, and post-swallow residue. Risk of penetration and aspiration was seen significantly more in patients with resection extending to the base of the tongue (hemiglossectomy and total glossectomy). Son, Choi, and Kim studied swallowing features in 133 operated patients with tongue cancer. Results revealed that tongue control, chewing, and poor oral transit were significantly affected in these cases. Aspiration was seen to be more frequent in cases with hemiglossectomy and total glossectomy [6]. Other abnormalities associated with glossectomy were inadequate tongue movements, delayed oral transit, reduced hyoid elevation, and penetration aspiration [7].

Further, radiation therapy had effects on the oral and pharyngeal stages of swallowing. Delayed swallow reflex, premature spillage of bolus into the airway, pharyngeal residue, and penetration and aspiration were strongly associated as a result of radiation therapy. Premature spillage of bolus in the valleculae and pyriform sinus, reduced swallow reflex, reduced hyolaryngeal elevation, and poor pharyngeal residue have been reported following radiation therapy. It was attributed to muscle fibrosis and reduced contractility of the muscles [8]. Further, the present study also witnessed silent aspiration in 7 patients (50%) of 14 patients who had undergone radiation therapy which is supported by studies [7, 9, 10]. Reduced sensations and poor cough reflex have been contributed for this factor in irradiated patients leading to silent aspirations.

Table 3 Results of Fisher's exact test revealing association between site and extent of resection and radiation therapy with swallowing dysfunction

	Resection of the mandible	Resection of the body of the tongue	Resection extending to the base of the tongue	Radiation therapy
Mastication	0.00**	0.10	0.15	0.43
Drooling	0.00**	0.33	0.43	0.48
Reduced Bolus formation	0.36	0.02*	0.29	0.36
Reduced lingua–velar contact	0.24	0.00**	0.01*	0.43
Delayed oral transit	0.01*	0.00**	0.25	0.10
Post-swallow residue	0.26	0.00**	0.08	0.71
Delayed swallow reflex	1.00	0.73	0.01*	0.00**
Pharyngeal residue	0.41	0.3	0.01*	0.00**
Penetration/aspiration	0.32	0.03*	0.01*	0.00**

*Significant at $p < 0.05$, **significant at $p < 0.01$

Conclusions

The study highlighted on the pattern of swallowing abnormalities typically seen following treatment of head and neck cancers. Oral preparation was influenced by resection of the mandible and body of the tongue while oral transit is affected in cases where the body of the tongue was resected. Pharyngeal phase abnormalities are typically seen in patients whose resection extended until the base of the tongue. Risk of penetration and aspiration increased with resection of tongue base and radiation therapy. It was also noticed that silent aspiration was frequent following radiation therapy, which further emphasizes the role of instrumental assessment in these cases.

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