Assessment of Swallowing Function in Patients with Head and Neck Cancer

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Difficulty in swallowing is a common complaint among patients with head and neck cancer. Preexistent dysphagia is often compounded by any of the side effects and sequelae of the current treatment modalities for malignancies of the head and neck. Surgery, radiotherapy, and chemoradiotherapy produce sensory and motor denervation and fibrosis of the upper aerodigestive tract musculature and mucosa. Clinicians must learn to anticipate and identify the various deficits of swallowing function in these patients. Flexible fiberoptic evaluation of swallowing and the modified barium swallow are critical tests for delineating the pathophysiology of these patients and establishing a protocol for their rehabilitation. Rehabilitation for patients with swallowing disorders decreases the morbidity of aspiration and allows for better nutrition, better hydration, and overall improvement in quality of life.

Introduction

Difficulty in swallowing, called dysphagia, is common among patients with cancer of the upper aerodigestive tract. More than two thirds of these patients present with dysphagia at the time of their diagnosis, and dysphagia may be the only presenting symptom in patients with cancer of the oropharynx, hypopharynx, or esophagus. In these patients, the degree of swallowing dysfunction is often heralded by a history of weight loss or recurrent pneumonia. Causes of dysphagia in patients with cancer of the head and neck include mechanical obstruction, interference with neuromuscular function, motor and sensory deficits, and discoordination. In addition to preexistent dysphagia, some form of swallowing dysfunction is expected as a side effect or sequela of the current modalities of treatment. Surgery, radiotherapy, and chemoradiotherapy produce sensory deficits, fibrosis of the musculature and mucosa of the upper aerodigestive tract, and deconditioning of the patient. These effects occur proportionally to the extent and intensity of the treatment.

Nonsurgical treatments such as chemotherapy and radiotherapy result in acute mucositis, often requiring nutritional supplementation via tube feeding. Al-Othman *et al.* [1] reported on 934 patients receiving definitive radiotherapy for head and neck cancer. In their experience, 22.5% of patients received feeding tubes due to nutritional problems resulting from acute radiation toxicity. The majority of these patients eventually had their feeding tubes removed; however, feeding tubes had to be replaced at a later date in 2.5% of patients. Another 2% required a feeding tube when late effects of radiotherapy induced swallowing dysfunction. Although these authors did not relate permanent swallowing dysfunction to the presence or need for a feeding tube during treatment, belief is growing that replacement of all oral intake with a feeding tube worsens the swallowing function because of the formation of synechiae or stricture at the level of the pharynx.

Some studies have specifically addressed quality of life (QOL) issues as they pertain to swallowing dysfunction after treatment for head and neck malignancy. Angelis *et al.* [2•] reported their experience with patients receiving chemoradiotherapy in organ preservation protocols. They found that, among 19 patients who were free of disease for 6 months or longer after surgery, 74% required a feeding tube at some point during their treatment. Furthermore, approximately 30% of patients remained dependent on a feeding tube for their nutritional requirements. In 14 patients who underwent videofluoroscopy (modified barium swallow [MBS]), abnormalities with propulsion of the bolus were identified in the oral cavity (93%), oropharynx (93%), and hypopharynx (86%). These findings clearly suggest that chemoradiotherapy results in generalized swallowing dysfunction. Despite abnormal swallowing, 21% of those tested had "functional" swallowing, mild dysphagia was present in 50%, moderate dysphagia was present in 14%, and severe dysphagia was noted in 14%.

Graner *et al.* [3] reported that the majority of patients receiving intra-arterial chemoradiotherapy in their study demonstrated significantly worse swallowing function after treatment. Patients were evaluated with a videofluoroscopic study, a functional swallow measure, and a QOL questionnaire. The authors reported that 73% of the patients experienced a decline in their swallowing function during and after treatment. Although pretreatment video-

fluoroscopic analysis revealed that 82% of patients had preexistent swallowing problems, analysis after treatment revealed an increased frequency of the abnormal events. Although the reported change in QOL before and after treatment was not statistically significant, this degradation in swallowing function should be addressed in counseling and presented as a likely result of proper treatment.

One common symptom after irradiation of the head and neck is xerostomia. Multiple agents, such as artificial saliva or pilocarpine, are commercially available to circumvent this effect and thus improve swallowing function and general patient comfort. Logemann *et al.* [4••] reported their experience with 30 patients who had received chemoradiotherapy for head and neck cancer. The swallowing function of the patients was evaluated with videofluoroscopic studies, measurement of salivary production, and questionnaires to determine self-wellness perception and the nature of their diet. Although decreased salivary production was noted, it did not correlate statistically with bolus transit times when analyzed with videofluoroscopic studies. However, decreased salivary production was clearly correlated with perceptions of swallowing dysfunction and thus with eventual choice of diet. One sobering fact is that xerostomia did not improve with time and was associated with alterations in the taste of food, although diets had a tendency to normalize nonetheless.

Surgical treatment of head and neck cancer also causes swallowing dysfunction. This dysfunction can involve acute swallowing changes resulting from pain, edema, swelling, or inflammation; or chronic changes, such as denervation, atrophy, scarring, and deconditioning. Endoscopic surgical resection of laryngeal and oropharyngeal tumors has been proposed to decrease surgical morbidity and thus improve outcomes. Jepsen *et al.* [5] reported on patients who underwent transoral laser resection of laryngeal cancers. In their experience, patients treated for cancer of the supraglottic larynx had a tendency to experience more dysphagia than those treated for glottic lesions. One confounding factor was that the majority (76%) of patients received postoperative radiotherapy, which may have contributed to the dysphagia. Patients receiving postoperative radiotherapy reported more severe swallowing dysfunction than those who did not. Sample size, however, was too small to ascertain statistical significance. Whether patients are treated with transcervical surgery, transendoscopic surgery, or radiotherapy, it appears that some degree of swallowing dysfunction will ensue.

Some of the most debilitated patients are those undergoing resection and postoperative radiotherapy for extensive oropharyngeal cancers. Skoner *et al.* [6] reported on 20 patients with oropharyngeal malignancy who underwent primary surgery, free flap reconstruction, and postoperative radiotherapy. The swallowing outcome of these patients was poor; only 68% of those who were able to swallow preoperatively could maintain their nutrition orally prior to radiation. Four months after radiotherapy, only 50% took their complete diet orally, 30% needed tube feeding to complement their oral intake, and 20% were completely dependent on the tube.

Reconstructive techniques also have an impact on the postoperative swallowing function. A recent study by Kimata *et al.* [7•] analyzed the relationship between the shape of reconstructed tongue defects and the resulting swallowing function. In 30 patients surviving longer than 6 months after subtotal or total glossectomy with microvascular reconstruction, the authors found that greater bulk resulting in protuberant flaps provided better swallowing than flat or concave reconstruction. In addition, preservation of at least one hypoglossal nerve with subtotal glossectomy was correlated with better swallowing outcomes.

Proper identification of swallowing dysfunction allows caregivers to anticipate feeding difficulties and nutritional deficiencies and thus to formulate an appropriate plan for therapy. An understanding of which instruments and resources are available to assist in the evaluation and treatment of swallowing dysfunction is therefore critical.

Evaluation

An approach based on the phases of swallowing is useful to reach a prompt and accurate diagnosis. The swallowing apparatus can be visualized as a hydrodynamic system in which the bolus of food is transferred through a series of in-line chambers that are separated by valves (*ie*, sphincters) at the entry and exit points. Its proximal portion is shared with the respiratory system, which, by means of another valve, is completely isolated at the time of swallowing. The bolus is contained within each chamber by the entry and exit valves until the next chamber in line is ready to receive it, at which time the bolus is transferred forward. Thus, problems can be categorized as involving transfer (*ie*, propulsion), valving ("leaky" or "too tight"), coordination of any of these events, or a combination.

Oral dysphagia

The lips and the apposition of the base of the tongue and soft palate (velum) separate the oral cavity from the atmosphere and the pharynx, respectively, serving as the entry and exit valves. Functional lips, base of tongue and palate, adequate salivation, dentition, an intact hard palate, adequate tongue mobility, strength, and bulk are necessary for the preparation and propulsion of the food bolus during the oral-preparatory and oral phases of swallowing.

Assessment begins with a thorough examination of the oral cavity for masses, deficits of tongue strength, range of motion, status of the gingivobuccal and linguomandibular sulci, neurologic deficits, and salivation. Tumors of the tongue or oral cavity can cause pain, mechanical tethering, or obstruction. Neurologic deficits of the lingual nerve result in loss of sensation, whereas hypoglossal nerve dysfunction results in motor dysfunction. Both deficits can cause a problem with the preparation and transfer of the

bolus. A facial paralysis produces an incontinent oral sphincter and drooling. These symptoms can be exacerbated by a deficit of the mental nerve (sensory). Loss of function or bulk of the velum or both can cause early spillage of the bolus into the pharynx, increasing the risk of aspiration. Xerostomia causes difficulty in the preparation of the bolus and its transfer.

Pharyngeal dysphagia

During the pharyngeal phase, the respiratory tract is isolated from the swallowing tract by the sphincteric action of the true and false vocal folds, the aryepiglottic folds, and the inversion of the epiglottis. In addition, the superior and anterior excursion of the larynx, mediated by the contraction of the suprahyoid muscles, brings the larynx to a "protected" position beneath the base of the tongue, dilates the pharynx, and opens the upper esophageal sphincter (exit valve). The nasal cavity is isolated by the closure of the velopalatine sphincter.

Physical examination provides an idea of the adequacy of the velopalatine sphincter and pharyngeal contraction, which are essential for the pharyngeal phase of swallowing. Examination of cranial nerves IX and X determines palatal elevation and pharyngeal sensation. Physical examination may identify the presence of compressive or obstructive masses, deep muscle fixation or fibrosis of the tongue base, or surgical changes that may interfere with the transfer of the bolus. Tumors that invade the suprahyoid muscles, the preepiglottic space, or the prevertebral fascia may inhibit the normal elevation and anterior excursion of the laryngotracheal complex, possibly leading to discoordination, poor propulsion, and decreased opening of the upper esophageal sphincter, and thus resulting in aspiration. Similarly, radiotherapy causes xerostomia, cranial neuropathies, and fibrosis, all of which promote dysphagia.

Flexible fiberoptic nasopharyngolaryngoscopy is used routinely to evaluate the laryngopharynx for the presence of tumors, absence of protective reflexes, pooling of secretions, and status of laryngeal function. Laryngeal abnormalities, such as vocal cord paralysis, superior laryngeal nerve deficits, or tumors, may result in laryngeal penetration and aspiration of the bolus, especially with liquids. Visual examination alone, however, does not provide a qualitative analysis of swallowing function. Challenges with colored boluses of liquids, semisolids, and solids under direct fiberoptic observation, known as flexible endoscopic evaluation of swallowing (FEES), provides a qualitative evaluation of the swallowing pattern. FEES is typically performed and evaluated by a team consisting of a speech pathologist and an otolaryngologist. During FEES, the patient is initially examined for anatomic or functional baseline abnormalities. Next, the patient is given a trial of a colored bolus to determine swallowing function, including aspiration, laryngeal penetration, pooling of secretions, and so forth. This test is then repeated with boluses of different consistencies and volumes. Therapeutic exercises and maneuvers are performed during the test to ascertain their impact on the swallowing dysfunction.

In a recent review, Hiss and Postma [8] eloquently discussed the evolution of FEES and cited several landmark studies establishing FEES as an adequate test of swallowing function. Compared with MBS, FEES was as sensitive or superior in detecting laryngeal penetration, aspiration, swallowing residue, and pharyngeal pooling in patients with cancer of the head and neck.

Flexible endoscopic evaluation of swallowing with sensory testing (FEEST) involves the application of a controlled burst of air onto the different areas of the supraglottis to ascertain the presence of the laryngeal adductor reflex. Cohen *et al.* [9] reported the results of 349 FEEST examinations. Patients undergoing a FEEST did not require any special sedation and avoided radiation exposure. FEEST can be performed safely in an outpatient setting. The only significant morbidity was epistaxis in 1% of the patients.

Aviv [10••] reported on a prospective, randomized trial of 126 patients assigned to FEES or MBS that was unable to demonstrate an advantage of either technique in predicting aspiration pneumonia in patients with dysphagia. The author noted that, whereas MBS evaluates the entire upper digestive system, its periodic nature can lead to missed aspiration, pooling, or discrete mucosal masses. Based on these results, the author concluded that FEES seems to be an adequate test for evaluation of the pharyngeal phase of swallowing. FEES and FEEST clearly have the advantage of patient convenience and do not involve any radiation exposure. However, a large number of patients still require an MBS for evaluation of their propulsive mechanism, velopalatine closure, and upper esophageal sphincter function.

Esophageal dysphagia

Rigid panendoscopy has been the standard mode of evaluation for the cervical esophagus in patients with head and neck malignancies. Under anesthesia, it facilitates painless biopsy, surveying of tumor extent, and ascertaining the absence of second primary tumors. Transnasal fiberoptic esophagoscopy can be used safely in the outpatient setting to evaluate the hypopharynx and esophagus. This procedure is better tolerated without sedation than the traditional flexible fiberoptic esophagoscopy because the diameter of the scope is much smaller. Postma *et al.* [11] described the use of transnasal fiberoptic esophagoscopy without sedation in the outpatient office setting. Esophageal dilation, replacement of tracheoesophageal prostheses, and biopsy can be performed under visualization. Imaging that involves the swallowing of contrast agents helps to elucidate abnormalities of the cervical and thoracic esophagus not otherwise detected by physical examination or fiberoptic endoscopy.

Conclusions

Swallowing dysfunction in patients with head and neck cancer may be preexistent or result from treatment of head and neck malignancies. Although organ preservation protocols have been emphasized, these approaches often result in considerable swallowing morbidity. We must take into account the competing interests of swallowing and the voice in our recommendations of treatment for patients with head and neck cancer. Precise identification and assessment of the dysfunction is helpful in the management and counseling of these patients. Fiberoptic technology has facilitated office evaluation of swallowing dysfunction.

References and Recommended Reading

Papers of particular interest, published recently, have been highlighted as:

- • Of importance
- •• Of major importance

1. Al-Othman MOF, Amdur RJ, Morris CG, *et al.*: **Does feeding tube placement predict for long-term swallowing disability after radiotherapy for head and neck cancer?** *Head Neck* 2003, **25:**741–747.
2. • Angelis EC, Feher O, Barros AP, *et al.*: **Voice and swallowing in patients enrolled in a larynx preservation trial.** *Arch Otolaryngol Head Neck Surg* 2003, **129:**733–738.

This article presents the authors' experience with a small cohort of patients undergoing an organ preservation chemoradiotherapy protocol for cancer of the larynx. It demonstrates the significant morbidity of chemoradiotherapy with respect to swallowing and illustrates the pathophysiology of the swallowing dysfunction.

3. Graner DE, Foote RL, Kasperbauer JL, *et al.*: **Swallow function in patients before and after intra-arterial chemoradiation.** *Laryngoscope* 2003, **113:**573–579.
4. •• Logemann JA, Pauloski BR, Rademaker AW, *et al.*: **Xerostomia: 12 month changes in saliva production and its relationship to perception and performance of swallow function, oral intake, and diet after chemoradiation.** *Head Neck* 2003, **25:**432–437.

This well-designed study demonstrates the deleterious effects of chemoradiotherapy over salivary function. The negative implications of xerostomia for swallowing and quality of life are well illustrated.

5. Jepsen MC, Gurushanthaiah D, Roy N, *et al.*: **Voice, speech, and swallowing outcomes in laser-treated laryngeal cancer.** *Laryngoscope* 2003, **113:**923–928.
6. Skoner JM, Anderson PE, Cohen JI, *et al.*: **Swallowing function and tracheotomy dependence after combined-modality treatment including free tissue transfer for advanced-stage oropharyngeal cancer.** *Laryngoscope* 2003, **113:**1294–1298.
7. • Kimata Y, Sakuraba M, Hishinuma S, *et al.*: **Analysis of the relations between the shape of the reconstructed tongue and postoperative functions after subtotal or total glossectomy.** *Laryngoscope* 2003, **113:**905–909.

This article shows how the reconstructive technique after glossectomy influences the swallowing function. Surgeons should consider swallowing function as one of the goals for reconstruction during surgery for cancer of the head and neck.

8. Hiss SG, Postma GN: **Fiberoptic endoscopic evaluation of swallowing.** *Laryngoscope* 2003, **113:**1386–1393.
9. Cohen MA, Setzen M, Perlman PW, *et al.*: **The safety of flexible endoscopic evaluation of swallowing with sensory testing in an outpatient otolaryngology setting.** *Laryngoscope* 2003, **113:**21–24.
10. •• Aviv JE: **Prospective, randomized outcome study of endoscopy versus modified barium swallow in patients with dysphagia.** *Laryngoscope* 2000, **110:**563–574.

This article validates the efficacy of FEES for evaluation of the pharyngeal phase of swallowing. It should be remembered, however, that some aspects of the swallow, like the function of the upper esophageal sphincter, the patency of the hypopharyngeal lumen, the coordination of all pharyngeal events, and the degree and distal level of the aspiration, are better delineated by MBS.

11. Postma GN, Bach KK, Belafsky PC, *et al.*: **The role of transnasal esophagoscopy in head and neck oncology.** *Laryngoscope* 2002, **112:**2242–2243.