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Dysphagia in Head and Neck Cancer Patients Treated With Radiation: Assessment, Sequelae, and Rehabilitation

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Dysphagia is commonly seen in patients undergoing radiation-based therapy for locally advanced squamous carcinoma of the head and neck. Within 4 to 5 weeks of starting therapy, patients develop mucositis, radiation dermatitis, and edema of the soft tissues. Resulting pain, copious mucous production, xerostomia, and tissue swelling contribute to acute dysphagia. As the acute effects resolve, late effects including fibrosis, lymphedema, and damage to neural structures become manifest. Both acute and late effects result in adverse sequelae including aspiration, feeding tube dependence, and nutritional deficiencies. Early referral for evaluation by speech-language pathologists is critical to (1) ensure adequate assessment of swallow function, (2) determine whether further testing is needed to diagnose or treat the swallowing disorder, (3) generate a treatment plan that includes patient education and swallow therapy, (4) work with dieticians to ensure adequate and safe nutrition, and (5) identify patients with clinically significant aspiration.
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With the increasing use of aggressive combined modality therapy and altered radiation techniques for the treatment of locally advanced head and neck cancer (HNC), the acute and late effects of treatment have become an area of intensive interest and investigation. One problem that has garnered attention is dysphagia associated with radiation-based function-sparing techniques. Radiation oncologists and medical oncologists treating HNC must be familiar with the basics of normal swallowing, the underlying mechanism by which radiation induces acute and late effect dysphagia, how swallowing is affected by treatment, the consequence of dysphagia, and the role of swallowing therapy in the prevention and treatment of dysphagia.

Normal Swallowing Function

Swallowing is a complex process that requires the precise coordination of over 25 pairs of muscles in the oral cavity, pharynx, larynx, and esophagus.[1] Neural control of swallowing, which has both voluntary and involuntary components, is mediated by interactions between cortical centers in both hemispheres, the "swallowing center" within the brainstem, cranial nerves (V, VII, IX sensory, IX motor, X and XII), and pharyngeal receptors (touch, pressure, chemical stimulus, and water).[2] The normal swallow (Table 1) is usually divided into 4 phases: oral preparation, oral, pharyngeal, and esophageal.[2] During the oral preparatory phase of swallowing, food is ground and mixed with saliva to form a food bolus. The bolus is then transported to the pharynx during the oral phase. During the pharyngeal phase, the swallowing reflex is triggered, resulting in (1) closure of the larynx to prevent aspiration; (2) contraction of the pharyngeal constrictors from superior to inferior; (3) laryngeal elevation, epiglottic inversion; and (4) relaxation of the cricopharyngeus to allow the food bolus to pass into the esophagus.[3,4] During the final phase, the peristalsis of the esophageal muscles results in movement of the bolus into the stomach. Disruption in any of these functions can result in dysphagia.

Swallowing Assessment

Swallowing assessment and therapy should be undertaken by certified speech-language pathologists (SLPs). SLPs should be considered an integral part of the treatment team for all patients with HNC.[5] SLP should be consulted early in treatment planning whenever possible and should provide routine follow-up so that they can intervene when necessary. The SLP will perform a clinical evaluation of swallowing.[6] As a part of the clinical evaluation of swallowing, the SLP will

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Table 1 Phases of normal swallowing[2-4,59]

Oral preparatory phase:
- Teeth, lips, cheeks, tongue, mandible, and palate grind and manipulate food
- Food mixed with saliva
- Formation of a food bolus consistency appropriate for safe swallow

Oral phase: (duration approximately 1 second)
- Lips and cheeks contract
- Tongue presses the food bolus against the hard palate and soft palate elevates
- Food bolus is moved backwards by the tongue
- A central groove is formed in the tongue for passage of bolus
- Bolus is moved to the tonsillar pillars, thus initiating the oral phase of swallowing
- The soft palate moves superior and posterior to close off nasopharynx

Pharyngeal phase: (duration approximately 1 second)
- Piston-like action of tongue to propel food posteriorly
- Closure of the larynx to the level of the true and false vocal cords
- Retroversion of the epiglottis over the laryngeal vestibule
- Closure of the laryngeal vestibule
- Elevation of the larynx under the tongue base
- Contraction of the pharyngeal constrictors
- Relaxation of the cricopharyngeal muscles
- Opening of the cricopharyngeal sphincter by upward and forward movement of the larynx

Esophageal phase: (duration approximately 3 to 4 seconds)
- Peristaltic contractions of musculature results in movement of the bolus into the stomach

(1) assess swallow function to determine whether there are any swallowing abnormalities present, (2) determine whether further testing is needed to diagnose or treat the swallowing disorder, (3) generate a treatment plan that includes patient education and swallow therapy, (4) work with dieticians to ensure adequate and safe nutrition, and (5) identify patients with significant aspiration risk.

Although referral for swallow assessment should be a part of the routine care and treatment of HNC patients, the treating physician should be aware of signs and symptoms that suggest clinically significant aspiration. "Trigger symptoms" that herald dysphagia are listed in Table 2.[5,7] Of particular concern are symptoms that indicate potential aspiration, including coughing or clearing the throat before, during, or after eating. Should patients develop any of these symptoms, an immediate referral for assessment by an SLP should be considered.

There are a number of instrumental methods for assessing swallowing function. The most commonly used method is the modified barium swallow study (MBSS).[8] The MBSS is a videofluoroscopic examination that allows evaluation of the oral and pharyngeal function. The purpose of the study was to identify disorders that impair swallowing, identify aspiration and the risk for pneumonia, and judge the patients' ability to maintain nutrition and hydration. Standardized protocols have been established that test swallowing capacity using contrast containing food boluses of varying sizes and consistencies, thus allowing the SLP to make dietary recommendations for patients with swallowing impairment. If abnormalities are identified, various compensatory measures (postural techniques, increased sensory input, and voluntary swallowing maneuvers) can be assessed for efficacy.

A second commonly used tool to assess swallowing is the flexible endoscopic evaluation of swallowing safety (FEES). FEES allows direct visualization of the nasopharynx, base of tongue, hypopharynx, larynx, and vocal folds.[9] Important aspects of function can be assessed including management of secretions, sensory deficits, and muscular function of the pharyngeal constrictors. Of particular importance, FEES allow direct visualization of the larynx with identification of premature spillage, pooling, laryngeal penetration, aspiration, and laryngopharyngeal reflux.[10] The study procedure is safe and can be done at the patient bedside if needed.[9] FEES does not assess the oral cavity and opening of the upper esophageal sphincter. Thus, many clinicians believe that the MBSS and the FEES provide complementary information.

Mechanism of Radiation-Induced Dysphagia

It has long been recognized that HNC and its treatment result in alterations in swallowing functioning. The cause of dysphagia for patients undergoing resection is evident. Tissue loss because of surgical excision, transection of muscles and nerves, and resulting scar and loss of sensation result in marked alteration in the functioning of tissues vital for normal swallowing. Data from the surgical literature indicate that the extent of dysphagia correlates with the site of primary,[11] the size of the tumor,[12] the extent of surgical resection,[13] and the type of reconstruction.[14]

Radiation therapy may also result in significant acute and late effect dysphagia, but the etiology of the underlying tissue damage differs. Acutely, radiation therapy results in damage to the mucosa and soft tissue within the radiation treatment volume.[15] This results in an inflammatory reaction and the production of reactive oxygen species.[16] Clinically, the pa-

Table 2 Triggers for dysphagia evaluation[5,7]

- Inability to control food, liquids, or saliva in the oral cavity
- Pocketing of food in cheek
- Excessive chewing
- Drooling
- Coughing, choking, or throat clearing before, during, or after swallowing
- Abnormal vocal quality after swallowing; "wet" or "gurgly" voice
- Buildup or congestion after a meal
- Complaint of difficulty swallowing
- Complaint of food "sticking" in throat
- Nasal regurgitation
- Weight loss

Table 3 Common swallowing abnormalities because of radiation therapy

Abnormalities in the oral preparatory and oral pharyngeal phase:
• Limitations in lip closure
• Results in drooling
• Loss of cheek muscles
• Results in pocketing of food in cheek
• Trismus
• Impacts oral opening and bite range
• Tongue weakness or decreased tongue elevation and lateralization
• Limits positioning of the food bolus
• Spillage of bolus into valleculae and pyriform sinuses
• Increase oral transit time and number of swallows
• Decreased sensory input
• Delayed swallow initiation
Abnormalities in the pharyngeal phase:
• Epiglottis edema, decreased motion. and inversion
• May result in risk of aspiration
• Decreased tongue base retraction
• May result in risk of aspiration
• Decreased contraction of pharyngeal constrictors Pauloski BA, Logemann JL: Impact of tongue base and posterior pharyngeal wall biomechanics on pharyngeal clearance in irradiated post-surgical oral and oropharyngeal cancer patients. Head Neck 2000: 22(2):120-131.
• Affects transport of bolus through the pharynx
• Affects clearance from the pharynx
• Decreased laryngeal elevation
• Increased risk of laryngeal penetration/aspiration
• Decreased anterior movement of larynx:
• Decreases cricopharyngeal opening which results in increase pharyngeal residue

tients develop mucositis, radiation dermatitis, and edema of the soft tissues. Pain, thickened and more viscous mucous production, xerostomia, and tissue swelling contribute to acute dysphagia.[17] By 3 months after treatment, clinical acute effects have largely resolved, and swallowing function begins to return for most patients. Nonetheless, a "continuing cascade of cytokines" results in ongoing effects on tissue secondary to radiation. Tissues become fibrotic and rigid with resultant loss of function. It is hypothesized that ongoing hypoxia and chronic oxidative stress may perpetuate tissue damage long after treatment has been completed,[18,19] thus explaining why some patients develop dysphagia years after therapy has been completed. Late-effect lymphedema and radiation-induced damage to neural structures may also contribute to dysphagia.

Swallowing Abnormalities Secondary to Radiation Therapy

HNC patients often present with swallowing abnormalities[20,21] Thus, prospective studies are needed to distinguish the effect of tumor versus treatment on the incidence and severity of late-effect dysphagia. Most studies evaluating late-effect dysphagia will begin assessments at 3 months after treatment when the acute effects of treatment have resolved. As noted earlier, many of the abnormalities identified on MBS and FEES are secondary to decreased compliance and contractility of soft tissues and muscles because of fibrosis and lymphedema. Muscle weakness because of atrophy and loss of sensation may also contribute to swallowing abnormalities. Table 3 lists commonly identified abnormalities in swallowing function in patients treated with radiation therapy–based treatment regimens. The type of swallowing abnormality correlates with the primary site with lower oropharyngeal swallow efficiency (OPSE) scores for patients with oropharyngeal, hypopharyngeal, and laryngeal tumors.[22] It is beyond the scope of this review to discuss these abnormalities in detail, but the reader is referred to the article by Mittal et al[23] for an in-depth discuss of this topic (Table 4).

An important but less commonly discussed manifestation of late-effect dysphagia is stricture formation. Lee et al[24] reported the results of a retrospective study of 199 patients treated with chemoradiation. Of 82 patients who underwent swallowing evaluation, 41 patients were found to have a stric-

Table 4 Examples of exercises and maneuvers for dysphagia therapy

Mendelsohn maneuver	Voluntary prolongation of laryngeal excursion and cricopharyngeal opening during swallowing Participants initiate the swallow and "hold" the larynx in the elevated position for 5 seconds, using the muscles of the neck
Shaker exercises	Targets upper esophageal sphincter dysphagia Patients lie flat on their back and lift the head 4 inches and look at their toes without lifting the shoulders Extended or repetitive format
Effortful swallow	Targets reduced pharyngeal peristalsis with residue after swallow Participant swallows hard, squeezing the tongue and walls of the throat together
Supraglottic swallow	Targets decreased airway protection, aspiration by increasing airway protection with closure of true vocal folds, dispels residue above the glottis after the swallow
Compensatory positions	Chin tuck/chin to chest: help with reduced bolus control, premature spillage into larynx, decreased tongue base movement Head rotation to affected side: compensatory measure for unilateral pharyngeal paresis or unilateral vocal fold dysfunction or cricopharyngeal dysmotility
Oral stage exercises	Includes lip closure, lingual and jaw ROM
Base of tongue exercises	Includes tongue retraction, yawn/gargle, Masako

ture (21% of total). Predictors for stricture formation included twice-per-day radiation, female sex, and hypopharyngeal primary. All 41 patients underwent dilation for treatment (16 patients: 1 dilation procedure, 17 patients: 2 procedures, and 8 patients: 3 or more). The efficacy of the dilations was not reported. An interesting side note to this study is the fact that more than half of strictures occurred below the area that received high-dose radiation. The authors hypothesize that decreased swallowing may result in increased fibrosis.

Risk Factors for Postradiation Swallowing Abnormalities

Several risk factors have been identified for the development of swallowing abnormalities secondary to radiation-based treatment. The structures within the radiation port and radiation techniques appear to influence late effects. Eisbruch et al[25] have identified "dysphagia/aspiration-related structures" (DARSs). DARSs are anatomic structures that when damaged by radiation therapy result in dysphagia and aspiration. They have shown that the use of IMRT can minimize radiation to these structures. Furthermore, they showed that minimizing radiation to select DARS may result in improved swallowing outcomes.[26] Similarly, Fua et al[27] showed that patients treated with IMRT fields junctioned with an anterior neck field with central shielding for nasopharyngeal carcinoma had significantly less grade 3 dysphagia and reduced length of feeding tube placement.

It may be hypothesized that increased acute inflammation may increase late-effect fibrosis and lymphedema resulting in increased dysphagia. Acute tissue damage heals in 2 distinct phases: a regenerative phase and a fibrosis phase. During the regenerative phase, tissues repair and are replaced by similar cell types. During the fibrotic phase, the normal cells are replaced by connective tissue.[28] It may be hypothesized that when the acute reaction is protracted or over exuberant, the repair process transitions from being beneficial to becoming harmful. The use of chemotherapy concurrently with radiation therapy clearly increases the rate of grade 3 and 4 mucositis.[29] Does the increase in acute mucositis result in increased fibrosis and late-effect dysphagia? Clinical experience would support this hypothesis; however, well-conducted studies to prove this are lacking.[18] One study comparing concurrent regimens found no difference in swallowing function.[22]

An additional factor that may contribute to acute and late swallowing abnormalities is the use of feeding tubes. There is considerable variability in practice patterns regarding the use of feeding tubes. Some clinicians place a prophylactic feeding tube in all patients undergoing treatment for locally advanced disease. Data would support the fact that patients who undergo tube placement prophylactically experience less weight loss.[30,31] Thus, some clinicians argue for the use of prophylactic feeding tube placement in all patients with locally advanced disease who are undergoing aggressive combined modality treatment regimens. Others argue that the placement of a feeding tube leads to decreased use of muscles of mastication and swallowing with resultant atrophy.[18,32] Furthermore, patients undergoing aggressive chemoradiation regimens experience profound muscle loss, which not only contributes to generalized debility but may also contribute to the deterioration in swallow function.[33] Data clarifying this relationship are needed.

Several other risk factors should be considered. Adequate lubrication is critical for normal swallowing function. Xerostomia secondary to chemotherapy, radiation, or medications may significantly affect food bolus formation and swallowing function and contribute to dysphagia.[34] Patients undergoing neck dissection after organ-preservation strategies have been shown to have an increase in percutaneous endoscopic gastrostomy (PEG) tube dependence.[35] Patients with a tracheostomy tube may experience increased difficulty with swallowing. Finally, genetic predisposition may explain differences in the observed late effects on a patient-by-patient basis.

Complications of Dysphagia

There are several important sequelae to oropharyngeal dysfunction. One of the most recognized is aspiration. Breathing and swallowing are physiologically linked events. They are timed in such a way as to ensure that the airway is protected during pharyngeal swallowing. Disordered swallowing may result in aspiration, pneumonia, and chronic bronchial inflammation. Aspiration is defined as the passage of materials below the true vocal cord. Aspiration may occur at different phases of swallowing: (1) before the pharyngeal phase because of the loss of control of the tongue or delayed reflexive swallowing, (2) during the pharyngeal phase because of inadequate airway closure, and (3) after the pharyngeal phase because of retained materials in the pharynx.[36] Aspiration usually manifests itself by cough or clearing of the throat before, during, or after swallowing.

Unfortunately, silent aspiration is frequent in irradiated HNC patients.[37] Furthermore, the cough reflex is ineffective or absent in almost half of patients.[38] Although some degree of aspiration may be tolerated by patients, particularly if they have an intact cough reflex, it is critical to identify patients with clinically significant aspiration. The consequences of aspiration are often underappreciated. Nguyen et al[39] reported on 55 patients treated with chemoradiation. Eight patients developed aspiration pneumonia; 5 died because of pneumonia. Contributing factors to the high morbidity/mortality was weight loss with accompanying immune suppression because of neutropenia.

A second common complication of late-effect dysphagia is permanent or long-term feeding tube dependence. Although patients may receive adequate nutrition via a feeding tube, there are many negative aspects of tube feeding that impact on patients and their families; tube feedings are expensive and may not be covered by insurance, feedings are time intensive and may require disruptions in the patients' activity, and minor complications are frequent. Of note, the presence of a feeding tube has been shown to be the most powerful predictor of quality of life in HNC patients 1 year after treatment.[40] Predictive factors for permanent feeding tube placements have been identified. Cheng et al[41] conducted an analysis of 724 HNC patients who had completed therapy a minimum of 1 month before study enrollment. Fourteen percent of patients had a feeding tube in place. Predictors of feeding tube placement included oro/hypopharyngeal primaries, stage III/IV disease, flap reconstruction, current tracheotomy, chemotherapy, or increased age. Of note, as the population ages, patients experience increasing baseline swallowing dysfunction.[42] Thus, particular care should be taken to identify swallowing issues in the elderly patients.

Finally, patients with swallowing abnormalities may consciously or unconsciously alter the type and consistency of food that they eat. Although some dietary changes are adaptive, others are maladaptive and result in nutritional deficiencies.[43,44] Long-term dietary inadequacies can lead to malnutrition with its associated adverse effects.

Prevention and Treatment of Dysphagia

Given the high complication rate and adverse impact on quality of life, it is critical to minimize dysphagia and its sequelae. Unfortunately, there have been few prospective, randomized trials evaluating preventive or therapeutic dysphagia interventions in the HNC population. That being said, it is important to understand current standards of care as well as areas of ongoing investigation.

Treatment Modifications

The balance between efficacy and toxicity in treatment of HNC is tenuous. With aggressive chemoradiation regimens, the maximum tolerated dose has been reached. Two major approaches can be taken to modify treatment regimens to optimize the therapeutic ratio: (1) the addition of supportive care agents that ameliorate toxicity or (2) alteration of the treatment regimen itself to minimize adverse events. Amifostine, a free-radical scavenger, is an example of a supportive care agent that can be added to treatment regimens to minimize adverse events. Currently, amifostine is Food and Drug Administration approved as a salivary gland cryoprotectant during radiation therapy. Randomized controlled studies have shown its efficacy in the prevention of radiation-associated xerostomia.[45] Theoretically, decreased xerostomia may improve management of the food bolus[34] with a resultant decrease in swallowing difficulties. Furthermore, decreased acute mucosal toxicity may potentially lead to decreased fibrosis and late swallowing effects. A meta-analysis evaluating the efficacy and toxicity of amifostine showed a significantly decreased incidence of dysphagia in patients treated with amifostine during HNC radiation-based therapy (P = .04; odds ratio = 0.26; confidence interval, 0.07-0.92).[46] The number of patients included in the analysis was small, but the data are provocative. The benefit of amifostine when given in conjunction with chemoradiation is poorly defined.

Intensity-modulated radiation therapy (IMRT) can be used to spare structures that are critical for swallowing function. Data clearly indicate that IMRT can spare the salivary glands and decrease treatment-associated xerostomia, which may improve oral phase function. Furthermore, a dose-response relationship exists between dysphagia and radiation to the superior and middle pharyngeal constrictor muscle.[25] Thus, IMRT may minimize radiation to "bystander tissues" that are involved in the biomechanics of swallowing. To that end, Eisbruch et al[26] evaluated whether IMRT or brachytherapy can reduce dysphagia in HNC patients. The dose-response relationship for the swallowing structures and dysphagia supported the use of "controlled" radiation techniques such as IMRT and brachytherapy (BT) to lessen the RT dose to the upper and middle pharyngeal constrictors.[26] Similarly, Mittal et al[23] showed that the use of tissue/dose compensation resulted in lower pharyngeal residue and better oropharyngeal swallowing efficiency.

Rehabilitation: The Role of Swallowing Therapy

For the patient who is experiencing swallowing abnormalities, the SLP will make recommendations regarding (1) safe swallowing strategies with an emphasis on avoiding aspiration, (2) therapeutic postures and exercises that may improve swallowing function over time, and (3) modifications in diet to ensure safe and adequate oral intake. It is critical that the patient, family, and health care team are informed about recommendations. For hospitalized patients, staff may need to implement specific procedures to ensure safe swallowing (eg, adjusting the patient's posture, administering liquid or crushed medications, and adjustment in feeding rates or constancy). For patients in the home environment, the patient and family are responsible for carrying through recommendations. Thus, education is a critical component of an adequate SLP consultation.

The major techniques used by SLP for swallowing therapy are (1) postural techniques, (2) sensory techniques, (3) motor exercise, (4) swallowing maneuvers, and (5) changes in diet (Table 4).[23,42] Postural techniques are changes in body position that maximize swallow function and minimize aspiration. Logemann[47] described in detail the rationale for the use of various postural techniques based on the disorder observed. Increased sensory response may be attempted through several techniques including stimulation via pressure, alterations in temperature, or alterations in taste. However, the most commonly used method is to alter the bolus consistency, placement, or size. The goal of motor exercise is to increase strength, mobility, and endurance of swallowing structures.[48] These techniques are used when weakness or loss of range of motion has been identified on swallowing evaluation.[49] Swallow maneuvers are used to place specific aspects of swallowing function under volitional control. They include the supraglottic swallow, the supersupraglottic swallow, the effortful swallow, and the Mendelsohn maneuver.[50] Under fluoroscopic or endoscopic guidance, the SLP can help identify the techniques that are most effective for maximizing swallow efficacy for the individual patient. Results may be enhanced when patients receive visual feedback from MBSS, FEES, electomyographic biofeedback systems, and monometers that measure intraoral pressure.[51]

More recently, neuromuscular electrical stimulation (NES) has been used as an adjunct to swallowing therapy. During NES, the muscles are stimulated in an attempt to increase motor strength. Definitive studies showing efficacy in the HNC patient population are lacking. Carnby-Mann and Crary[52] conducted a meta-analysis to assess the effect of NES on swallowing. Of 81 trials reviewed, only 7 were included in the analysis. A small but significant effect size favoring NES was noted.

Critical Issues in Swallowing Rehabilitation

Efficacy

Although the use of swallowing rehabilitation is generally believed to be efficacious, there are few rigorous prospective randomized studies in HNC patients treated with concurrent chemoradiotherapy (CCR). It may be argued that such trials are needed because the majority of patients may recover swallowing function over time without the addition of swallowing rehabilitation. Large prospective randomized trials comparing swallowing rehabilitation versus observation would be difficult to conduct, however. First, there are ethical concerns about withholding therapy for patients with significant dysfunction. In addition, HNC patients constitute a heterogeneous population, and it would be very difficult to identify patients with identical swallowing impediments.

Recognizing these caveats, available data would support the recommendation that swallowing evaluation and rehabilitation be offered to all patients with locally advanced HNC undergoing CCR. Logemann et al[53] evaluated the relationship of speech and swallow dysfunction with the use of range of motion exercises between 1 and 3 months postoperatively for oral cavity or oropharyngeal cancer. Although this was not a population treated primarily with CCR, the investigators showed a significant correlation between range of motion exercises and oropharyngeal swallow efficiency on liquids. Significant differences were also noted for global swallowing measures, favoring the ROM group.[53] Postural techniques clearly result in decrease aspiration by 50% to 75%.[38,54] Swallowing exercises may improve swallowing efficacy.[55]

Timing

The optimal timing of swallowing therapy has not been established. Clearly, even brief periods of oropharyngeal rest are associated with dysphagia.[56] Furthermore, data would support the concept that there is a "window of opportunity" during which dysphagia rehabilitation may be optimized. This may relate to the development of fibrosis, the effects of which are difficult to ameliorate. Logemann et al[53] showed that at baseline, the majority of patients show some evidence of swallow dysfunction. Moreover, the greatest increase in swallow disorders was noted at 3 months after CCR, with no significant improvement in many of these disorders by 12 months after CCR[53] (ie, if disorders were noted at 3 months, significant recovery was not the rule). Others have shown similar findings. Denk et al[12] reported on prognostic factors for swallowing rehabilitation after head and neck surgery. They found that patients who were referred for early therapy had improved outcomes. Thus, speech and swallow intervention should be considered early after CCR.

Based on data that indicated that early swallowing rehabilitation is superior to late swallowing therapy, the question arose as to whether pretreatment swallowing exercise could further improve late effects. Kulbersh et al[57] conducted a retrospective, cross-sectional assessment of swallow function, comparing 25 patients who received pretreatment swallowing exercises with 12 patients who received standard care. Patients who received swallowing therapy had an improvement in swallowing as assessed by the M. D. Anderson Dysphagia Inventory (70.4 *v* 47.1, $P = .0083$). Similarly, Carroll et al[58] evaluated the efficacy of pretreatment rehabilitation in 18 patients with advanced HNC who received chemoradiotherapy (CCR). Nine patients received pretreatment swallowing exercises, starting 2 weeks before CCR including the tongue hold, tongue resistance, effortful swallow, the Mendelsohn maneuver, and Shaker exercises. The authors found that patients in the pretreatment arm had significantly improved posterior tongue base position during swallow and improved epiglottis inversion over the control group. No significant differences were noted in PEG use 12 months after CCR.[58] The utility of pretreatment swallow intervention remains an area of active investigation.

Conclusions

HNC patients undergoing chemoradiation are at high risk for acute and late-effect dysphagia. Therefore, the SLP should be considered an essential part of the treatment team. One of the critical sequela of dysphagia is aspiration. Postural maneuvers can decrease the rate of aspiration in a high percentage of patients. In addition, available data would indicate that swallowing rehabilitation can improve outcomes. Although the data are limited, early intervention appears to be superior to delayed intervention. Furthermore, methodologically sound studies to evaluate interventions to improve swallowing are needed.

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