Post-Radiation Dysphagia

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Swallowing is a complex process that begins with the placement of food in the mouth and ends when the food enters the stomach. It involves voluntary and involuntary stages which are coordinated through several cranial nerves and a multitude of muscles that control the function of the oral cavity, the pharynx (skull base to the lower border of the cricoid), the larynx, hyoid bone, and esophagus [1, 2].

Swallowing is initiated by the stimulation of receptors in the oropharyngeal area. Sensory impulses reach the brain stem through cranial nerves VII, IX, and X, while motor control is exercised through cranial nerves IX, X, and XII. The cricopharyngeal sphincter (CPS) relaxes as the bolus reaches the posterior pharyngeal wall before it reaches the CPS. Cranial nerve V contains both sensory and motor fibers and is important to chewing.

Swallowing physiology consists of three phases [3]:
1. Oral phase (1 s): The oral tongue and teeth reduce the food to a bolus. As the food is transported back toward the pharynx, receptors in the oropharyngeal mucosa trigger the pharyngeal phase.
2. Pharyngeal phase (1 s): During this stage, the velopharyngeal port closes to prevent food from entering the nose. The hyoid bone and larynx begin their forward and superior ascent, the epiglottis is folded down to an inverted position, the tongue base moves toward the posterior pharyngeal wall, and pressure is generated by the top-to-bottom contraction of the pharyngeal constrictor muscles, which push the bolus of food toward the esophagus. Lastly, through laryngeal and hyoid elevation and anterior movement, the cricopharyngeus muscle relaxes, resulting in the opening of the CPS.
3. Esophageal phase: When the CPS opens, the bolus of food enters the upper esophagus and is transported down to the stomach through peristalsis.

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Patients with head and neck cancer tend to be elderly. With advanced age, swallowing physiology becomes compromised, resulting in increased bolus "holding", delayed onset of swallow, slower pharyngeal transit time, and reduced generation of pharyngeal pressure [4, 5].

7.1 Evaluation of the Swallowing Mechanism

7.1.1 Objective Evaluation: Instrumental Assessment

- Videofluorography (VFG) is the most commonly used procedure to assess swallowing dysfunctions. VFG, including modified barium swallow and esophagogram, can visualize the oral, pharyngeal, and esophageal phases of swallowing. During VFG, the patient is given food in measured volumes and viscosities. Swallowing physiology is viewed in the lateral and anteroposterior planes and temporal measures are made. The duration of physiologic events during the entire swallow can be measured as they change during swallows of boluses of various volumes and viscosities. Oropharyngeal residue and aspiration can be quantified. Oropharyngeal swallowing efficiency (OPSE), a global measure of the safety and speed of swallow, is calculated by measuring the total oral and pharyngeal transit time of the bolus divided by the percentage of the bolus swallowed [6–9].

- Manometry, in which the patient swallows a soft tube containing pressure sensors, measures pressures generated in the mouth, pharynx, and esophagus during swallowing. Manometry is used primarily to measure pressure changes in the esophagus and has value for studying oropharyngeal swallowing dysfunctions [10, 11].

- Functional endoscopic evaluation of swallowing (FEES) provides views of the laryngopharynx different from those seen with VFG. This procedure, which is easy to perform, uses fiberoptic endoscopy (FE) to view mucosal and anatomical integrity, pharyngeal residue, swallowing with sensory testing, and aspiration [12]. Wu et al. [13] have discussed the advantages and disadvantages of using the fiberoptic endoscope vs VFG to evaluate patients with swallowing disorders.

- Ultrasonography can be used to study tongue physiology during swallowing [14]. However, this procedure has no value for assessing other phases of deglutition.

7.1.2 Objective Evaluation: Observer-Assessed

Several tools are available to assess short- and long-term cancer treatment-induced swallowing dysfunctions. Common Terminology Criteria for Adverse Events (CTCAE) are frequently used to assess acute toxicity. Late toxicities can be assessed using the Radiation Therapy Oncology Group (RTOG)/European Organization for Research and Treatment of Cancer (EORTC) criteria and the Subjective Objective Management Analytic (SOMA) scale [15–17].

7.1.3 Subjective Evaluation: Patient-Reported Quality of Life

Some of the instruments used to assess quality of life (QOL) in patients with head and neck cancer, including swallowing dysfunctions, include: the University of Washington Quality of Life tool (UWQOL) [18]; the M.D. Anderson Dysphagia Symptom Inventory (MADSI-HN) [19]; the EORTC-QLQ H&N [20]; the Performance Status Scale for Head and Neck Cancer patients (PSS-H&N) [21]; the Radiation Therapy Instrument Head and Neck (QOL-RTI/H&N) [22]; the Functional Assessment of Cancer Therapy-H&N (FACT-H&N) [23]; and the Head and Neck Radiotherapy Questionnaire (HNRQ) [24]. While these instruments all measure some aspects of head and neck cancer–related QOL, it is not clear which one best applies to the assessment of swallowing dysfunctions in patients with head and neck cancer and to various treatment modalities.

7.2 Baseline Swallowing Function in Patients with Head and Neck Cancer

Pauloski et al. [25] compared 352 patients with head and neck cancer with 104 controls. Pretreatment, 59% of patients complained of dysphagia. On VFG