Changes in swallowing after partial resection of larynx and hypopharynx

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Abstract. Changes in swallowing after partial resection of larynx and hypopharynx. Eating is a necessity of life and it requires swallowing, which is a physiologically complex process. Head and neck cancer itself and its treatment may cause severe disruption of the swallowing process as a result of the tumour bulk, the disturbance of sensitivity and motor function, and organ deficit. Broadly speaking, swallowing dysfunction can manifest as diminished propulsion of the bolus, and aspiration. Swallowing rehabilitation is multidisciplinary teamwork comprising modification of posture, protective swallowing manoeuvres, bolus control, diet modification, oral hygiene, the use of instruments and supporting psychosocial care. It should be started as early as the pre-treatment phase to optimise nutritional status and the psychosocial condition of the patient, and therefore quality of life. Postoperative radiotherapy appeared to have the greatest impact on patients’ health-related quality of life independent of other clinical factors following surgery for laryngeal carcinoma. After-care for irradiated laryngeal carcinoma patients should focus more on the patient’s quality of life and swallowing function.

Disruption of the swallowing mechanism in head and neck malignancies

Eating is a necessity of life and swallowing is a physiologically complex process. In normal swallowing, the act of swallowing is guided by stereotypical reflexes when the bolus enters the hypopharynx. The bolus is transported across the larynx into the oesophagus. To protect the lower airway from aspiration, respiration ceases and the larynx is closed at three levels: the true vocal folds, the ventricular folds and the aryepiglottic folds.1,2 Additionally, the larynx is pulled in a cranial and anterior direction and reaches the base of tongue. This movement widens the hypopharynx and enhances upper oesophageal sphincter relaxation. This creates a local reduction pressure and directs the bolus into the oesophagus both by a vis a tergo and a vis a fronte. During swallowing, parts of the bolus may enter the larynx. In order to prevent aspiration, respiration resumes by an inspiratory act when the bolus has reached the oesophagus after the pharyngeal phase of swallowing. An intact cough reflex is necessary to prevent or reduce possible aspiration. Undisturbed swallowing is based on the integrity of the involved structures as a whole. The structures must be sound, flexible and mobile. Swallowing is guided by a complex neuronal coordination for adequate sensibility and motor function. Jafari et al.3 found that the internal superior laryngeal nerve plays an important role in the sensory regulation of swallowing and airway protection. Pauloski et al.4 videofluoroscopically assessed pretreatment swallowing function in 352 patients with various cancer lesions in the head and neck. Fifty-nine percent of the patients complained of difficulty with swallowing. Patients had significantly longer oral and pharyngeal transit times, larger amounts of oral and pharyngeal residue, shorter cricopharyngeal opening durations, and lower swallow efficiencies. The pharyngeal phase of swallowing in particular is affected by malignancies of the tongue base, pharynx, and larynx.5,6 Stenson et al.7 assessed swallowing function in patients with cancer of the oral cavity, oropharynx, larynx, and hypopharynx prior to treatment and compared it with patients with sinonasal, nasopharyngeal, and unknown primary carcinomas. Hypopharyngeal and laryngeal disease sites showed a high degree of pre-treatment functional impairment in the areas of aspiration status, cervical oesophageal function, and pharyngeal function. These researchers recommended a comparison of post-treatment function with baseline pre-treatment dysfunction, especially in...
multimodality therapies that aim to preserve function. Nguyen et al. assessed the influence of age, co-morbidity factors and tumour characteristics on dysphagia severity in the diagnosis of head and neck cancer in a retrospective study of 236 patients. Swallowing appeared to be not significantly affected by age and co-morbidity factors like diabetes, hypertension, coronary artery disease, peripheral vascular diseases and arthritis. Patients with locally advanced stages (T3-T4, N2-N3) were found to be at risk of severe dysphagia. Patients with oral cavity tumours appear to be less at risk of dysphagia than those with tumours in other anatomic locations. This concurs with the study of Pauloski et al. in which patients with lower stage tumours and oral cavity lesions reported fewer swallowing complaints. Nguyen et al. found that patients with long-term dysphagia after treatment for head and neck cancer are at risk of aspiration. They recommend modified barium swallow to identify these patients.

The consequences of disruption of the swallowing mechanism

Malignancies of the upper aerodigestive tract may disrupt the integrity of the structures and neuronal control (sensibility and motor function). Their bulk can also play a disruptive role. Life-threatening swallowing dysfunction, respiratory insufficiency and impairment of vocal communication may occur. This makes patients with head and neck cancers particularly vulnerable. In broad terms, swallowing dysfunction can manifest as diminished propulsion of the bolus and aspiration.

Dysphagia may cause malnutrition and weight loss, which in turn may exacerbate complications and result in increased rates of hospitalisation, mortality, additional costs and the impairment of quality of life. It is therefore important to identify the factors that may affect dysphagia severity before, during and after treatment in order to maintain optimal nutritional status.

Aspiration is another consequence of the disruption of the swallowing mechanism. Clinical symptoms of aspiration are post-feeding choking, noisy breathing and cough or dyspnoea at night. A particular concern should be silent aspiration. This is supported by Rosen et al., who found that the clinicians’ educated prediction of aspiration was not correlated with aspiration determined by videofluoroscopy in a consecutive sample of 27 patients without previous treatment or tracheostomy. Logemann reported that approximately 50 percent of patients who aspirate do not cough or give any external sign of food or liquid entering the airway.

Therapeutic aspects of disruption of the swallowing mechanism

Swallowing rehabilitation stricto sensu should be started as soon as possible after surgery in order to teach the patient how to swallow more safely and effectively. Swallowing rehabilitation comprises modification of posture, protective swallowing manoeuvres, control of bolus, modification of diet, oral hygiene, and the use of instruments.

Several swallowing techniques (conscious or sub-conscious) have been described for the adaptation of behavioural and head/body postural acts of the patient in order to reduce aspiration and facilitate propulsion of the bolus. Specific exercises can be used to strengthen muscles and improve movement and coordination.

In most cases, patients swallow in an upright position. Postural changes may be made, such as head turn, head tilt, chin tuck, neck extension and lying on the side.

Swallowing should take place at low speed with multiple swallows, and various “manoeuvres” can be applied. The most frequently used manoeuvres are the supraglottic swallow manoeuvre (voluntary closure of the vocal folds prior to the swallow), the super-supraglottic swallow manoeuvre (airway closure at the level of the arytenoid to base of epiglottis), the Mendelsohn manoeuvre (voluntary prolongation of laryngeal elevation and cricopharyngeal opening during swallowing), the effortful swallow manoeuvre (increased pressure on the bolus), and the Masako manoeuvre (swallow with tongue stabilised anteriorly between the teeth).

The consistency of the food must be adjusted. Substances that are too liquid exacerbate the risk of aspiration, while over-solid substances may interfere with propulsion. The boluses should be small. Modern dietetics provide a large range of edible nutritional supplements. In severe swallowing disturbances the application of a feeding tube, as in percutaneous gastrostomy, may be necessary.

Instrumental aids can be beneficial for swallowing rehabilitation. Examples include specially designed drinking cups and spoons.
Finally, oral hygiene must be a focus of attention. Infected oral secretions involve an increased risk of aspiration pneumonia.

The outcome of swallowing rehabilitation in head and neck cancer patients depends on the nature and extent of the pre-treatment cancer and post-treatment course. Swallowing rehabilitation must therefore be tailored to the individual. Care for swallowing disorders is therefore multidisciplinary teamwork. All the caregivers (head and neck surgeon, medical oncologist, radiation therapist, phoniatrician, dentist, speech pathologist, radiologist, dietician and nurse) play their specific role. The patient’s immediate circle, such as partners and family they see on a daily basis, should not be passed over and they must be involved in care for patients with swallowing disorders. They can be assisted by a social worker. Last, but not least, the patients themselves play a critical role in the rehabilitation process through active involvement. The patient must understand that more or less severe changes in swallowing will occur after treatment and that they will receive support from professional caregivers. A good mental status is necessary for optimal rehabilitation. Adequate communication between all the members of the team is necessary to ensure that the patient’s swallowing rehabilitation proceeds optimally. Contact with fellow-sufferers may provide insight and empathy. The authors of this paper strongly support the recommendation of Logemann et al. to involve the various caregivers as early as the pre-treatment phase in order to facilitate the rehabilitation process and to prepare patients and their circles for what they can expect after the treatment.

**Health-related Quality of life (HRQL) related to swallowing after partial laryngectomy**

Patients with head and neck cancer have multiple, and often severe, functional, psychological and social problems. The problems are associated with the diagnosis, the treatment and the rehabilitation of their disease, and may have a major negative impact on their quality of life. Multimodality therapy using preservation protocols and comprising surgery, radiotherapy and chemotherapy/radiochemotherapy is increasingly applied in the care of advanced head and neck cancer and has resulted in increased survival rates. It is, however, of utmost importance to maintain quality of life at the highest possible standard. This means that the preserved organ must function adequately. Consequently, organ functionality should play an important role in treatment decisions and ethical discussions.

Terrell et al. found several demographic and clinical characteristics that are significant predictors of quality of life in 570 patients with upper aerodigestive tract cancers. The presence of a feeding tube proved to have the most negative impact on quality of life, followed by medical comorbid conditions, the presence of a tracheotomy tube, chemotherapy, and neck dissection. In addition, hospital site, age, education level, sex, race, and marital status were significant predictors of quality of life. These findings indicate the multifactorial complexity of the course of events that determine functional quality and therefore quality of life.

Health-related Quality of life (HRQL) is a subjective construct influenced by different factors, mainly swallowing and breathing functions. For the long-term HRQL of patients with laryngeal carcinoma after surgery, disease- and treatment-related variables, as well as sociodemographic factors, have been identified as determinants. Most of the published studies indicated that HRQL was better for factors such as lower disease stage, partial laryngectomy or hyperfractioned radiotherapy. Clinical determinants, however, often do not affect HRQL separately, but correlate with each other. Most of the T3 tumours and almost every T4 tumour of the larynx, for example, are laryngectomised. High disease stage is an indication for radiotherapy for possible lymphatic node metastasis. Moreover, patient age as well as the time since operation at the measurement point have been found to be correlating factors for health-related quality of life.

Not only the wealth of possible influences but also the diversity of end points (consisting of physical, psychological and social components) should be considered when talking about HRQL. That means that many HRQL measurements have been developed and validated in large studies. The questions in the EORTC QLQ-C30 target the general adverse effects in tumour patients; the EORTC QLQC35 look at the specific problems of the head and neck region in a more detailed manner. All the scales and items in these questionnaires are more or less inter-correlated. Nevertheless, there is no sum score of the questionnaires, and even if there were,
the score would not reflect the complexity of tested HRQL anyway. However, testing each scale on its own leads to the exacerbation of statistical uncertainty because of multiple testing. This makes valid conclusions very difficult to obtain. To escape from this dilemma, some authors have adopted the “Global Health Status” scale of the EORTC QLQ-C30 as the dependent variable.

Bindewald et al. assessed the correlation of operation mode, postoperative radiotherapy, and disease stage factors with the health-related quality of life (HRQL) measures after surgery for laryngeal carcinoma. They incorporated all the relevant scales of one questionnaire in one multivariate model for robust statistics and made univariate analyses of every scale for differentiation. They re-analysed the data from two multi-institutional cross-sectional studies. A group of 218 laryngectomies and 153 partial laryngectomy patients in and near Leipzig, Germany, were interviewed in two cross-sectional studies using the general and the head- and neck-specific quality of life questionnaires of the European Organization for the Research and Treatment of Cancer (EORTC QLQ-C30 and EORTC QLQ-H&N35). Multifactorial univariate and multivariate models were calculated, with laryngectomy vs. partial laryngectomy, radiotherapy (irradiated or not), and disease stage (International Union Against Cancer [UICC] stages I/II vs. III/IV) as influencing factors and the HRQL scales and items as dependent variables. Analyses were adjusted for patient age and the time elapsed since the operation.

Laryngectomies were more affected in their sense of smell (P<.001). In irradiated patients, scores for functioning levels and many symptom scales were worse (P<=.050). Both operation mode and postoperative radiotherapy were independently associated with head- and neck-specific HRQL in multivariate analysis. Differences between disease stage groups, however, were not significant. Patient age was a factor for HRQL, but time since operation was not.

The laryngectomies in this study had many more “problems with smell” than partially resected patients. This finding concurs with many studies analysing senses at the scale level (smell and taste together), an example being a cross-sectional comparison of laryngectomy vs. partial laryngectomy by Sewnak et al. The data of Bindewald et al. showed that the significant difference is for smell, not taste. In the judgment of Bindewald et al. the very large difference (P<.001) for “problems with smell” made multivariate testing of the whole H&N35-questionnaire significant. The second finding for operation mode in univariate analysis was the higher score for “dry mouth” in partially resected patients. This seems to be a paradox for an item of this kind that is sensitive to irradiation, because postoperative radiotherapy was applied to laryngectomies more often than to PL patients. In any case, the small difference in all the HRQL scales is astonishing; on the basis of clinical experience, everybody would rate HRQL in laryngectomies lower than in partially resected patients. One reason for the small difference might be the adjustment to other variables, but the subjectivity of HRQL rating could be another explanation. In an unadjusted comparison of voice intelligibility in laryngectomised and partially resected patients, the laryngectomies rated their voices better, in spite of speaking worse in an objective test. Discriminative expectations of the groups were thought to be the cause for these paradoxical ratings. Higher expectations for postoperative HRQL in partially resected patients could be a problem in terms of estimating the objective difference in HRQL compared with laryngectomised patients.

Postoperative radiotherapy turned out to be the factor with the strongest impact on patient HRQL in the study of Bindewald et al. The social lives of irradiated patients seem to be affected, and head- and neck-related symptoms in particular are severe. In addition to the common irradiation-sensitive symptoms like “dry mouth”, “sticky saliva”, “pain in the mouth”, a finding of interest in this study was the “problems with taste”. They were highly significant, while “problems with smell” did not attain significance in the adjusted model. The absolute difference for “problems with smell” in the irradiation group is eliminated by adjustment in multi-factorial analysis. This confirms the split in the “senses scale” in EORTC QLQ-H&N35 for patient samples with surgery for laryngeal carcinoma. The patients in our study were treated between 1986 and 2004. In the last few years, many new approaches for radiotherapy have been developed. Other new radiation therapy concepts (like intensity-modulated-radiotherapy, navigated interstitial brachytherapy or combined radio-
chemotherapy) used in the postoperative treatment of laryngeal carcinoma patients should be assessed for their impact on HRQL.

From the study of Bindewald et al., it may concluded that postoperative radiotherapy seems to have the greatest impact on patients’ HRQL independently of other clinical factors following surgery for laryngeal carcinoma. After-care for irradiated laryngeal carcinoma patients should focus more on patients’ quality of life and swallowing function.

Conclusions

Rehabilitation and care for swallowing disorders in patients with partial resections of the larynx and hypopharynx should be provided by a multidisciplinary team that communicates well. Since the outcome is a result of complex events, the rehabilitation process should start as early as the pretreatment phase and must be tailored to the individual. Monitoring the nutritional status of the patient is crucial. Modality therapy using preservation protocols is increasingly applied in care for advanced head and neck cancer. The main aim of this approach is an increased survival rate. It is also of the utmost importance to maintain quality of life at the highest level possible. Postoperative radiotherapy seems to have the greatest impact on patients’ HRQL independently of other clinical factors following surgery for laryngeal carcinoma. After-care for irradiated laryngeal carcinoma patients should focus more on patients’ quality of life and swallowing function.

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