**A prospective study of long-term dysphagia following total laryngectomy**

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**Abstract.** A prospective study of long-term dysphagia following total laryngectomy. Objective: To evaluate the degree of dysphagia in patients before and after total laryngectomy using the Performance Status Scale for Head and Neck Cancer Patients (PSS) and to determine the effects of post-operative radiation therapy, neck dissection, and pharyngoesophageal spasm on PSS scores.

**Methods:** We performed a controlled, prospective study at a tertiary referral university hospital. Twenty consecutive patients undergoing laryngectomy were included. Patients were followed for at least two years post-operative, without evidence of local, regional, or distant disease. Only patients with squamous cell carcinoma limited to the endolarynx requiring total laryngectomy with or without elective neck dissection for surgical management of cancer and with no pre-operative treatment were included. Dysphagia was evaluated by PSS prior to surgery and again two years post-operatively with an emphasis on eating in public and normalcy of diet domains. Video fluoroscopic evaluation of swallowing was performed one year after treatment.

**Results:** The relative number of patients with low mean scores in PSS (i.e. usually swallow paste of fluid food in presence of some selected persons or alone; ≤ 50) increased after total laryngectomy (p = 0.04). Patients with lower scores reported more frequent spasm of the pharyngoesophageal segment (p = 0.005). Mean scores of both domains decreased after surgery (p < 0.05).

**Conclusion:** Eating in public and normalcy of diet scores decreased in 50% of patients after total laryngectomy. **Trial Registration:** Eating in public and normalcy of diet scores decreased in 50% of patients after total laryngectomy.

**Introduction**

Quality of life (QoL) and functioning are two important health domains to consider, alongside survival, when evaluating the success of head and neck cancer therapy.1,2 QoL is a complex, multidimensional concept that is unique to each individual and necessitates self-report for adequate evaluation.3 It is affected by a range of physical and psychological characteristics, including emotional, physical, functional, social, financial, and spiritual components.2 The World Health Organization defines QoL as “an individual’s perceptions of their position in life, in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns”.3

This can be expressed as “reflecting a measure of the difference or ‘gap’ between one’s perceived reality and one’s expectations or wishes”.4 Functioning is different from QoL. According to the World Health Organization International Classification of Functioning, Disability, and Health (WHO-ICF), an impairment, activity limitation, and/or participation restriction may result if an individual is affected by a disease or its treatment.5 Functioning thus does not relate to well-being or life satisfaction; rather, it represents an individual’s performance in the activities of daily life, e.g. walking, eating, or speaking.5

The Performance Status Scale for Head and Neck Cancer Patients (PSS) is designed to measure disabilities of head and neck cancer patients in the areas of eating and speaking. Due to the disease itself or its treatment, eating patterns among head and neck cancer patients may become less socially acceptable. Increased time for feeding is often required, considerable messiness is involved, and special food preparation is needed. In addition to speaking and eating problems, the social involvements of head and neck cancer patients are often curtailed. Communication difficulties may result in frustration, anxiety, and isolation from others. Similarly, problems with eating and ensuing embarrassment may interfere with the patient’s ability to socialize with others in situations in which food or drinks are a significant aspect of the activity. This simple, practical assessment tool measures these functions in a
standard and systematic manner and was designed to be readily acceptable to both the patients and their caretakers. This tool is also appropriate for repeated administration. PSS measures functioning more than QoL, but problems in swallowing and eating in public affect self-esteem and one’s reaction to others. Thus, patients’ well-being and life satisfaction could be compromised if he/she could not eat his or her preferred dish, for example. Preservation of swallowing, a natural airway, and speech are critical components that impact QoL in head and neck cancer patients. Of these vital functions, swallowing has the largest impact on global QoL. The objective of the current study was to compare mean scores of the PSS domains of eating in public and normalcy of diet before and after total laryngectomy, and to investigate the relationship between post-operative radiation therapy, neck dissection, and pharyngoesophageal spasm with PSS scores.

Materials and methods

The local Institutional Review Board, Ethical Committee in Research of Faculty of Medicine of University of Campinas, approved the study protocol. All patients provided informed consent. Consecutive patients treated by total laryngectomy and followed for at least two years post-operatively without evidence of local, regional, or distant disease were included in the current study. Inclusion criteria were a diagnosis of squamous cell carcinoma exclusive to the endolarynx without clinical and/or radiological evidence of lymphatic metastases requiring total laryngectomy with or without elective neck dissection and without previous treatment. Patients with cancer of the hypopharynx or those submitted to salvage surgery after failure of concomitant radiochemotherapy for larynx cancer were excluded. All histopathologic analyses were provided by our institution. All patients were submitted to multi-slice computed tomography of the larynx and videolaryngoscopy with rigid Hopkins lens endoscopes (Storz®); all images were recorded and digitally archived. Follow-up was performed with clinical examination according to our clinical surveillance protocol. Computerized tomography of the neck and chest was performed at six-month intervals. The TNM staging system was employed.

We translated and adapted the PSS questionnaire to Brazilian-Portuguese following internationally-accepted guidelines. Two bicultural experts translated the original English version of the PSS questionnaire to Brazilian-Portuguese. A third bicultural expert compared the two versions and an iterative consensus was reached. The consensus version of the Brazilian-Portuguese translation was sent back to the original translators who performed a similar back-translation process (from Brazilian-Portuguese to English). This back-translated version was then compared with the original English-language version to ensure that the translations were suitable. Discrepancies between the original and back-translated versions were resolved by repeating the process as needed.

To ensure face validity, the translated questionnaire was first distributed to two expert ENT surgeons and two speech pathologists experienced in managing patients with dysphagia. They were instructed to review and comment on the suitability of the questions to ensure that target information would be obtained. Following refinement, three laryngectomees then completed the questionnaire, and upon completion was asked to comment on the clarity of questions, format of questionnaire, ease of completing the questionnaire, and the suitability/understandability of the language and terminology. Minor changes were made to the questionnaire format before distribution by mail.

To evaluate the interrater reliability of the new scale, two members of the research team (psychologist and research assistant) simultaneously rated 20% of the patient group. Kappa statistics, describing the degree of agreement between the raters’ scores, were calculated separately for each subscale.

Swallowing was evaluated through the eating in public and normalcy of diet domains of the PSS (Table 1). The understandability of speech domain was not included in the current study. The questionnaire was administered one month pre-operatively and again two years post-operatively. Relevant treatment information, including neck dissection and radiation therapy, was collected by chart review. Patients were submitted to levels II, III, and IV elective selective neck dissection if the risk of lymphatic metastases was high. Adjuvant radiotherapy was used when positive margins, presence of angiolymphatic invasion, perineural invasion, multiple metastases, or extracapsular spread of metastases...
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Three speech language pathologists evaluated each patient including administration of the PSS; a mean score was obtained for each subscale in every patient. In addition, videofluoroscopic examination of swallowing and phonation with tracheoesophageal voice with voice prosthesis was performed in all patients after one year of treatment in a blinded fashion by three speech language pathologist with consistencies of thin liquid, thickened liquid, and paste bolus to evaluate for the presence of spasm or stenosis on pharyngoesophageal segment (PES) or other anatomical alterations including pharyngeal pouches or absence of relaxation of cricopharyngeal muscle during swallowing. All exams were recorded in DVD format for evaluation of swallowing in slow motion or frame-by-frame analysis. Evaluation of antero-posterior diameter was performed just above the tracheostomy level in lateral projection during and after swallowing and during and after phonation with voice prosthesis. Pharyngoesophageal spasm was defined as a narrowing of the PES observed under videofluoroscopy during phonation but not during swallowing with relaxation of PES. In cases of stenosis, a narrowing of PES is observed during phonation and swallowing. Relaxation of the PES is not observed during swallowing. The pharyngeal transit of bolus was evaluated to determine if it was cleared with a single swallowing movement or required multiple efforts to clear the pharynx. Transit time was evaluated with recorded slow motion analysis of swallowing coupled to timer of DVD player software PowerDVD™ XP from Cyberlink™ for Windows XP. A mean score of ≥70 for both domains was considered the cut off value for good swallowing and a score of ≤50 was considered restriction in swallowing (Table 1).

Statistical analyses were performed via binomial tests of the relative number of patients with impairment of mean score after surgery. Evaluation of mean scores of the domains of interest before/after surgery and mean transit time was performed using the t-test. The presence of spasm...
in pharyngoesophageal segment after surgery and the influence of post-operative radiation therapy, neck dissection, and impairment of pharyngeal transit time was evaluated using the Fisher Exact Test. Statistical analysis was performed using version 12.0 of the SPSS statistical program (SPSS, Chicago, IL) for Windows XP®. The level significance was set at 5%.

Results

Twenty patients were enrolled in this study. The length of follow-up ranged from 36 months to 74 months, with a mean of 42 months. Nine patients were staged as T3N0M0 and eleven patients as T4aN0M0 after CT scan of larynx and chest. For the two subscales used in this study, good interrater reliability was found: for normalcy of diet, Kappa = 0.86 (standard error [SE] = 0.08); for eating in public, Kappa = 0.82 (SE = 0.11).

Seventeen patients (85%) had a mean score ≥ 70 for the eating in public and normalcy of diet domains and three patients (15%) had mean score ≤ 50 on both subscales pre-operatively. Eight patients (47%) of those with a mean score ≥ 70 reported decreased scores on both subscales (≤ 50) after total laryngectomy, while one patient (33%) with low pre-operative scores reported increased mean scores after surgery (mean score ≥ 70). Two patients (66%) with low mean scores (≤ 50) on the two domains and nine (53%) with high PSS scores (≥ 70) remained unchanged after surgery.

After surgery, 47% of patients with high scores on both domains reported decreased mean scores (≤ 50). The relative number of patients with decreased mean scores on both domains after surgery was significant (p = 0.04) (Table 2). Among all 20 patients, the mean pre-operative score on the eating in public domain was 70 (SD ± 21.8), while that on the normalcy of diet domain was 71.5 (SD ± 21.7). After surgery, the mean score was 51.3 (SD ± 30.6) for eating in public and 53.5 (SD ± 21.5) for normalcy of diet. For both subscales, the difference in mean scores before and after surgery was statistically significant (p < 0.05).

Six patients with mean score ≤ 50 (60%) had pharyngoesophageal spasm on videofluoroscopic evaluation, while no patients with mean score ≥ 70 had spasm during phonation or after swallowing (p = 0.005). No patient presented with stricture or stenosis of the pharyngoesophageal segment on videofluoroscopic evaluation during phonation or after swallowing. Pouch was not observed in any patient and relaxation of cricopharyngeal muscle was absent in all. Mean transit time for all patients was 1.3s (SD ± 0.3; 95%CI 1.3 ± 0.07). Those with mean score ≤ 50 had a prolonged pharyngeal transit time (1.4s SD ± 0.2s; 95%CI 1.4 ± 0.1) requiring multiple efforts to completely clear the pharynx with impaired radiological swallowing compared to those with mean scores ≥ 70 (1.0s SD ± 0.3; 95%CI 1.0 ± 0.1) (p < 0.005). The proportion of patients with impaired transit time (100%) when PSS scores was low (< 50) was higher than the group of patients with high PSS scores (> 70) (0%; p = 0.000005).

Nine patients underwent post-operative radiotherapy and 14 underwent neck dissection. Both parameters were unrelated to a decrease in either domains of the PSS after total laryngectomy (p = 0.95 and 1.00, respectively).

Discussion

The PSS® is one of the few instruments designed to quantify the impact of dysphagia on performance status. The other commonly-employed instrument, the MDADI (M.D. Anderson Dysphagia Inventory), is the first validated and reliable self-administered questionnaire designed specifically to evaluate the impact of dysphagia in head and neck cancer patients. The SWAL-QOL (swallowing-quality-of-life instrument), is a comprehensive QoL instrument, but was designed for patients with neurogenic oropharyngeal dysphagia; it is designed to obtain the neurologically-impaired patient’s perspective on QoL effects attributable to dysphagia.

Dysphagia is an expected morbidity of total laryngectomy. Deficits may be related to alterations of superior digestive tract including fibrosis of base of tongue or pharynx with resulting deposit of foods, hypertonia of cricopharyngeal muscle, and stenosis or modifications in esophageal phase or peristalsis of esophagus. It is important to evaluate the patient submitted to total laryngectomy soon after surgery to identify dysphagia, often characterized by residue in pharyngeal area. Few investigations have examined the nature of this alteration, in immediate or later post-operative period as total laryngectomy is not associated
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Table 2

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<tr>
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<th>Score ≥ 70</th>
<th>Score ≤ 50</th>
<th>Total</th>
<th>p value</th>
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<td></td>
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<td></td>
<td></td>
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<tr>
<td>After surgery</td>
<td>9</td>
<td>1</td>
<td>10</td>
<td></td>
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<tr>
<td></td>
<td>8</td>
<td>2</td>
<td>10</td>
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<tr>
<td>Total</td>
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<td>3</td>
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with aspiration and pneumonia. Frequency of dysphagia after total laryngectomy ranges from 10% to 72% and may be in the immediate post-operative period in up to 98% of patients and up to 58% after three years of follow-up. In this post-treatment setting, dysphagia has been shown to have a great impact on life of patient.  We confirmed this in the present study with significant decrease in PSS scores. The relative number of patients with lower scores increased more than three times from 15% to 50% at two years post-operative follow-up. Typically, investigation of dysphagia after total laryngectomy involves observation of the swallowing mechanism with contrast medium. Previous studies demonstrated increased time required for bolus transport through the pharynx. In addition, increased pharyngeal resistance to food flow and poor lingual propulsion has been reported. In our patients, many reported the sensation of stopped food, sensation of choking and nasal regurgitation despite the absence of PES stenosis or pouches on videofluoroscopic evaluation. Most patients have pharyngoesophageal spasm. This spasm appears during phonation and not during swallowing and jeopardizes the acquisition of tracheoesophageal voice. However, treatment of these spasms is related to improvement of swallowing, as observed in our previous study. All patients with low mean scores in the domains of normalcy of diet and eating in public had alterations in pharyngeal transit. We observed inadequate force of the sequential constrictor contraction to adequately propel the bolus through the pharynx. The anterior pharyngeal wall, the site of suture line, does not contract during pharyngeal peristalsis. The pharynx is more tortuous due to anterior fixation to the skin and tracheostomal region. Removal of the larynx itself increases resistance to flow as the superior and anterior movement of larynx is lost, and opening of the inferior hypopharynx occurs only with difference in pressure gradient without the help of anterior movement of larynx.

One subject presented with a cough after swallowing. Xerostomia secondary to radiation therapy had a significant impact on quality of life. Dysphagia secondary to radiation therapy treatment can acute occurring 10 to 17 days after irradiation, with decreased saliva production. Late effects of radiation therapy may include impairment of swallowing reflex and pharyngeal peristalsis for up to two years post-treatment. Despite the absence of an effect of radiation therapy on swallowing in our data, some studies observed swallowing impairment due to fibrosis of pharyngeal constrictor muscle or prelaryngeal muscles. Radiation therapy in the neck area does not impair voice production with tracheoesophageal speech, and does not harm the PES. Our data suggest that most patients had the greatest difficulty with solids. Liquids and pastes were tolerated significantly better. No patient had narrowing of the pharyngoesophageal segment on videofluoroscopic examination, dysphagia could be due to dysfunction of the pharyngoesophageal segment. Treatment with botulinum toxin could improve speech rehabilitation and might also relieve this dysfunction and improve swallowing. Botulinum injection is an outpatient procedure used in selected patients with persistent spasm at least six months post-operatively, as most spasms improves spontaneously. Another treatment modality is the pharyngeal myotomy during reconstruction of pharynx after total laryngectomy to prevent spasm of the pharyngoesophageal segment but with increased risk of hypotonicity of pharyngeal muscle with hypotonic voice that does not improve with rehabilitation.

Conclusions

Total laryngectomy is related to impairment of swallowing in 50% of patients. We observed a statistically significant increase in the relative number of patients with
mean PSS scores ≤ 50 after surgery (p = 0.04) for both domains. There was a statistically significant difference in the mean scores for the eating in public and normalcy of diet domains before and after total laryngectomy (p < 0.05). Lower scores (≤ 50) were related to the presence of pharyngoesophageal segment spasm (p = 0.005) and did not correlate with post-operative radiation therapy or concomitant neck dissection. All patients with low mean scores (≤ 50) had a statistically significant difference in the transit time with impaired radiological swallowing compared to those with mean scores ≥ 70 (p < 0.005). The relative number of patients with impaired transit time was higher in the group of patients with low mean scores in both domains (p = 0.000005).

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