SPEECH AND SWALLOWING FUNCTION IN HEAD AND NECK CANCER PATIENTS: WHAT DO WE KNOW?

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Abstract

In this paper, we report on common speech and swallowing dysfunction that occurs after surgery, radiotherapy or chemo-radiotherapy for head and neck cancer (oral cavity, pharynx and larynx sites). We review speech therapy interventions and discuss available evidence for the use of these techniques. Methodological quality is low in the majority of published studies that describe rehabilitation after head and neck cancer treatments and speech disability has received very little attention. Although many researchers have investigated swallowing impairment, a wide variety of measurement tools have been employed, making results across studies difficult to compare. There is an absence of good data on swallowing and/or speech outcomes after surgery, radiotherapy or chemo-radiotherapy for head and neck cancers. Further work is needed to first, undertake rigorous scientific studies of functional outcomes (speech, swallowing, activity and societal participation) with this under-researched population and, second, to scientifically examine the usefulness of available therapeutic techniques for improving treatment results.

Speech pathologists are traditionally the professionals who assess, diagnose and manage voice, speech and swallowing problems in people who present with head and neck cancer. The term head and neck cancer in this paper includes cancers of the oral cavity, pharynx and larynx; ICD sites COO-C14 and C32.[1]

Ideally, a pre-treatment meeting between therapist and patient occurs, when informational counselling about anticipated changes and likely management of speech and swallowing problems takes place. Patients' baseline speech and swallowing functions are documented, using objective recordings, such as audio-taping of voice and speech and video-fluoroscopic recording of swallowing function. In this way, functional changes attributable to treatment, rather than those changes due to the cancer itself, can be ascertained. Objective pre-treatment measures are also useful for planning rehabilitation.

The aim of speech and swallowing rehabilitation is to first optimise function (usually by direct therapy programs, such as exercise regimens) and second, to introduce compensatory strategies (diet changes, intra-oral or voice prostheses) or manoeuvres (such as postural changes for safer swallowing), when improvement in function cannot, or does not, occur. Impairment in speech or swallowing can negatively impact on patients' quality of life (QoL), resulting in reduction in social participation and/or in activity. These life changes can be assessed using a tool such as Australian Therapy Outcome Measures (or AusTOMs)[2] and may form goals in rehabilitation.

In this paper, we describe typical population-specific voice, speech and swallowing difficulties, as they relate to differing head and neck cancer sites and sizes, then discuss common therapeutic interventions and examine evidence for their continued use. Tracheostomy care is beyond the scope of this paper, so has not been addressed.

Oral cancer

One challenge for head and neck cancer researchers is to accrue adequate numbers of patients to enable meaningful analysis of data. This is particularly true for oral cancers, where it is difficult for any one institution to accrue many patients within a specific surgical resection/reconstruction cohort.[3] Multi-centred, collaborative research is therefore essential to address this problem of small numbers when assessing functional outcomes from different treatments.

Treatment for oral cancer usually involves surgery with, or without, radiotherapy, and this often impacts on speech and/or swallowing function. It is generally accepted that the biggest influencing factors on functional outcomes after surgery will be the extent of the resection and the type of reconstruction technique used. The more extensive the resection, the greater will be the swallowing impairment.[4] When considering the best technique of reconstruction for good speech and swallowing to result, the issues become less clear. Primary surgical closure (pulling together and suturing remaining tissue), or a laser resection, reportedly result in better speech and swallowing outcomes than does the use of free flaps.[3] Unfortunately, the surgeon does not always have the luxury of these choices.

Surgery to the tongue can impact on the oral stage of swallowing, as well as on speech. The degree of impairment is largely dependent on the extent of lingual tissue resected and it has been stated by Lazarus that, "if less than 50% of the tongue is resected and reconstruction is by primary closure, patients can regain fairly functional swallowing".[5] Patients requiring total glossectomy are, unfortunately, usually limited to a diet of thin and/or thick fluids, and use postural/compensatory techniques to swallow orally.

Speech intelligibility is largely influenced by the type of reconstruction used and this, in turn, is influenced by

available sensation, bulk and mobility, if a flap is employed. Following floor of mouth resection, the oral tongue may be tethered as part of the surgical closure, thereby limiting its movement for speech and swallowing. Such surgery negatively impacts on the pharyngeal stage of swallowing, particularly if tongue base tissue or faucial arch tissue is included in the resection, as this may reduce, respectively, pharyngeal motility and triggering of the pharyngeal swallow.[5]

If a mandibulectomy occurs, limitations to lip and jaw movements will reduce speech intelligibility and the oral stage of swallowing will be slow. Resection of either the hard or soft palate can result in hypernasal speech and oral bolus residue or nasal regurgitation of food/fluids may be observed, if the surgical repair is ineffective.

When post-operative radiotherapy is required, further problems are introduced. In one published study, oral cancer patients who received post-operative radiotherapy demonstrated worse swallowing outcomes than did those who received surgery alone.[6] Xerostomia following radiotherapy results in prolonged oral transit and reduces the patient's ability to masticate solids. Post-radiation fibrosis may limit movements of the tongue, pharyngeal wall and jaw (often due to trismus). These, in turn, negatively impact on both speech and swallowing function.

Laryngeal cancer - small tumours

With an early cancer of the glottis (larynx) on one, or both vocal folds (T1 or T2), a patient's initial complaint at presentation is often that of a hoarse/husky voice. In Australia, radiotherapy is commonly the first line of treatment for early glottic cancer – although, increasingly, laser surgery is being offered as an alternative.

There are no published comparative data of voice outcomes from these two modes of treatment. In a recent prospective study of 50 patients undergoing radiotherapy treatment for early glottic cancer at Peter MacCallum Cancer Centre from 2000-2004,[7] patients' perceptions of their voice quality and their QoL significantly improved post-treatment, as did their objective and perceptual voice measures. Objectively, mean speaking fundamental frequency (or 'vocal pitch') did not significantly change, although breathiness and strain in the voice recordings were demonstrably reduced.[7]

Voice results after endolaryngeal surgery (with or without laser) for treating early laryngeal squamous cell carcinoma (SCC) are equivocal, as no comprehensive objective voice outcome data have been published. Indeed, in a recent review of radiotherapy versus open surgery versus endolaryngeal surgery (with or without laser), Dey et al stated, "There is currently insufficient evidence to guide management decisions on the most effective treatment (for early laryngeal SCC)".[8]

The value of voice therapy (identifying and addressing vocal misuse/abuse; giving advice and guidance on correct voice production and providing vocal exercises) in preventing, or reducing, dysphonia during and after treatment has not yet been ascertained; these studies remain to be done.

Laryngeal cancer – large tumours

For patients with more extensive (T3 or T4) tumours of the glottis, options for treatment include an organ preservation protocol, using chemo-radiotherapy, or having a total laryngectomy.

Chemo-radiotherapy treatment

Initially, it may seem attractive to preserve the organ (larynx), but preservation of form does not always translate into preservation of function, and patients need to have this point explained, before they consent to treatment.

In reality, we have no good scientific data on swallowing outcomes on which to base our pre-treatment advice to patients. Despite the large number of clinical trials that have been and continue to be undertaken with this population, swallowing outcomes are either not reported at all, or only crude, subjective measures are used.[9] Further, there are no well designed published studies documenting voice or speech changes after chemo-radiotherapy treatment for laryngeal cancer.

Total laryngectomy

A primary (ie. done at the time of total laryngectomy) tracheo-esophageal puncture, or TEP, is currently the world's best practice for speech rehabilitation after a total laryngectomy. Such surgical-prosthetic voice restoration may also be offered months – or even years – post-cancer surgery. Since the 1970s, when Blom and Singer advanced surgical voice restoration in the USA,[10,11] silicon voice prostheses have proliferated worldwide, becoming more user-friendly and easy for patients and clinicians to use.[12] Much research has been undertaken and improvements in surgery and prosthetics made and success rates for speech restoration after laryngectomy are now around 95%, at experienced cancer centres where swallowing and voice rehabilitation is offered.[13] Speech pathologists are the key people who ensure such results occur and many are specialised in post-laryngectomy rehabilitation. They ensure that correct sizing, fitting and type of silicon voice prosthesis occurs post-surgery, before training patients (and/or families) to be self-caring with their speech devices.

Swallowing changes after total laryngectomy are under-researched and dysphagia is likely under-reported, as patients often expect to have changes in function and an altered diet, so they do not always report the full extent of their swallowing problems after laryngectomy.[14]

Oropharyngeal cancer

Sites of oropharyngeal cancer include the soft palate, retromolar trigone, tonsils, base of tongue and superior and lateral pharynx. If the base of tongue or pharyngeal wall is affected, then speech may not necessarily be grossly impaired, but swallowing almost certainly will be. The movement of the tongue base is crucial to the efficiency of the swallow, as this area contributes, via its pressure generation against the pharyngeal wall, to the propulsion of the bolus through the pharynx.[15]

Chemo-radiotherapy is commonly used in the management of oropharyngeal cancers. While data on swallowing outcomes after such treatment remains limited, a recent systematic review identified the most commonly reported impairments in swallowing after radiotherapy.[9] These included: poor pharyngeal motility with subsequent pharyngeal residue; epiglottic immobility; reduced laryngeal excursion; poor closure of the laryngeal vestibule; and, often silent, aspiration. Fibrosis of the pharyngeal/ laryngeal muscles reportedly contributes to the above problems, further compounding the pre-treatment effects of the tumour itself.

Surgery may involve the base of tongue and/or lateral pharyngeal walls, when velo-pharyngeal closure may be compromised resulting in nasal sounding (ie. hypernasal) speech and nasal reflux (usually of fluids) during swallowing.

Ablative surgery to the oropharynx usually includes combined resection of the soft palate and tonsillar pillars.[16] This type of resection can interfere with transport of a bolus through the pharynx, because normal sensory input is interrupted by use of tissue flaps for reconstruction. Such tissue flaps may be bulky and mechanically interfere with the passage of food. Further, they act passively, not actively, resulting in the loss of normal propulsive action supplied by the pharyngeal constrictors.

Management of speech problems

There are no published assessments of speech that are cancer-specific. Speech pathologists use tests such as the Frenchay Dysarthria Assessment (FDA),[17] a motor speech assessment standardised on a UK population of adults with dysarthria of neurological origin (eg. from Parkinson's Disease, Motor Neuron Disease, etc).

This test is used to measure speech impairment only and is divided into components, such as: respiration; tongue, lip, soft palate movements; ability to sustain vowel sounds; and intelligibility of words, sentences and conversation. Comparing age and gender-matched normative data, speech features that are defective can be identified using the FDA and then addressed in therapy.

In a recent study examining the effects of head and neck cancer on speech, the FDA was found to be a practical, valid and reliable tool for use with an Australian head and neck cancer population.[17] In that pre-treatment study, people with head and neck cancer were shown to have worse speech intelligibility than the general population and the site of cancer dictated the resulting speech impairment. Research needs to be undertaken to examine how head and neck cancer treatment may further impact on speech intelligibility.

Direct therapy to maximise residual function after treatment involves range of motion (ROM) and strength (resistance) exercises for lips and/or tongue, with the aim of improving either speech or swallowing (or both). There are no definitive published data on the effectiveness of ROM exercises, but researchers have reported promising results from a preliminary study of 102 patients with surgically treated oral and oropharyngeal cancer. Those who performed ROM exercises reported significantly better function (of swallowing and, to a lesser degree, speech) when compared to patients who did not complete these exercises.[18] Research is currently underway in the US, investigating the use of ROM exercises with the head and neck cancer population, to establish more convincing evidence as to their efficacy.

Following surgery, speech and swallowing rehabilitation should ideally commence as soon as suture lines/surgical defects have healed. While there are no definitive data on the optimal time for therapy to commence, patients who receive this during the first three months post-treatment have been shown to have a better outcome than did those who had later rehabilitation.[18] This is further supported by data documenting that the level of speech and swallowing function at three months post-treatment is characteristic of patients' function at one year later.[19,20] In a study by Pauloski,[19] patients received relatively small amounts of therapy during their post-treatment phase. Further research is required into the optimal dosage/type of therapy for maximising function.

Where speech is no longer possible, a communication aid may be helpful. A range of portable speech devices are available, from those with simple written output (eg. Lightwriter®), to synthetic speech boards (with pre-set phrases that can be pressed to speak, using an electronic voice output) or an artificial larynx (eg. Servox®), where a battery-driven vibrator, hand-held against the neck, provides a substitute for sound that is normally generated by the vocal folds. Many laryngectomees use such devices.

Each patient needs to be carefully evaluated for the use of any speech aid and their daily needs and requirements, as well as an assessment of physical (especially hand) dexterity, may direct the choice of a suitable aid.

Management of swallowing problems

Swallowing impairment may be managed using compensatory strategies and/or an active therapy program. The initial post-treatment assessment usually involves an oromotor and clinical swallowing examination, and appropriate compensatory strategies may be implemented at this time. However, in many cases a bedside clinical examination may not be enough, as detailed information about swallowing physiology, including the presence of silent aspiration, cannot be detected in this way. A videofluorography swallow study (VFSS) is the most commonly used method for accurately screening for aspiration in the head and neck population, as this procedure enables the whole tract and its physiology to be visualised. The volume and timing of the bolus presentation can be controlled, ensuring an accurate diagnosis of dysphagia, not just screening for (the presence or absence of) aspiration.

Compensatory strategies do not necessarily change the swallowing physiology, but rather they redirect and/or improve the flow and direction of food and eliminate the patient's symptoms, especially aspiration.[15] Compensatory strategies include: (i) postural changes

Table 1

Postures used for eliminating aspiration or residue, the disorders they are designed to address, and the rationale for their use.

Disorders observed on VFSSs	Posture applied	Rationale
Inefficient oral transit	Head back	Gravity clears oral cavity[21]
Delay in triggering the pharyngeal swallow	Chin down	Widens valleculae – stops bolus entering airway[22]
Reduced posterior tongue base movement	Chin down	Pushes tongue back towards pharyngeal wall[22]
Unilateral vocal fold palsy/ surgical removal of vocal fold	Head rotated to affected side	Directs bolus down stronger side; improves vocal fold closure[21,23]
Reduced closure of laryngeal entrance and vocal folds	Chin down; Head rotated to affected side	Improves protective position of epiglottis; narrows laryngeal entrance[22]
Unilateral pharyngeal palsy	Head rotated to affected side	Directs bolus toward stronger side of pharynx[23,24]
Reduced pharyngeal contraction	Lying down on one side	Eliminated gravity effect on pharyngeal residue
Unilateral oral and pharyngeal weakness (same side)	Head tilted to stronger side	Directs bolus toward stronger side by gravity[23,27]
Cricopharyngeal (c-p) dysfunction	Head rotated	Pulls cricoid cartilage away from posterior pharyngeal wall; reduces resting pressure in c-p sphincter[27]

Adapted from Logemann[15] and Sullivan[28]

which may change the dimensions of the pharynx, so giving better airway protection without increasing the effort or work for the patient during the swallow; (ii) sensory input being increased either prior to, or during, the swallow; (iii) modifying volume and speed of food presentation; (iv) changing food viscosity or consistency and; (v) introducing intra-oral prostheses.

Such compensatory strategies are often introduced first during a VFSS, when initial diagnosis of dysphagia is being made.

Table 1 presents the postures which have current evidence for their use and their rationale.

Although there are limited published data regarding the beneficial effect of palatal augmentation prostheses and/or obturators for improving speech and swallowing, these devices are commonly used in clinical practice. Their use markedly reduces oral residue after swallowing, as the prosthesis enables the patient to re-establish intra-oral pressure and/or allows them to achieve stronger tongue-to-palate contact for more efficient oral bolus transport.[29]

Active therapy procedures are designed to change swallowing physiology (not just to compensate for the dysphagia) and require the patient to follow the directions of the clinician and (usually) practise independently and regularly. Resistance, range of motion and bolus control exercises may also be included in a repertoire of active therapy procedures.

Swallowing manoeuvres are used to teach patients to gain voluntary control of selected aspects of the pharyngeal stage of the swallow.[27] Such manoeuvres may include a supraglottic swallow, where the airway can be voluntarily closed at the level of the true vocal folds before, and during, the swallow and the super-supraglottic swallow, which is designed to close the airway entrance by the patient bearing down after breath-holding. The action of bearing down closes the false vocal folds and tilts the arytenoids anteriorly to meet the base of the epiglottis, thus giving strong closure of the entrance to the laryngeal vestibule.

The Mendelsohn manoeuvre (voluntarily increasing the extent and duration of laryngeal elevation, thereby increasing the duration/width of cricopharyngeal opening) or an effortful swallow (designed to increase posterior tongue base movement) may both be used to manage problems in the pharyngeal stage of swallowing.

Conclusion

Speech and swallowing rehabilitation for people with head and neck cancer is a complex and specialised area of speech pathology work.

Many treatments for head and neck cancer result in speech and/or swallowing impairments and these, in turn, may reduce a patient's activity, societal participation and QoL.

Early referral to a speech pathologist is desirable – where possible, before head and neck cancer treatment commences.

Accurate diagnosis and evidence-based therapy can improve speech and swallowing deficits, and there is good scientific evidence for the use of many manoeuvres/compensatory strategies.

There is a need for multicentre, hypothesis-driven quality research into functional outcomes in people who are being treated for head and neck cancer. □

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