An interdisciplinary approach to voice disorders

Emma Farley (Meds 2013), Ashley Kim (Meds 2013)
Faculty Reviewer: Dr. K. Fung

The larynx serves the dual purpose of airway protection and phonation. It is covered by the epiglottis during swallowing, and is patent during respiration and phonation, during which air passes past the modified sides of the larynx, the vocal folds or cords. The upper border of the conus elasticus is thickened, which forms the true vocal folds. Histologically, the outermost layer of the vocal fold is composed of stratified squamous epithelium. Deep to this lies the lamina propria, a flexible fibrous layer containing elastin, collagen, and fibroblasts. The lamina propria is divided into three clinically important layers – superficial, intermediate and deep, which become gradually more stiff as the collagen to elastin ratio increases. Deep to this membranous cover lies the body of the thyroarytenoid muscle.

Phonation requires the presence of not only the vibratory vocal folds, but other upper airway structures – the pharynx, oral and nasal cavities - for resonance and articulation. Phonation is produced during the glottis cycle. The first step is the accumulation of air pressure beneath the approximated vocal folds. At a particular pressure, called the phonation threshold pressure, the vocal folds begin to part in a wave-like fashion from inferior to superior. The vocal folds are simultaneously moved laterally by the air column, and quickly return to the midline due to their intrinsic elastic properties. This cycle repeats approximately 100 times per second in men and 220 times/second in women. The amplitude, frequency, wave morphology and periodicity (volume, pitch and vocal quality, respectively) are varied by changes in air pressure and/or tissue quality. Amplitude is increased or decreased by providing a greater or lesser exhaled force, paired with an increase or decrease in tension of vocal folds (affected principally by the thyroarytenoid muscle). Pitch is increased by contraction of the cricothyroid muscle, which lengthens and thins the vocal folds, and decreased by contraction of the thyroarytenoid muscle, which shortens the fold and increases their mass.

Disorders of and disruptions to the vocal folds may have devastating consequences in everyday communication, and especially for those who rely on their voices professionally. This article will address some of the most common vocal disorders of professional singers, their cause, identification, management, prevention, and the role of a multidisciplinary team in maintaining vocal health.

VOCAL HYGIENE AND THERAPY

First-line treatment for many organic vocal disorders, such as nodules, polyps and cysts is vocal therapy. Vocal therapy serves to improve vocalization technique, and to minimize harmful behaviours, while maximizing healthful ones. Holmberg et al. used voice therapy in the treatment of vocal fold nodules, and showed perceptual improvement in vocal quality, and reduction in nodule size. Their protocol for vocal therapy consists of 5 different approaches to vocal health, and it was concluded that the therapy as a whole is required to significantly improve vocal quality. The first is vocal hygiene, which entails patient education on normal phonation, types of abusive behaviours (voice overuse) and abusive substances (smoke and caffeine), and etiology and consequence of vocal nodules. The second is respiration – a focus on reducing the effort of speech breathing and exercises to train the proper management of air supply. Third are direct facilitation measures which aim to reduce loudness, coupled with “yawn-sigh” exercises, which relaxes vocal musculature and softens vocal onset. The fourth is relaxation techniques and stress management. Last, the patients were instructed to carry over all of the above techniques to real situations.

A second element in vocal technique is the vocal warm-up. Warm-up exercises include stretches of the face and torso, deep breathing triggers, sustaining vowels on various pitches with varying intensity, humming and lip-buzzing, glides, and the production of consonants. The aim of the warm-up is to maximize phonation, resonance and respiration. Elliot et al., showed that vocal warm-up reduces viscosity of the vocal folds, but that this result alone does not uniformly increase ease of phonation (phonation threshold pressure) among subjects. It is instead hypothesized that the vocal warm-up affects other properties of the vocal folds, such as amplitude, vibration periodicity, and nervous control of laryngeal muscles. Baylock conducted preliminary research that studied the effect of vocal-warm up in four subjects with voice disorders. He reported a significant improvement in voice production according to acoustic measures and self-rating, but noted that more studies were needed to corroborate these results. A recurring problem in the literature seems to be the inter-subject variability in vocal physiology, and the difficulty of finding an adequate measure to assess the different effects of the warm-up. Therefore, the efficacy of warm up in voice disorders is still inconclusive.

A third consideration in the management of any vocal disorder is the prompt treatment of secondary dysphonia. Examples are acid reflux, acute laryngitis, and allergic laryngitis. One of the most important causes that should be ruled out is laryngopharyngeal reflux (LPR). Unlike the stomach, the larynx does not have the intrinsic ability to protect from gastric acid related mucosal damage. In addition to the inherent susceptibility of the larynx to acid damage, carbonic anhydrase type 3 (important in regulating pH by producing alkaline bicarbonate) is normally present in true vocal folds, however, diminished or absent in vocal folds affected by LPR.

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symptoms of LPR include throat clearing, hoarseness, excessive mucus, cough, globus sensation as well as laryngoscopic findings which include posterior laryngeal edema, true vocal fold edema, and pseudosulcus9,11(Figure 2). The general approach to the treatment of LPR is similar to the treatment of gastroesophageal reflux8. Dietary modifications consist of limiting foods and beverages containing caffeine, alcohol and peppermint, which may weaken lower esophageal sphincter tone11. The evidence surrounding the use of PPIs for the management of LPR remains somewhat inconclusive9-11. However, for patients with LPR who have symptoms that impact their professional or social responsibilities (like singers, actors, lecturers), it is recommended that treatment with PPIs be started at high doses11, as well as administration of H2 blockers and antacids when reflux is anticipated after meals9.

In all cases of voice disorders, a multidisciplinary team consisting of otolaryngologists, family physicians, speech pathologists and vocal teachers are required. While speaking voice is sometimes unaffected by vocal fold lesions, the reduced vocal range, increased effort and impaired endurance experienced by professional singers, have far greater implications to their career12. The possibility of secondary causes of dysphonia such as LPR, highlights the significance of a thorough history and physical, which can reveal risk factors and possible etiologies that lie outside the larynx. The role of the family physician is particularly important in isolating and directing appropriate treatment or referral14. The role of the speech language pathologist lies in the education of regular speech, assisting in phonation, articulation, respiration and resonance12. Vocal teachers contribute specialized expertise in vocal hygiene, warm ups and education of proper singing techniques, as well as general professional guidance. Not surprisingly, it is widely appreciated that combined interdisciplinary treatment modalities support better outcomes for patients12-14.

PROBLEMS FOR SINGERS: VOCAL FOLD LESIONS

Benign vocal fold lesions are common in professional voice users. The most likely culprit of these lesions include vocal overuse, misuse (excessive muscle tension) and abuse (voice overuse or whispering)15. During any of these acts, there is excessive mechanical stress applied to the vocal folds. The mechanical stress of excessive vibrations of the vocal fold affect the vocal fold mucosa itself, rather than the underlying musculature16,17, resulting in fatigue damage18. Vocal tissue traumatized by repeated collision forces, vocal fold accelerations and decelerations, and heat dissipation, which result in tissue breakdown and remodelling16,17,19. The remodelling phase induces mass lesions, including vocal fold nodules, polyps and cysts. While the histology and pathology of benign vocal lesions is not fully understood, some studies try to correlate the different types in order to determine the best possible management15.

Vocal polyps are benign, hyperplastic lesions of the laryngeal mucosa. They are normally situated unilaterally20 and anteriorly on the vocal fold21. It is hypothesized that vocal polyps are due to areas of vibration-induced hyperaemia and vasodilatation resulting in edema21. The edema then leads to degeneration or fibrosis21. Vocal polyps are also associated with smoking and acid reflux22. First-line treatment is generally regarded to be vocal behavioural therapy15, but debate remains over whether patients should primarily attempt vocal therapy measures (as in the case of vocal fold nodules), or proceed immediately to surgical intervention. A well-defined microphonosurgery exists, developed by Hochman and Zeitels, which preserves more of the vocal fold microstructure than typical cold instrument or laser removal22. Stajner-Katusic et al., investigated the vocal quality of five males, before, one month after and six years after surgical vocal polyp removal. Their data showed significant improvement of vocal quality across several vocal measures, including self-estimation by the participants23. Conversely, Cohen and Garrett showed that vocal therapy was effective in improving vocal quality, by reducing the size of vocal polyps (but not eliminating vocal polyps) in 50% of their participants, while the other half required surgery24. The response to treatment was attributed to the polyp type. Translucent (immature, edematous) polyps, seen by videostroboscopy, were significantly more likely to benefit from vocal therapy, when compared to fibrotic, hyaline, or hemorrhagic (mature) polyps24. In addition, incomplete glottal closure after vocal therapy was discussed as a potential indication for surgical referral. Without glottal closure, air would still escape during singing and phonation, resulting in persistently inefficient vocal use, suggesting the need for aggressive treatment24. In this study, long-term follow-up was not performed, and there was no accounting for differences in methodology between vocal therapists. It was concluded that although not for everyone, there is a specific patient population that would maximally benefit from vocal therapy alone, while others should proceed directly to surgery24.

Nodules, or “singer’s nodes” occur bilaterally and symmetrically on the vocal folds and are attributed primarily to vocal abuse or misuse1,25(Figure 3). Vocal fold nodules, similarly to polyps, are benign areas of edema and fibrosis25. It is worth noting that the difference between nodules and polyps is not always evident, and there is a lack of clear histological distinction26. Vocal fold nodules present with hoarseness and breathiness due to a failure of the vocal folds to approximate, pitch breaks and fatigability25. As detailed above, the first line treatment for vocal nodules is behaviourally-based vocal therapy1. An intervention review in 2009 found that there were no high quality randomized controlled trials, which compared surgical and non-surgical interventions for vocal nodules26. The article reiterates the lack of definite histologic distinction between nodules and polyps, as well as the lack of gold-standard assessment measures of vocal quality as barriers to performing adequate trials26. Other vocal fold pathology that is important to rule out by an otolaryngologist, include laryngeal papillomatosis, granulomas, dysplasia and carcinoma, all of which have been documented in singers as causes for voice impairment.

CONCLUSIONS

Like many other occupational health issues, dysphonia is associated with decreased quality of life, and may lead to loss of work in populations whose professions rely on vocal ability27. Otolaryngologists provide a major role in both surgical and non-surgical corrections of nodules that are not amenable to conservative, behavioural or vocal therapy treatments. Surgery was once believed to be professional suicide for singers a decade ago15, but this rapidly changing perspective reflects the advances in microsurgery that have created positive outcomes for appropriately selected patients23,24. Voice medicine reiterates the importance of multidisciplinary care and combined expertise that cater to the overall goals of a particular patient population. As always, health care professionals should be aware of these modalities that lie outside of traditional medicine.

REFERENCES