Histopathologic and Physiologic Features of the Aging Larynx

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Age-related changes in larynx can have a direct impact on voice quality and general comfort level. Furthermore, older people are often exposed to a wide array of environmental and medicinal irritants (indirect factors) that compound the problem, particularly in the case of long-term tobacco smoking. Older patients may also suffer from a host of medical conditions that can affect vocal quality, such as cancer, vocal fold paralysis, Parkinson's disease, amyotrophic lateral sclerosis, benign essential tremor, diabetes, and other endocrine dysfunctions.

Histopatholgic Features

Histologic changes seen within the aging larynx appear to occur with approximately equal frequency in both sexes. Histologic examination suggests that the yellowish discoloration seen clinically represents fat degeneration or keratosis of the mucous membrane.

Age-related changes have been observed in laryngeal muscles. These include change in the distribution and size of muscle fibers and a loss of muscle mass. In the vocalis muscle, observations have included atrophy, degeneration and decrease in fiber diameter. Breakdown of fibrous support of the muscle and type I and type II fiber decrease have been reported. Other age-related laryngeal muscle changes included changes in the suspensatory muscle, which may contribute to diminished laryngeal elevation.

All three layers of the lamina propria (deep, intermediate and superficial) have been reported to change with age. Changes in the deep layer in males include collagen fiber breakdown and increase in density. It has been suggested that these changes may contribute to bowing and irregularities in the medial (vibratory) surface of the vocal folds. In females, little change has been reported in the deep layer. It has been reported that the intermediate layer becomes thinner, there is a decrease in density of fibers and a deterioration in contour. Elastic and collagen fiber bundles began to lose their well-defined weave. The collagen fibers have a tendency toward separation and waviness. The elastic fibers have evidence of fragmentation and breakdown. In the superficial layer, connective tissues thicken and become edematous. Reports on changes in the epithelium include: increases in thickness with age, thinning and yellowing with less firm attachment to the underlying lamina propria.

Effects of aging have been observed in laryngeal glands, mainly vestibular ones. Mucous glands may degenerate or atrophy, vestibular glands involute with increasing age. A decrease in the amount and quality of secretions may cause the surface of vocal folds to become dry or less hydrated and result in irregular vibration and laryngeal sicca syndrome.

Observations of aging in laryngeal cartilages have included calcification and ossification of hyaline cartilages. Changes in the cricoarytenoid joint include thinning of articular surfaces, breakdown and disorganization of collagen fibers in cartilage matrix and surface irregularities; it has been suggested that these changes may influence the extent of approximation of vocal folds and smoothness of adjustments during voicing.

Physiologic Features

The classic characteristics that listeners associate with 'old voice' include reduced loudness, hoarseness or harshness, lower pitch, vocal tremor, increased breathiness, increased strain and unsteadiness.

A number of studies have identified acoustic characteristics associated with advanced age and these include: for males, higher fundamental frequency, higher variability in fundamental frequency and intensity, increased perturbation (jitter) and greater spectral noise; for females, lower fundamen-

tal frequency, increased variation in fundamental frequency and increased jitter.

Age-related aerodynamic changes have been measured in laryngeal airway resistance, subglottal air pressure and air flow duty cycle in males, but less so in females. In males, bowing, glottal incompetence and prominence of vocal processes have been reported. In females, edema and lower laryngeal position have been observed. On videostroboscopy, glottal incompetence, reduced periodicity and amplitude of mucosal waves are changes that have been associated with aging voice.

Reduced laryngeal EMG amplitudes and decreased firing rates were observed for the thyroarytenoid muscle in old compared with young individuals, with changes in firing rate observed only for older males. While subglottal air pressures were comparable, absolute EMG values for the thyroarytenoid and lateral cricoarytenoid muscles as well as for sound pressure level (SPL) were lower for old compared to young individuals. These differences were observed consistently and were interpreted to be associated with muscle atrophy, peripheral degeneration or reduced central drive to laryngeal motor neuron pools. It was suggested that old individuals appeared to have a weaker and less efficient laryngeal adductory system.

Histopathologic and physiologic features document age-related changes in laryngeal structure and function with advancing age. These changes contribute to a functional age-related impact of vocal hypofunction or compensatory hyperfunction.