LARYNGEAL AFFERENTS AND THEIR REFLEX ACTIONS
(for full explanation see unabridged document)
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Respiratory Functions of the Larynx
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In keeping with its many physiological roles and the need for several types of feedback control, the larynx has a rich sensory innervation. A few afferent fibers run in the RLNs (181,211), but by far the major share are in the SLNs, chiefly in the internal branches (137, 230, 233). As noted by Sant'Ambrogio et al. (183), the internal branch of the SLN of the cat contains -2,200 myelinated afferent fibers (57) compared with -3,000 in the cervical vagus, which supplies most of the thoracic and abdominal viscera (1). These numbers emphasize the abundance of sensory information that the larynx provides relative to its size.

Many investigators have recorded the activity of single afferent fibers in the SLN (4,25,29,48,50,72,112,132,136,181-185,199-201,210). The literature is confusing because different classification schemes have been adopted by different workers. Detailed reviews of laryngeal receptor physiology have been published by Wyke and Kirchner (233) and Widdicombe (230).

A. Mechanoreceptors

The most thoroughly investigated general category of laryngeal receptors are those responding to displacement or deformation, i.e., mechanoreceptors. Sampson and Eyzaguirre (181) distinguished "touch" receptors, lying in or near the laryngeal mucosa, and "deep" mechanoreceptors, which appeared to be located in the laryngeal muscles or joints. Boushey et al. (29) classified mechanoreceptors in two groups, depending on their spontaneous activity: group 1 fibers had little or no spontaneous.activity and most adapted quickly after mechanical stimulation, whereas group 2 fibers were spontaneously active and showed slow and incomplete adaptation. Group 1 units were stimulated by ammonia, S02, and COZ, whereas those in group z were unaffected by SO2 and inhibited by C02. Recent studies by Davis and Nail (48,50), using similar classification criteria ("silent" and "tonic" receptors), confirm many of the findings of Boushey et al. (29) and provide a detailed description of the responses of both types of receptors to static and dynamic (vibratory) mechanical stimulation.

Hwang et al. (101) studied the responses of SLN afferents to sustained changes in transmural pressure of the isolated upper airway in cats. Although some of the units studied were initially silent, all responded to positive or negative pressure steps and most adapted slowly and incompletely to sustained transmural pressure differences.

In a series of investigations, Sant'Ambrogio and colleagues (136, 182-185) used a spontaneously breathing animal preparation, employing a T-tube tracheotomy, to identify and classify laryngeal receptors, according to their responses to transmural pressure, airflow, and laryngeal movements. By use of this preparation, which enables the investigator to direct the respiratory airflow through the upper airway or to divert it through the tracheotomy, three types of receptors were identified and characterized. "Pressure" receptors, many of them tonically active, show slowly adapting increases in activity in response to collapsing or less commonly distending transmural pressures in the larynx (136,183). These receptors are similar to the "group 2" receptors of Boushey and co-workers (29) and the "tonic" units of Davis and Nail (48, 50). "Flow" receptors, initially identified by their response to airflow through the larynx (183), have subsequently been found to be **"cold"** receptors, which are activated by convective and evaporative cooling of the laryngeal mucosa during inspiration (182, 185). These units, which are insensitive to gentle mechanical stimulation, do not correspond to the "silent" receptors of Davis, which responded to local probing and were not consistently activated by cold air or saline (48). Finally, some receptors ("drive" receptors) are activated by laryngeal movements accompanying the breathing cycle (183, 184). Some of these units become inactive during laryngeal muscle paralysis by cold blockade of the RLNs, but others are activated entirely or in part by transmitted tracheal motion (184).