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Coordination of intrinsic and extrinsic tongue muscles during spontaneous breathing in the rat.

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The muscular-hydrostat model of tongue function proposes a constant interaction of extrinsic (external bony attachment, insertion into base of tongue) and intrinsic (origin and insertion within the tongue) tongue muscles in all tongue movements (Kier WM and Smith KK. Zool J Linn Soc 83: 207-324, 1985). Yet, research that examines the respiratory-related effects of tongue function in mammals continues to focus almost exclusively on the respiratory control and function of the extrinsic tongue protrusor muscle, the genioglossus muscle. The respiratory control and function of the intrinsic tongue muscles are unknown. Our purpose was to determine whether intrinsic tongue muscles have a respiration-related activity pattern and whether intrinsic tongue muscles are coactivated with extrinsic tongue muscles in response to respiratory-related sensory stimuli. Esophageal pressure and electromyographic (EMG) activity of an extrinsic tongue muscle (hyoglossus), an intrinsic tongue muscle (superior longitudinal), and an external intercostal muscle were studied in anesthetized, tracheotomized, spontaneously breathing rats. Mean inspiratory EMG activity was compared at five levels of inspired CO2. Intrinsic tongue muscles were often quiescent during eupnea but active during hypercapnia, whereas extrinsic tongue muscles were active in both eupnea and hypercapnia. During hypercapnia, the activities of the airway muscles were largely coincident, although the onset of extrinsic muscle activity generally preceded the onset of intrinsic muscle activation. Our findings provide evidence, in an in vivo rodent preparation, of respiratory modulation of motoneurons supplying intrinsic tongue muscles. Distinctions noted between intrinsic and extrinsic activities could be due to differences in motoneuron properties or the central, respiration-related control of each motoneuron population.

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