Respiratory variability modulated by vagal and spinal pulmonary afferents

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Introduction: Respiratory variability is important in order to respond to internal and external perturbations. While vagal afferents have been shown to be important for feedback during breathing, the influence of spinal afferents has not been as well described. We hypothesized that disruption of vagal and spinal afferents reduces respiratory variability during eupnea and alters respiratory response during thoracic mechanical restriction (banding).

Objective: To prove that disruption of vagal and spinal afferents reduces respiratory variability during eupnea and alters respiratory response during thoracic mechanical restriction

Material and Methods: We measured costal diaphragm and thyroarytenoid electromyography (EMG) activity in sodium pentobarbital anesthetized spontaneously breathing male and female Sprague Dawley rats. We conducted three sets of experiments to elucidate contributions of vagal, and spinal afferents: A) inhalation of 10% nebulized lidocaine to attenuate pulmonary vagal afferents B) bilateral injections of 10% lidocaine into the pleural space to attenuate thoracic afferent feedback; C) bilateral tracheal vagotomy caudal to the larynx. Solutions of 10% lidocaine were mixed with saline and 2% Evans Blue dye to confirm the distribution of lidocaine following nebulization and injection. Additionally, banding was performed before and after each experimental protocol.

Results: Banding significantly increased costal diaphragm amplitude which was further increased with each intervention, however there was a gender specific increase in thyroarytenoid activity with only ~50% of males demonstrating this phenomenon. Both lidocaine protocols demonstrated features of vagotomy including reduction of each eupneic phase duration coefficient of variance as well as alterations in EMG amplitude.

Conclusions: These results demonstrate gender-specific effects of the respiratory system to challenges, and provide preliminary evidence of the importance of non-vagal pulmonary feedback. Moreover, this present study could have broad clinical implications in disorders such as spinal cord injury.

Keywords: vagal, spinal injury, respiratory variability, eupnea, respiratory response, thoracic mechanical restriction, gender

This work **was supported by** NIH grants HL 111215, HL 103415 and OT20D001983, the Craig F. Neilson Foundation Pilot Research Grant 546714, Kentucky Spinal Cord and Head Injury Research Trust, and the Commonwealth of Kentucky Challenge for Excellence.