Published in final edited form as:
Respir Physiol Neurobiol. 2011 October 15; 179(1): 1–2. doi:10.1016/j.resp.2011.06.027.

Respiratory muscles and motoneurons ☆

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1. Foreword

In this Special Issue of Respiratory Physiology & Neurobiology we seek to draw attention to respiratory muscles and motoneurons, including how they are recruited during respiratory and non-respiratory tasks, and how they develop. Although the content favors consideration of fundamental scientific issues, there is considerable information on system responses, including one review that describes how hypoglossal motoneurons are being used as a model to address motoneuron pathology. The common thread arising from this collection of articles is that we know remarkably little about the mechanism/s by which respiratory muscle motoneurons are recruited during breathing. This deficiency is due in large part to the challenges of recording from respiratory pump and upper airway muscles in behaving human subjects, but nonetheless continues to hamper the translation of findings obtained in animal preparations to the bedside; a challenge that we suggest can only be overcome by attracting young physician scientists to the field.

Our current knowledge of respiratory motoneuron physiology, even in reduced animal models, is derived primarily from the study of phrenic and hypoglossal motoneurons. Comparatively little work has been done on other inspiratory and especially expiratory muscle motoneuron pools. However, even within the well-studied phrenic and hypoglossal motoneuron pools, some key questions remain. For example, many investigators have considered the hypoglossal system to be a homogenous motoneuron pool despite the fact that this motor nucleus supplies drive to seven different muscles in the mammal tongue. In addition, the physiologic mechanisms determining respiratory motoneuron recruitment order

☆This is the Foreword for the Special Issue “Recruitment of Respiratory Motoneurons”, guest-edited by Fregosi et al.

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have not been definitively established, and whether or not the capacity for neuroplasticity is similar for different respiratory motoneurons within and across motor pools is not known.

The eleven articles contained within this Special Issue cover a wide range of topics that we consider important to the field of respiratory muscle motoneuron physiology. The issue begins with a review of spinal respiratory motoneurons and interneurons with insights from studies of spinal cord injury (Lane, 2011), a comparison of phrenic and upper airway motoneuron recruitment patterns in breathing-related and volitional tasks in both animal (Mantilla and Sieck, 2011) and human models (Hudson et al., 2011), and the central, respiration-related control of phrenic (Lee and Fuller, 2011) and expiratory muscle motoneurons (Iizuka, 2011). From here, the integrated control of pump and upper airway muscle motoneurons is examined, including the response to respiratory loads (Hill and Eastwood, 2011) and a comparison of neuroplasticity in the phrenic and hypoglossal motoneuron pools (Baker-Herman, 2011). A consideration of the major gaps in our understanding of tongue muscle and hypoglossal motoneuron anatomy and physiology is considered next (Fregosi, 2011), followed by a detailed discussion of the respiration-related and volitional control of genioglossus muscle motor units (Bailey, 2011). The issue concludes with a consideration of how synaptic transmission in the hypoglossal motoneuron pool develops (Berger, 2011), as well as how excitotoxic and oxidative stress alters the function of developing hypoglossal motoneurons (Cifra et al., 2011).

Contained within each article are kernels of information that we hope will reinvigorate research in the field, resurrect old ideas or identify new directions that will move the field quickly and vertically, rather than slowly and horizontally. Although suggestions to forge new collaborations and to incorporate the most advanced tools into our work may appear especially daunting when competition for funding is so fierce, we believe that these strategies are the most efficient means of moving the field forward.

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