Abstract Preview - Step 3/4

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Session: W30 Neural mechanisms of respiratory rhythm generation

Title: Multiple oscillators for respiratory pattern formation

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Text: The mammalian respiratory central pattern generator (CPG) exhibits robust but flexible behaviour. The core circuitry of this CPG is located within the pre-Bötzinger (pre-BötC) and Bötzinger (BötC) complexes. This circuitry sends and receives drives from other brainstem compartments, such as the retrotrapezoid nucleus/parafacial respiratory group (RTN/pFRG), pons, nucleus tractus solitarii and raphé. Using the arterially perfused *in situ* preparation, we demonstrate that the mechanisms essential for breathing involve both intrinsic cellular properties and network interactions, with a major emphasis on reciprocal inhibition. We have described three different oscillatory regimes whose expression is dependent on metabolic state, physiological or pathological conditions. Under normal conditions, the CPG produces normal breathing characterized by a three-phase respiratory pattern consisting of inspiration, post-inspiration and E2 phase of expiration. Removal of the pons induces apneusis, a two-phase pattern featuring prolonged periods of inspiration and lack of post-inspiratory activity. One-phase oscillations occur following prolonged anoxia, when the CPG produces gasping, essential for auto-resuscitation. We have recently described a fourth oscillatory regime involving interactions between the respiratory CPG core (BötC /pre-BötC) and a second late-expiratory (late-E) oscillator located in the RTN/pFRG. We proposed that in eupnoea, the late-E oscillator is inhibited by BötC /pre-BötC circuits. The late-E oscillations emerge with enhanced respiratory efforts (during hypercapnia or anoxia). These drive late-E discharges in the abdominal nerve, providing the active expiration function, and are coupled with the respiratory oscillations produced by the BötC /pre-BötC core. We have developed a large-scale computational model of interactions between BötC /pre-BötC and RTN/pFRG circuits to suggest and explain the role of late-E oscillations. The model provides important insights into rhythm and pattern generation, and the etiology of respiratory pathologies. Our findings reveal the remarkable plasticity within the respiratory neural network and explain the mechanisms for metabolic state-dependent rhythms.
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