

New insights into gill chemoreception: Neuroepithelial cells as multi-functional O₂, CO₂ and ammonia sensors

William K. Milsom, Michael G. Jonz and Steven F. Perry

Department of Zoology, University of British Columbia and Department of Biology,
University of Ottawa, Canada.

Early studies on the control of cardiorespiratory reflexes in fish demonstrated the important role of the gill in mediating responses to hypoxia. By the mid-1990s, physiological studies aimed at recording directly from the gill nerves solidified the gill as a major site of O₂ chemoreception, while microscopic examination had identified a population of neuron-like, neuroepithelial cells (NECs) of the primary gill filaments as the likely O₂ chemosensors. A number of laboratories are now investigating the structural, physiological and biochemical aspects of chemosensing by gill NECs in a variety of species, and their role in mediating cardiorespiratory reflexes. Recent studies have shown that gill chemoreceptors in fish mediate not only ventilatory responses to low O₂, but also high CO₂ and ammonia. Moreover, NECs isolated from dispersed gill tissue responded directly to changes in these gases. Thus, gill NECs are emerging as multi functional sensors that regulate ventilation. While the specific molecular mechanisms of sensing and transduction in NECs are still largely unknown, important elements appear to be inhibition of membrane K⁺ channels, which generates a receptor potential, and voltage-gated Ca²⁺ entry. In addition, there is now evidence that hydrogen sulfide may act as an O₂ sensor.