New insights into gill osmoregulation: Control of the paracellular pathway

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The role of the teleost gill epithelium in osmoregulation has been the subject of numerous studies. Within this area, mechanisms of transcellular solute movement through gill ionocytes and the transport machinery associated with these processes are usually the center of attention. In contrast, factors that regulate the paracellular transport pathway have received less consideration. Nevertheless, it is broadly acknowledged that alterations in the paracellular permeability of the teleost fish gill epithelium contribute significantly to overall strategies of osmoregulation. In vertebrate epithelia, paracellular permeability is regulated by the tight junction (TJ) complex, which is the apical-most juxtaluminal cell-cell element. The TJ complex is composed of transmembrane and cortical TJ proteins, and the protein composite of the complex appears to control the 'barrier' properties of the structure. Recent studies have revealed a large number of genes encoding for TJ proteins in teleost fishes. This is primarily attributable to an expansive claudin superfamily, but also includes the transmembrane protein occludin as well as cytosolic zonula occludens-1. However, in an architecturally complex heterogeneous epithelium such as the teleost fish gill, the challenge is to experimentally dissect which TJ proteins play an important role in osmoregulatory strategies. Recent progress in this area is discussed.