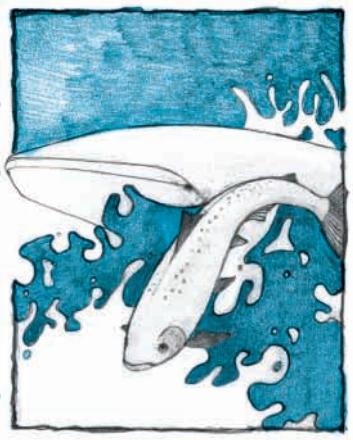
ION TRANSPORT



PENDRIN PROTEIN PRESENT IN EURYHALINE ELASMOBRANCH!

Pendrin is a recently discovered protein in mammals that has the ability to transport chloride ions in exchange for a variety of different molecules including bicarbonate. Chloride/bicarbonate exchange is important in euryhaline organisms and it insures chloride uptake when the animal is in freshwater. David Evans' team presents new evidence that pendrin is present in the Atlantic stingray (*Dasyatis sabina*) gill tissue, which is believed to be the site of chloride/bicarbonate exchange in the elasmobranch.

Bicarbonate and protons are produced in the cell by the enzyme carbonic anhydrase. The active elimination of protons from within the cell by V-ATPases leaves bicarbonate to build-up, creating a favorable bicarbonate gradient for chloride/bicarbonate exchange. Evans' lab recently collected evidence suggesting that pendrin is responsible for chloride/bicarbonate exchange in V-ATPase cells of the mammalian kidney.

In elasmobranchs (sharks, skates and rays), the gills are the primary site of acid/base-related ion transport. Up until now, the identity or cellular location of a chloride/bicarbonate exchanger in the elasmobranch gill was not known, even though evidence suggests that net bicarbonate secretion occurs across the gill epithelium. However, there are cells in the elasmobranch gill teeming with V-ATPases, which are similar to the bicarbonate-secreting cells in the mammalian kidney where pendrin is found. Thus, there were three main objectives of the present study. Firstly, the authors sought to determine if pendrin-like transporters were present in elasmobranch gill cells. Secondly, if the presence of this transporter was dependent on whether the stingray was adapted to freshwater or seawater. And thirdly, whether these transporters are associated with cells that are rich in V-ATPases, similar to the bicarbonate-secreting cells of the mammalian kidney.

By using semiquantitative immunoblotting, a pendrin or pendrin-like exchanger was located in the gills of both freshwater and marine Atlantic stingrays. The relative abundance of pendrin immunoreactivity was highest in the gills of freshwater stingrays. Immunohistochemical findings demonstrated that the location of these pendrin-like transporters on the gill filament was also influenced by environmental salinity, as freshwater stingrays appeared to have more discrete pendrin immunoreactivity on the apical membrane of the cell, which separates the external environment from the cell's interior. As Piermarini and co-workers point out, greater protein expression and apical membrane association of a pendrin-like exchanger in freshwater stingray gills makes sense, as there is a crucial need for enhanced chloride uptake from freshwater in order to counteract the large diffusional loss of chloride into the environment. Double-labeling experiments clearly demonstrated that pendrin immunoreactivity was found in V-ATPase-rich cells, similar to the mammalian kidney. Therefore, these elasmobranch gill cells could potentially be the site of pendrin-mediated chloride/bicarbonate, similar to chloride/bicarbonate exchange in the mammalian kidney. However, the function of pendrin in the stingray gill is yet to be determined.

This study presents the first evidence of a pendrin-like transporter in an ion-transporting tissue from any lower vertebrate and has furthered the development of the Atlantic stingray gill epithelium ion transport model.

10.1242/jeb.00151

Piermarini, P. M., Verlander, J. W., Royaux, I. E. and Evans, D. H. (2002). Pendrin immunoreactivity in the gill epithelium of a euryhaline elasmobranch. *Am. J. Physiol.* **283**, R983-R992.

M. Danielle McDonald
University of Miami
mcdonald@rsmas.miami.edu