Fluid equilibrium in prehistoric organisms sheds light on a turning point in evolution

September 22 2011

Maintaining fluid balance in the body is essential to survival, from the tiniest protozoa to the mightiest of mammals. By researching recent genomic data, Swiss researchers have found genetic evidence that links this intricate process to a turning point in evolution.

The study was led by Bernard Rossier, Professor Emeritus, University of Lausanne, along with colleagues Romain A. Studer, Emilie Person, and Marc Robinson-Rechavi. Dr. Rossier will discuss the team's findings at the 7th International Symposium on Aldosterone and the ENaC/Degenerin Family of Ion Channels, sponsored by the American Physiological Society. Dr. Rossier's presentation, "Evolution of ENaC and Na-K-ATPase as Limiting Factors of Aldosterone Action," is based in part on the team's recent article published in the journal *Physiological Genomics.*

Timing Is Everything

In humans, the hormone aldosterone affects fluid balance by controlling the epithelial sodium channel (ENaC), a protein that traverses a cell's membrane and facilitates the movement of salt into and out of the cell. By searching for genes that descended from a common ancestral DNA sequence (homologs), the researchers found that the emergence of ENaC and Na, K-ATPase (sodium pump), an enzyme that also plays a role in sodium transport, coincided with the emergence of multi-celled organisms.

Dr. Rossier and his team focused their analysis on eukaryotes—organisms whose cells contain complex structures within enclosed membranes¬—and sought to determine when and where on the eukaryotic family tree ENaC first appeared. When tracing the alpha, beta, and gamma subunits of ENaC back, the team found that the beta subunit appeared slightly before the emergence of Metazoans (multicellular animals with differentiated tissues) roughly 750 million years ago.

"The alpha subunit is an old protein found everywhere, in any kind of organism, but the beta and gamma subunits appear much later in evolution," said Dr. Rossier. "The appearance of the beta subunit is particularly significant because it is required for the function of the sodium pump. Without it, a functional sodium pump cannot be expressed at the cell surface. What is interesting is that it appeared right before the dividing point between unicellular organisms and multicellular organisms."

The team also found homologs of ENaC in a single-celled organism, the Naegleria gruberi. Although N. gruberi is a eukaryote and shares a common ancestor with Metazoans, it is located on a different branch of the eukaryotic family tree, among the Excavates. At first glance it might make sense to assume that both Metazoans and Excavates got their ENaC from their common eukaryotic ancestor, but ENaC is absent in all other branches of the eukaryotic tree.

Dr. Rossier said that although it is possible that the genes for ENaC originated in the common ancestor of eukaryotes and were lost in all branches except the Metazoa and the Excavates, there is another possibility. There could have been a lateral transfer of genes between N. gruberi and a Metazoan ancestor, one that lived between the last common ancestor of all eukaryotes and the first Metazoans.

Whether a Metazoan transferred the genes for ENaC to N. gruberi or the other way around, Dr. Rossier is not sure. Either way, the fact that ENaC gene family appeared just before the emergence of Metazoans suggests it is somehow linked to the development of multi-celled organisms, he said.

More information: Dr. Rossier's presentation, "Evolution of ENaC and Na-K-ATPase as Limiting Factors of Aldosterone Action," is based in part on the team's recent article published in the journal *Physiological Genomics.*

Provided by American Physiological Society

Citation: Fluid equilibrium in prehistoric organisms sheds light on a turning point in evolution (2011, September 22) retrieved 25 April 2024 from https://phys.org/news/2011-09-fluid-equilibrium-prehistoric-evolution.html