Newly discovered molecular switch helps decide cell type in early embryo development

August 11 2008

Researchers have discovered a central molecular switch in fruit fly embryos that opens new avenues for studying the causes of birth defects and cancer in humans. Writing about their study in the Aug. 12 *Developmental Cell,* scientists at Cincinnati Children's Hospital Medical Center determined the switch to be a main tuning mechanism for instructing cells whether to form sensory nerves or blood cells in different parts of the body.

The molecular switch occurs when two central control genes, Hox and Senseless (Sens), compete for influence to regulate genetic signals that instruct cells to differentiate and begin tissue and/or blood formation, said Brian Gebelein, Ph.D., a researcher in the division of Developmental Biology at Cincinnati Children's and corresponding author of the study.

Conserved between species through the course of evolution – all the way from Drosophilia fruit flies to vertebrates and humans – Hox genes are responsible for regulating other downstream genes, to determine body position and help form major body structures during early development. Sens regulates downstream genes that support the development of sensory organs, such as those important to hearing, touch or sight.

Dr. Gebelein said the competition between Hox and Sens appears to be complementary, creating a balance of instructional influence that results in normal development. Looking forward the researchers plan to deepen their understanding of how this balance works, and what happens in the

way of birth defects or disease when it becomes unbalanced should Sens or Hox exercise excessive dominance.

"We now have a central mechanism we can use as a tool to look for triggers in the genome that work with Hox and Sens to regulate the formation of neurons and blood cells," said Dr. Gebelein. "This allows us to identify other key genes downstream of Hox and Sens, determine their role in development based on what happens with cell fate decisions, and look for the causes of birth defects and disease."

Although Hox genes have long been known to specify distinct cell types along the developing body axes of vertebrates and non-vertebrates, it hasn't been clear how they regulate downstream gene transcription to form specific cells or tissues. In what the researchers called "an unexpected Hox transcriptional mechanism," they detected the permissive regulation of a secreted protein called EGF, or epidermal growth factor. EGF is a cell messenger protein that affects cell differentiation, growth and epidermal development. The research team noticed that Hox's permissive regulation of EGF led to cell specification when it interacted with the influence of Sens in the peripheral nervous system.

Dr. Gebelein's laboratory studies nervous system development and genes that specify neuron subtypes, their formation and how they migrate to their appropriate locations in the developing body. Understanding the influence of Hox transcription factors in cell differentiation along the anterior and posterior axis of the Drosophilia melangaster fruit fly is an important focal point of this research.

In collaboration with H. Leighton Grimes, Ph.D., of Cincinnati Children's division of Immunobiology, Dr. Gebelein is also studying how Hox competes with Sens and its control of a growth factor called Gfi-1. In the current study, the researchers note that ongoing mouse studies at

Cincinnati Children's show Gfi-1 and Hox are linked to neural and blood development. The researchers are looking into the implications this has for leukemia, said Dr. Gebelein, also an associate professor of pediatrics at the University of Cincinnati School of Medicine.

Source: Cincinnati Children's Hospital Medical Center

Citation: Newly discovered molecular switch helps decide cell type in early embryo development (2008, August 11) retrieved 1 May 2024 from https://phys.org/news/2008-08-newly-molecular-cell-early-embryo.html

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.