MedicalXpress

Researchers identify traffic cop mechanism for meiosis

December 12 2013, by James Devitt

Researchers at NYU and the Whitehead Institute for Biomedical Research have identified the mechanism that plays "traffic cop" in meiosis—the process of cell division required in reproduction. Their findings, which appear in the journal eLife, shed new light on fertility and may lead to greater understanding of the factors that lead to birth defects.

"We have isolated a checkpoint that is necessary for a genome's viability and for normal development," says Andreas Hochwagen, an assistant professor in NYU's Department of Biology, who co-authored the paper with Hannah Blitzblau, a researcher at the Whitehead Institute for Biomedical Research. "Without this restraining mechanism, chromosomes can end up irreversibly broken during meiosis."

Most cells in an organism contain two sets of chromosomes, one inherited from the mother and the other from the father. However, sexual reproduction relies on the production of gametes—eggs and sperm—that contain only one set of chromosomes. These are produced through a specialized form of cell division—meiosis.

In this process, maternal and paternal versions of each chromosome pair up and swap sections of their DNA through a process known as homologous recombination—a "reshuffling" that gives rise to chromosomes with new combinations of maternal and paternal genes. This is followed by cell division.

However, in order for normal development to occur, chromosomes must be replicated prior to their reshuffling. The disruption of this process jeopardizes reproduction and can spur a range of birth defects, notably Down syndrome.

Blitzblau and Hochwagen sought to determine what coordinates these processes to ensure they occur in proper order. Doing so would offer insights into how deviations from normal functionality could affect fertility and result in birth defects.

To do so, they examined budding yeast—a model organism in cell biology because its chromosome replication and regulation are similar to that of humans.

Through a series of manipulations, in which the researchers inhibited the activity of individual proteins, they found two enzymes that were necessary for meiosis: Mec1, which is similar to ATR, known to suppress tumors in humans, and DDK, which is a vital coordinator of chromosome reshuffling.

Specifically, they found that Mec1 senses when chromosomes are being replicated and transmits a molecular "wait" signal to DDK. In this way, Mec1 acts like a traffic cop that allows chromosome replication to finish without interruption, before giving DDK the ok to begin the reshuffling.

Provided by New York University