Growing without cell division

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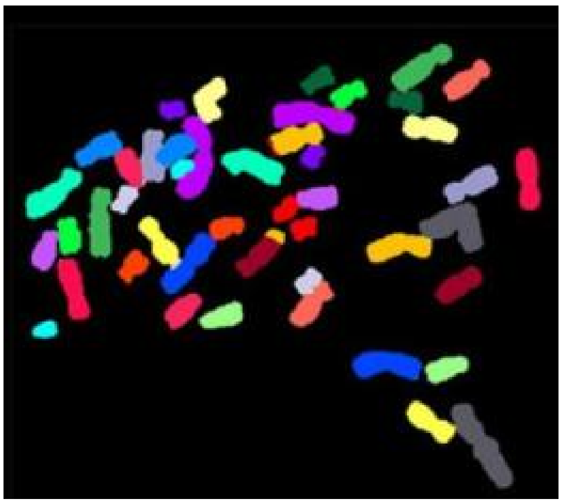

This is a color-coded image of human chromosomes. Credit: National Institute of General Medical Sciences, NIH.

An international team of scientists, including biologists from the University of North Carolina at Chapel Hill, may have pinpointed for the first time the mechanism responsible for cell polyploidy, a state in which cells contain more than 2 paired sets of chromosomes.

When it comes to human chromosomes and the genes they carry, our tissue cells prefer matched pairs. Bundled within the nucleus of our cells are 46 chromosomes, one set of 23 inherited from each of our parents. Thus, we are known from a cellular standpoint as "diploid" creatures.

But a cellular chromosome situation common in plants and in many insects is polyploidy, in which there are more – sometimes a lot more – than two sets of chromosomes. Here, growth occurs through an increase in cell size versus an increase in cell number via cell division (mitosis). This allows more DNA to be crammed into the cell nucleus.

Polyploidy also appears in some tissues of otherwise diploid animals, including people – for example, in specialized organ tissue such as muscle, placenta, and liver. These biologically highly active tissues also produce large polyploid cells.

An intriguing slice of discovery science led by geneticist Bruce Edgar, PhD of the University of Heidelberg, Germany, was published on-line Sunday, Oct 30, 2011 in the journal *Nature*. The research team may have pinpointed for the first time the regulatory mechanism responsible for cell polyploidy.

Study co-author Robert J. Duronio, PhD, professor of biology and genetics at UNC and a member of the UNC Lineberger Comprehensive Cancer Center said, "Many organisms achieve growth by increasing cell size rather than cell number." He pointed out that many cells of fruit flies (Drosophila), for example, enter a specialized cell cycle known as the endocycle, which results in polyploidy. Here mitosis is bypassed and the cell replicates its DNA without undergoing mitosis.

"We mathematically modeled the behavior of molecules known to control this special type of cell cycle and the progression to polyploidy. We then made certain predictions about how these molecules were regulated during the endocycle that we tested in fruit flies."

Duronio said the study demonstrated that genes turned on and off in a cyclical manner was important for cells to continue endocycling and become polyploid. "We showed that one particular perturbation, or mutation, of this mechanism blocked the ability of cells to do that."

The UNC researcher said further research will determine if the findings "… take us one step closer to being able manipulate cells becoming polyploid. And that might be important for, say, liver regeneration or liver diseases, where it's thought that polyploidy in liver cells may be important for liver function, either for liver detoxification or other aspects of liver biology."

Provided by University of North Carolina School of Medicine