Free-floating RNA and sperm might be pathway for epigenetics

In the last decade, geneticists have discovered that not all genetic information that makes us who we are is put together when sperm meets egg. We now know that there is some DNA that resides in the mitochondria of the egg cell that will become the blueprint for the mitochondria of all the cells of our body, for instance. And we know that through some mechanisms, our genetic information can be selectively read through the influence of outside environmental factors, through epigenetics.

The process by which environmental information can be transferred has largely been a mystery. We do know that a mom's pregnancy diet can alter fetal genes through the placenta when a baby is in utero, but it's been largely unclear how other epigenetic information gets transferred.

But, a study released this month points to a method involving glow in the dark RNA and sperm. Italian scientists grafted human melanoma cells to mice. These cells were inserted with a bacterial gene that causes phosphorescence.

The researchers found that free-floating RNA from the tumor cells found their way through the animal's blood stream and into sperm cells. When that sperm fertilizes an egg, the RNAs are transferred to the offspring, likely affecting how its genetic information is expressed and interpreted.

Because we already know that RNAs regulate how genes are expressed and are susceptible to environmental signals, the researchers propose that their finding could be a model for how genetic information about the environment conveys from one generation to the next.

There are some caveats: tumor cells are known to shed DNA rampantly, it's part of the process of cancer metastasis, so other cell types should be used to see if they also transfer RNA to sperm.

Sayer Ji at GreenMedInfo described the finding as proof that sex will one day no longer be required for procreation. This is simply not true. In order to convey the epigenetic RNAs to the next generation, that affected sperm has to find an egg and make an embryo.

Ji also suggests that the study proves that our 'moment to moment' lifestyle decisions could affect our offspring:

> If your somatic cells, which are continually affected by your nutritional, environmental, lifestyle and even mind-body processes, can transfer genetic information through exosomes to the DNA within your germline cells, then your moment-to-moment decisions, behaviors, experiences, toxin and toxicant exposures, could theoretically affect the biological 'destinies' of your offspring, and their offspring, stretching on into the distant future.

This is far fetched given that the mice in the study were exposed to tumors for 45 days before they were tested. Skipping your kale smoothie last Tuesday is not reason to panic.

But Ji is right that the study is some of the first proof of a potential way in which the environment directly impacts our genes. We already knew the Mendel's genetic model of an static, genetic black box was wrong, but we need to know the specific mechanisms at play to gain understanding of the epigenetic processes that influence so many modern diseases from diabetes to schizophrenia.

Additional Resources:

- Shaking up science with transgenerational epigenetics and blurred species boundaries, Genetic Literacy Project
- How epigenetics, our gut microbiome and the environment interact to change our lives, Genetic Literacy Project
- Can we inherit fear of a smell? The latest on transgenerational epigenetics, Genetic Literacy Project