Arsenic and the Placental Epigenome
Unlocking the Secrets of Prenatal Exposure

Experts suspect that epigenetic changes such as DNA methylation may be involved in adverse health effects associated with fetal arsenic exposure. Previous studies have investigated associations between arsenic exposure and DNA methylation in adult and umbilical cord blood cells. Now researchers present an extensive epigenome-wide analysis of placental DNA methylation in relation to fetal arsenic exposure.

Methylation varies among different cells and tissues, so past DNA methylation studies have been limited by their reliance on blood cells. By studying methylation in placental cells, investigators are able to measure variations in a tissue where it may have specific impacts on health outcomes.

The placenta, which connects the developing fetus to the uterine wall, largely controls the fetal environment. It transfers nutrients to the fetus and shuttles waste products out. It regulates fetal blood cells. The placenta is a rich source of information on fetal exposures and development.

Arsenic measured in maternal urine and toenail clippings did not predict methylation in placental cells. However, higher arsenic levels in placental samples were associated with altered methylation levels at 163 different DNA regions. In particular, the researchers found 11 methylation markers in the LYRM2 gene, and methylation decreased at all 11 markers as arsenic exposure increased. When they measured LYRM2 mRNA levels they found that decreased DNA methylation at the targeted loci was associated with expression of the gene.

It’s not yet known what function LYRM2 might perform in the placenta, although other genes in the same family play an important role in the synthesis of proteins that help to metabolize metals. Researchers are now working to understand the functional implications of the observed epigenetic differences and what they might mean for fetal growth.

Placenta studies like this one represent the forefront in environmental epigenetics, according to Wright. Like blood or urine, the placenta is a very accessible tissue—most are simply discarded after birth. But the placenta also grows and expresses growth factors. This may make it a better surrogate for target tissues that also grow during development, such as the heart, brain, or liver, Wright says.

That said, epigenetic differences among placentas don’t necessarily reflect differences in other tissues, although they may elucidate the effects of environmental factors on various molecular pathways. Says Marsit, “The placenta may offer a unique way to study how environmental exposures alter the growth and development of harder-to-reach tissues on the molecular level.”

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