Study finds changes in fetal epigenetics throughout pregnancy

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Researchers at Mount Sinai School of Medicine have found that epigenetic marks on human placentas change from the first trimester of pregnancy to the third, a discovery that may allow clinicians to prevent complications in pregnancy.

The finding marks a dramatic departure from the prevailing opinion that epigenetic programming is permanently established 12 weeks after fertilization. Published in the April issue of the *American Journal of Obstetrics and Gynecology*, the study indicates that clinicians may be able to change the course of a pregnancy through early diagnosis and treatment.

"Our research shows that there are several 'windows of opportunity' during pregnancy to detect risks and also change pregnancy outcomes that may arise later," said the study's senior investigator, Men-Jean Lee, MD, Associate Professor, Obstetrics, Gynecology and Reproductive Science, and Preventive Medicine, Mount Sinai School of Medicine. "We have developed an assay that can allow clinicians to diagnose problems early enough to potentially prevent conditions such as preeclampsia and fetal growth restriction."

Epigenetics generally refers to factors that modify how a gene behaves while not altering the DNA nucleotide sequence of the gene itself. The placenta contains a group of genes, known as "imprinted" genes, which regulate fetal growth. In healthy fetal development, one copy of these genes is normally active and the other copy is silent. Loss of imprinting

(LOI) occurs when both sets of genes are reactivated, and is an indicator of potential complications such as preeclampsia and fetal growth restriction.

Using an LOI assay developed by James G. Wetmur, PhD, and Jia Chen, ScD, of Mount Sinai School of Medicine, the research team assessed LOI at the first trimester in 17 placentas and at full term in 14 different placentas. The surprising results showed that more LOI occurred in the first trimester than at full term.

Dr. Lee and her team concluded that genomic imprinting appears to be an ever-changing process in the placenta, meaning that pregnancy risks can change throughout the course of gestation. Previously, the medical community believed imprints remained static after 12 weeks. This same Mount Sinai research team had also previously discovered that the epigenetic marks in placentas from pregnancies with preeclampsia and fetal growth restriction were different from normal pregnancies at full term.

"Ours is the first study to examine LOI in the first trimester and compare it to that of full-term placentas," Dr. Lee said. "Now that we know the epigenetic make-up in the placenta changes during the course of a pregnancy, we can develop biomarkers to see if those pregnancies destined to develop preeclampsia or fetal growth restriction can be detected early enough in pregnancy to allow prevention of these diseases."

An estimated 10 percent of pregnancies are complicated by fetal growth restriction, which increases the risk of stillbirth, cerebral palsy, feeding intolerance, and failure to thrive. Preeclampsia, a condition characterized by high blood pressure and swelling during pregnancy, affects between 7 and 10 percent of pregnant women.

"More research is necessary to determine the impact of this discovery on potentially reducing the risk of other serious conditions like autism, cancer, and childhood obesity," said Dr. Lee.

Provided by The Mount Sinai Hospital