Mom's in control—even before you're born

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The egg's epigenetic 'blueprint' is important for placenta development in pregnancy. Credit: Image adapted from 'Egg sperm' by Zappys Technology Solutions on Flickr, licensed under the Creative Commons Attribution 2.0 Generic (CC BY 2.0) license

Researchers have uncovered previously unappreciated means by which epigenetic information contained in the egg influences the development of the placenta during pregnancy. The research, which was performed in mice, indicates that a mother's health, even before conception, may influence the health of her fetus, and opens questions on how a mother's age may influence placental development.

Epigenetic information is not encoded within the DNA sequence but is critical for determining which genes are on or off. One of the ways this is achieved is via DNA methylation, a biological process where the DNA is chemically tagged to silence genes. DNA methylation marks are laid down in each egg during their development in the ovaries and, after fertilisation, some of these marks are passed onto the fetus and placenta.

In exploring the purpose of this maternal information in fetal development, focus so far has been on a small number of genes termed 'imprinted genes'. However, there are nearly one thousand other genomic regions where methylation in the egg cell is passed onto the early embryo. The researchers set out to explore the importance of this type of methylation on the development of the placenta, a vital organ in pregnancy, and their findings are presented in the latest issue of the journal *Developmental Cell*.

"We were surprised to find that DNA methylation from the egg played a much larger role in placental development than methylation that was introduced after fertilisation, whereas in the embryo both are important," explains Miguel Branco, a group leader from Queen Mary University of London who led the work. "Evolution, it seems, has granted mothers the tools to control the growth of their progeny during pregnancy by instructing on placental development."

By using mice in which methylation of the egg's DNA had been blocked, the researchers found that DNA methylation occurring during the development of the egg was essential for correct placental development. In particular, the research identified several genes regulated by methylation in the egg that are involved in cell adhesion and migration - both vital properties for cells of the developing placenta in establishing connections with maternal tissues to support embryo development.

"This was an exciting result for us," said Myriam Hemberger, a group leader at the Babraham Institute. "The phenomenon of gene imprinting explains some of this but our results show that the importance of DNA methylation in early development extends beyond imprinting.

Specifically, maternally-inherited DNA methylation marks are important for normal placentation as they specify cellular properties such as adhesiveness and invasive character, as well as determining the correct balance of cell types needed in the placenta."

The research opens questions regarding the potential influence of maternal health on the fetus long before conception.

"We know that nutrition, environment and ageing affects the DNA methylation pattern in our cells, including in egg cells," states Wolf Reik, Head of the Epigenetics programme at the Babraham Institute. "One of the questions prompted by this research is whether DNA methylation changes relating to age could contribute to the deterioration of egg quality, subsequently affecting the success of either the embryo or the supporting placenta."

Provided by Babraham Institute

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