Scientists unravel the mysteries of human embryogenesis and evolution

Recently, with the support by the National Natural Science Foundation of China and the Chinese Academy of Sciences, the group led by Liu Jiang (刘江) from Beijing Institute of Genome, cooperating with Chen ZiJiang's group in the Center for Reproductive Medicine, Shandong University and Liu JianQiao's group in Guangzhou Medical University, has revealed how the epigenetic information directs the gene expression pattern in human early embryos. This work was published in *Cell* (2018, 173: 248—259)

Human life starts from a fertilized egg. One of the most important questions in science is how a fertilized egg develops into a complicated organism with about 200 cell types and 36 important organs. Humans have 25,000 genes. During human development, different genes should be expressed at the right time and right place. Setting the order of gene expression is called "the Programming of Gene Expression". Computer software is coded by computer language. Similarly, one of the languages for the Programming of Gene Expression is called "Chromatin Accessibility".

Normally, each cell in our body can express more than 10,000 genes. However, the first 2 days after fertilization is a very special period during human early embryogenesis. During this period, almost no genes are expressed in human embryos. Until now, it remains unknown how human genomes become active and start expressing new genes in early embryos. Traditionally, it needs a million cells to investigate chromatin accessibility landscape. Liu and his colleagues established a method by using only 50 cells to study it. They found a key molecular OCT4 which plays a crucial role during zygotic genome activation. In addition, scientists found that older genes usually start the expression at early embryonic stages, and younger genes usually start the expression at later stages. The reason is that the switch controlling the expression of older genes is turned on at the earlier embryonic stage.

This study also found an interesting result associating with human evolution. DNA mutations can drive human evolution. Transposons are a class of DNA elements, which can jump from one position to another in genome. The jump of transposons can introduce DNA mutation. In human genomes, there are a limited number of transposons that have the activity of mobility. Scientists found that these transposons usually only have activity in early embryos, but not in differentiated tissues. Mutations generated in early embryos can trigger higher change to pass into germ line, and then pass to the next generations. Therefore, the activation of transposons in early embryos will have high impact on human evolution.

The discovery in this study opens the gate in understanding the regulation of gene expression during human embryogenesis, which makes China in the leading position in the research of human development. This study may benefit the assisted reproductive technology in future.

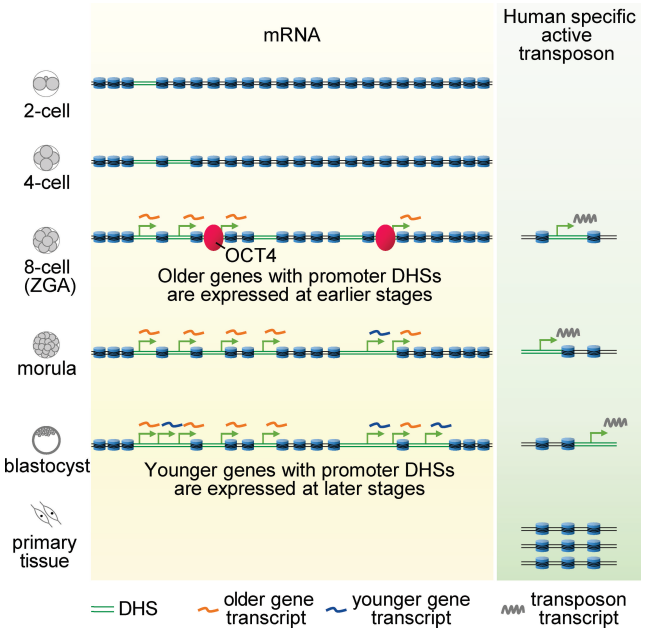

Figure The dynamic landscape of open chromatin during early human embryogenesis.