Cambridge scientists unlock cause of some types of infertility

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Martyn Blayney

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Scientists may have found the cause of some types of infertility, including recurrent miscarriage, after new research found some human eggs carry the wrong number of chromosomes.

The pioneering study published in Science by the Medical Research Council (MRC) Laboratory of Molecular Biology in Cambridge, in collaboration with Bourn Hall Clinic, has revealed some of the reasons why this happens.

And the revolutionary techniques developed in this study may help to improve the selection of eggs for IVF treatment.

Dr Melina Schuh, the lead researcher based at the MRC, said: "Healthy human eggs are vital to life, but we still know very little about how these eggs develop. Our work is the first time that the process of meiosis in human eggs has been mapped out in a step-by-step way. This window into their development sheds light on why eggs are so likely to contain the incorrect number of chromosomes and could help to improve fertility treatments."

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Using high-end imaging techniques, the scientists studied more than 100 immature eggs. For the first time ever, they were able to watch in real time the step-by-step process that leads to the formation of fertilisable human eggs.

During this process, an egg needs to eliminate half of its chromosomes because the other half will be contributed by the sperm during fertilisation.

But human eggs frequently have an incorrect number of chromosomes – a phenomenon called aneuploidy.

The fertilisation of aneuploid eggs is the major cause of miscarriages and of Down's syndrome but because human eggs are virtually unstudied, it has been unclear why human eggs are so frequently aneuploid.

Scientists have now found that unlike in other cell types, the cellular machinery – a spindle – that eliminates the chromosomes is assembled over an extremely long time period compared to other cells in the body and is very unstable in human eggs. This frequently led to an abnormal arrangement of chromosomes in the spindle and an uneven distribution of chromosomes during cell division.

The research suggests that differences in the mechanism by which the spindle is assembled could explain why chromosome separation in human eggs is less reliable than in other cell types.

Professor Patrick Maxwell, chairman of the MRC Molecular and Cellular Medicine Board, said: "This work dramatically increases our understanding of how human life begins, whether through natural or assisted conception. Each year thousands of women in the UK are offered new hope through fertility treatments but there is still a risk that many eggs will not contain the correct number of chromosomes, resulting in miscarriages.

"This work will help researchers understand more about how human eggs are created and find ways to reduce fertility problems."

Martyn Blayney, head of science at Bourn Hall, welcomed the publication.

"From the first approach by Melina's group we realised the potential importance of this research and that partnership with an IVF unit was essential for it to progress further," he said.

"Human oocytes for study are scarce and very precious and we are extremely grateful to our patients who have allowed us to use oocytes unsuitable for their treatment in this project. These generous donations have culminated in the groundbreaking discoveries published today.

"It is only through research such as this that we can understand the reasons for heartbreaking conditions such as recurrent miscarriage. A deeper understanding of how the egg develops may improve the techniques we have for embryo selection which could ultimately lead to improved success rates."

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