Three-dimensional model of human placenta developed

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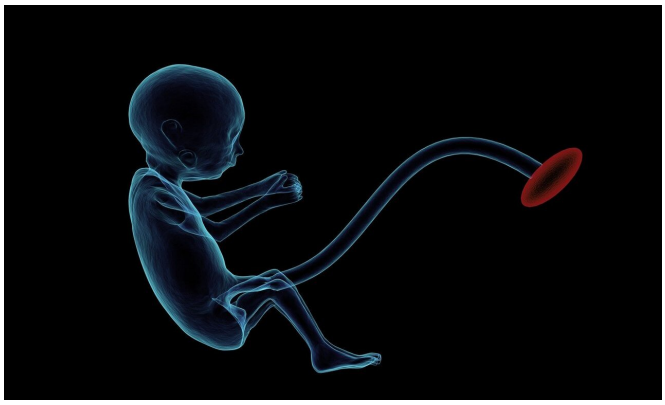

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The placenta is the organ connecting mother and embryo. Its main functions are the exchange of nutrients, gases and metabolic products and the production of hormones and other substances essential for embryonic development. Placental malfunctions are the main cause of pregnancy complications and can lead to miscarriage and other serious disorders that endanger both mother and child. So far, the mechanisms underlying these disorders remain largely unexplained, not least because up until now there has been no reliable human cell culture model system. MedUni Vienna researchers have now successfully developed a 3-D model of the human placenta.

The 3-D in vitro model of the early human placenta was produced in a collaborative project involving the research groups of Martin Knöfler from MedUni Vienna's Department of Obstetrics and Gynecology (Division of Obstetrics and Gynaecology) and Paulina Latos from MedUni Vienna's Center for Anatomy and Cell Biology.

First organoid model of the placenta – based on other tissue culture models

"Over the last few years, 3-D tissue culture models, called organoids, have rapidly been established for many different human organs. In most cases, these organoids consist of only a few cell types from the respective tissue and therefore have a simpler structure than the original organ," explain the researchers. Working on this basis, the team from the Medical University of Vienna managed to develop an organoid model of the placenta, consisting of the prevailing placental cell population, so-called trophoblasts.

Knöfler and Latos explain, "As a puretrophoblast organoid without blood vessels or connective tissue components, this model mirrors the trophoblast-specific placental structure in a Petri dish." This was done by optimising the culture conditions that had already been successfully applied in organoid models of other tissues.

A significant advantage of the placenta organoids is their capacity for self-organisation, self-renewal and constant growth, stress the MedUni Vienna scientists, since they contain both stem cells and progenitors. Moreover, these 3-D structures also contain the three main cell types of the human trophoblast population.

The MedUni Vienna researchers were able to underpin the groundbreaking advantages of this organoid system with a study substantiating the role of the WNT signaling pathway (which is crucial for development and growth of many tissues) in self-renewal and differentiation of the trophoblast organoids. The organoid model system can also be pharmacologically and genetically manipulated. This opens up new possibilities for studying physiological and pathophysiological processes of the human placenta.

"The fact that there were no self-renewing cell culture model systems available for the human placenta made it difficult, if not impossible, to study the causes of malfunctions. Establishment of the

placenta organoid system will improve this situation significantly and will help advancing drug development and consequently medical treatments for dangerous gestational disorders," says Knöfler, one of the leading international experts in placental research and last author of the study.

More information: Sandra Haider et al. Self-Renewing Trophoblast Organoids Recapitulate the Developmental Program of the Early Human Placenta, *Stem Cell Reports* (2018). DOI: 10.1016/j.stemcr.2018.07.004

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