Development of the immune system before and after birth

The newborn's immune system is suddenly confronted with microorganisms, food and numerous environmental influences at birth. How do the baby's immune cells prepare for this moment during pregnancy and birth? How do external influences shape the immune system immediately after birth? And what influence does an event like a premature birth have? These and many other questions about the development of the child's immune system around birth are being investigated by scientists from the Facult of Medicine at the University of Freiburg together with researchers from the LMU Munich, the University Hospital RWTH Aachen and other institutions in the Collaborative Research Center/Transregio "Perinatal Development of Immune Cell Topology (PILOT)." PILOT was approved by the German Research Foundation (DFG) on November 25, 2022, and will be funded with a total of 12 million euros for an initial period of four years starting January 1, 2023.

"Our major goal is to better understand the early and highly complex adaptation of the immune system and thus give children the best start in life," says PILOT spokesperson Prof. Dr. Philipp Henneke, head of the Department of Pediatric Infectious Diseases and Rheumatology at the Center for Pediatric and Adolescent Medicine at the Medical Center - University of Freiburg. Co-speaker is Prof. Dr. Markus Sperandio from the Institute of Cardiovascular Physiology and Pathophysiology at the LMU Biomedical Center.

Immune cells can usually develop largely undisturbed while enjoying the protection of the womb. At the moment of birth, they must abruptly adapt to external influences. "Events such as a premature birth or an infection during pregnancy can disrupt this development. In this consortium with scientists from all over Germany, we want to find out exactly what happens and how we can prevent undesirable developments," says Henneke.

Immune development in lungs, skin and intestines

To this end, the scientists are studying in particular "boundary tissues" between the interior of the body and the environment, such as the intestine, lungs, skin, brain and placenta. "Today, we have unique analytical methods at our disposal that allow us to determine the spatial distribution and properties of immune cells in the tissue very precisely. Thanks to this cellular mapping, we obtain important information about the precise tasks of individual cell types, even with the smallest cell numbers," says Henneke, who is also a member of the Centre for Integrative Biological Signalling Studies (CIBSS) excellence cluster at the University of Freiburg.

With the help of automated image analysis and machine learning, novel algorithms are developed in PILOT to decipher the complex processes during the maturation of immune cells. For their studies, the researchers use, among other things, new computer-based analysis techniques, novel experimental models of natural immunity and tissue samples from newborns. "In this way, we ensure that we combine a fundamental mechanistic understanding with clinical concepts right from the start," says Henneke. With the integrated research training group Co-PILOT, young scientists are integrated early and intensively into the interdisciplinary research consortium from medicine, biology, pharmacy and mathematics, among others.

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Further information

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