



Pioneering care for preemies – from artificial placentas to brain-healing stem cells

New treatments being developed by EU-funded researchers will improve both survival rates and the long-term health of babies born early.

11 July 2024 - By MICHAELA NESVAROVA

Dr Niels Rochow is a researcher and neonatologist at Klinikum Nürnberg, in Nürnberg, Germany, one of the largest municipal hospitals in Europe.

His work, looking after newborns born early or with medical problems, keeps him very close to the topic of his research. He recalls a tense battle over the weekend to save a premature baby's life.

'She was born early and was in a bad state. We fought for two and a half days to keep her alive.' The baby's survival depended on invasive artificial ventilation technology and external lung and kidney support.

Although sometimes lifesaving, these devices were originally developed for adults and scaled down for neonatal care. They are not well adapted to a baby's tiny body, are highly invasive and can damage immature lung tissue.

Currently, premature babies frequently need to be heavily medicated and connected to a mechanical ventilator pumping air into their lungs.

'These babies are full of tubes and essentially paralysed,' said Rochow. This treatment often leads to side effects and can cause chronic lung disease, impacting the child's whole life.'

Short- and long-term impact

Every year, about 15 million babies are born preterm – classified as before the 37th week of pregnancy. A full-term pregnancy is 40 weeks, but a lot happens in those last three weeks. Currently, around 7% of births in the EU are classified as preterm.

Despite advancements in neonatal intensive care, progress in improving long-term health outcomes for these infants has been slow. Two million preterm babies lose their lives – before they even start – every year.

In fact, the [Global Burden of Disease](#) study in 2010 estimated that preterm births were the leading cause of death and disability in children under the age of five – greater than either malaria or pneumonia.

Having missed the crucial developmental milestones that normally occur in the last part of the pregnancy, survivors also have increased risks of long-term health consequences. They are more likely to suffer respiratory issues like bronchitis and asthma, and be affected by a range of neurodevelopmental disorders due to brain injury.

Like mother's womb

Dr Rochow is one of a team of European and international researchers that received a grant through the European Innovation Council (EIC) [Pathfinder](#) programme to work on a better alternative – a system they call an artificial placenta, or ArtPlac.

The goal is to simulate the conditions of the mother's womb, potentially reducing complications and improving outcomes for the most vulnerable newborns.

'In the womb, the baby is connected to the natural placenta which serves as a lung, a kidney and a feeder,' said Professor Jutta Arens, one of the lead engineering scientists working on the four-year [ArtPlac](#) project, which kicked off in 2023.

'This placenta cannot be reconnected after birth, which is why we are developing a device that replaces its functions in the most natural way possible.' By connecting to the baby's belly button, the artificial placenta allows the infant to develop and heal naturally, offering a less invasive alternative to current methods.

ArtPlac will also make it easier for parents to have physical contact with their child from the start. Artificial ventilators are not only very invasive, they are also awful for parents, according to Rochow.

'If you hear your baby cry, you want to hold it. Yet, you can't. With ArtPlac, parents could be close to the baby and interact with it more easily.'

ArtPlac will undergo initial in-vitro testing in the last quarter of 2024. This will be followed by proof of principle in-vivo testing which will be carried out on a premature lamb. The aim is to be able to perform initial clinical trials on babies within the next few years.

Early injury, lifetime consequences

Although advances in healthcare mean that more than half of all babies born before 28 weeks [survive](#), a large proportion of these will have a lifelong disability. Even babies born late preterm – between 32 and 37 weeks – are at increased risk.

The brain damage caused by premature birth, known as encephalopathy of prematurity (EOP), can result in long-term disorders like cerebral palsy, severely impaired cognitive functions, attention deficit and hyperactivity disorder (ADHD) and autism spectrum disorder (ASD). Brain injury can also be caused by a lack of oxygen during birth (asphyxia) or a stroke around the time of birth.

For example, it is estimated that a quarter of all cerebral palsy cases are associated with preterm birth. Diagnosing a brain injury in a preterm baby, however, is complicated and can take days to weeks. Even then, there are few options for treatment.

Dr Bobbi Fleiss is a researcher and senior lecturer at the Royal Melbourne Institute of Technology (RMIT) in Melbourne, Australia. She leads the RMIT Perinatal Brain Injury lab and is passionate about understanding injury to the brain in newborn babies and how to make outcomes for these infants better.

‘The standard procedure is applying cooling therapy, which has to happen within six hours after birth,’ explains Fleiss. ‘It is very stressful.’

Fleiss is part of a global team of researchers that received funding from the EU to develop an effective alternative treatment for preterm brain injury. Led by the French National Institute of Health and Medical Research (INSERM), the [PREMSTEM](#) project runs from 2020 to the end of 2024.

It brings together world-leading clinicians, researchers, stakeholder advocacy groups and an industrial partner specialising in neonatology and drug development from eight countries: Australia, France, Germany, Italy, the Netherlands, Spain, Sweden and Switzerland.

Brain-healing stem cells

Like ArtPlac, PREMSTEM takes its inspiration from nature’s own design. Blood that remains in the umbilical cord after birth contains a special kind of cell called a stem cell.

These cells have the ability to grow into many different kinds of cells, such as bone marrow cells, blood cells or brain cells. This makes them very valuable for treating a wide range of diseases.

PREMSTEM is using stem cells from donated umbilical cords to create a groundbreaking and easy-to-administer new treatment that could help heal neonatal brain injuries.

‘Think of stem cells as little factories that produce helpful chemicals and support the brain in helping itself,’ said Fleiss. ‘Our goal is to provide an intranasal treatment using a fine mist containing the stem cells.’

Specifically, a simple nasal spray containing stem cells is sprayed into the baby’s nose. From there, the stem cells travel to the brain, find the damaged areas and assist the brain in repairing itself.

PREMSTEM researchers have successfully tested different delivery systems, several of which have proven to be effective in reducing brain injury in animals. They expect that clinical trials testing the new treatment in human babies should begin in 2026.

The success of these projects could be life-changing for millions of babies and their families. ‘Even if we help one percent of them, it’d be wonderful,’ said Fleiss.

‘My dream is to see every baby leaving the hospital with smiling families. I hope every parent’s biggest stress will be how to strap their baby into a car seat. Nothing more.’

Research in this article was funded by the EU’s Horizon Programme including, in the case of ArtPlac, via the European Innovation Council (EIC). The views of the interviewees don’t necessarily reflect those of the European Commission. If you liked this article, please consider sharing it on social media.

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