Amniotic fluid stem cells repair gut damage

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Stem cells taken from amniotic fluid were used to restore gut structure and function following intestinal damage in rodents, in new research published in the journal *Gut*. The findings pave the way for a new form of cell therapy to reverse serious damage from inflammation in the intestines of babies.

The study, funded by Great Ormond Street Hospital Children's Charity, investigated a new way to treat necrotizing enterocolitis (NEC), where severe inflammation destroys tissues in the gut. NEC is the most common gastrointestinal surgical emergency in newborn babies, with mortality rates of around 15 to 30 per cent in the UK.

While breast milk and probiotics can help to reduce the incidence of the disease, no medical treatments are currently available other than surgery once NEC sets in. Surgical removal of the dead tissue shortens the bowel and can lead to intestinal failure, with some babies eventually needing ongoing parenteral nutrition (feeding via an intravenous line) or an intestinal transplant.

In the study, led by the UCL Institute of Child Health, amniotic fluid stem (AFS) cells were harvested from rodent amniotic fluid and given to rats with NEC. Other rats with the same condition were given bone marrow stem cells taken from their femurs, or fed as normal with no treatment, to compare the clinical outcomes of different treatments.

NEC-affected rats injected with AFS cells showed significantly higher survival rates a week after being treated, compared to the other two

groups. Inspection of their intestines, including with micro magnetic resonance imaging (MRI), showed the inflammation to be significantly reduced, with fewer dead cells, greater self-renewal of the gut tissue and better overall intestinal function.

While bone marrow stem cells have been known to help reverse colonic damage in irritable bowel disease by regenerating tissue, the beneficial effects from stem cell therapy in NEC appear to work via a different mechanism. Following their injection into the gut, the AFS cells moved into the intestinal villi - the small, finger-like projections that protrude from the lining of the intestinal wall and pass nutrients from the intestine into the blood. However, rather than directly repairing the damaged tissue, the AFS cells appear to have released specific growth factors that acted on progenitor cells in the gut which in turn, reduced the inflammation and triggered the formation of new villi and other tissues.

Dr Paolo De Coppi, UCL Institute of Child Health, who led the study, says: "Stem cells are well known to have anti-inflammatory effects, but this is the first time we have shown that amniotic fluid stem cells can repair damage in the intestines. In the future, we hope that stem cells found in amniotic fluid will be used more widely in therapies and in research, particularly for the treatment of congenital malformations. Although amniotic fluid stem cells have a more limited capacity to develop into different cell types than those from the embryo, they nevertheless show promise for many parts of the body including the liver, muscle and nervous system."

Dr Simon Eaton, UCL Institute of Child Health and co-author of the study, adds: "Once we have a better understanding of the mechanisms by which AFS cells trigger repair and restore function in the gut, we can start to explore new cellular or pharmacological therapies for infants with necrotizing enterocolitis."