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Amniocyte-derived Patch for Repair of Congenital Heart Defects

Category
Technology: Patch for neonatal heart repair

Problem
Current cardiac patch materials are biologically inert and do not grow with a pediatric patient

Technology Overview
Pre-vascularized patch with amniocyte-derived cells surrounding polyurethane core

IP Status

- Available for Collaboration

Value Proposition

- Customizable for each patient
- Biocompatible and biodegradable
- Promotes tissue remodeling

Market Attractions

- Congenital heart defects

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Problem: Congenital heart defects (CHD) are the most common type of birth defect and are considered a leading cause of birth defect-associated infant illness and death. About 40,000 babies are affected each year in the US (source: CDC). When treating patients with CHD, surgical repairs often require patches. Currently, polymers are the most common patch materials used in CHD repairs. However, these materials do not grow with the patient and may require further surgeries to replace the patch. Additionally, they have mismatched mechanical properties and a lack of contractility which can contribute to complications (heart failure, arrhythmia and aneurysm). An ideal patch would be made of materials that are biocompatible, biodegradable and contain cardiac cells with contractility and conductivity similar to native cardiac tissue.

Technical Solution and Key Value Propositions: A University of Colorado research group led by Dr. Jeffrey Jacot has developed a new cardiac patch to treat CHDs. The multilayer patch has biodegradable engineered scaffolds and promotes tissue remodeling. Compared to current patches that are biologically inert, the present patch has a polyurethane core surrounded by a pre-vascularized structure that can attach to the host. Endothelial cells and mesenchymal stem cells derived from the amniotic fluid surrounding a fetus diagnosed with CHD are used to create the patch.

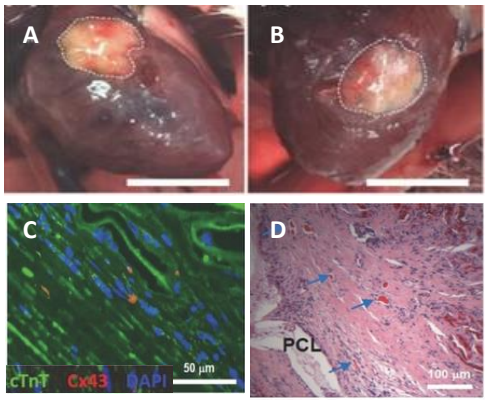

Figure 1. Engineered Multilayered Myocardial Patch in Rat Model. *(A) All patches were incorporated into the native tissue 4 weeks after surgery. (B) At 8 weeks post-surgery, most of the scar fibers on the right ventricle disappeared and vascular tissue were formed. (C) Muscular tissue formed and aligned around the core with positive staining for cardiac troponin T and Connexin 43. (D) No calcification was visible on patched area.*

In vitro and in vivo studies in rats have been completed and demonstrate that the patch is capable of full thickness defect repair and regeneration (Figure 1).

Key Documents and Sources:

1. Full-Thickness Heart Repair with an Engineered Multilayered Myocardial Patch in Rat Model. Pok et al., 2017. Adv Healthc Mater.
2. In Situ Vascularization of Injectable Fibrin/Poly(Ethylene Glycol) Hydrogels by Human Amniotic Fluid-Derived Stem Cells. Benavides et al., 2015. Journal of Biomaterials Research, Part A.
3. Amniotic fluid-derived stem cells demonstrated cardiogenic potential in indirect co-culture with human cardiac cells. Gao et al., 2014. Annals of Biomedical. Engineering.
4. Capillary-like Network Formation by Human Amniotic Fluid-Derived Stem Cells within Fibrin/Poly(Ethylene Glycol) Hydrogel. Benavides et al., 2014. Tissue Engineering Part A.
5. Amniotic fluid-derived stem cells for cardiovascular tissue engineering applications. Petsche et al., 2013. Tissue Engineering Part B.