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Injectable Gels Based on Porcine Cardiac Extracellular Matrix for Minimaly Invasive Delivery of Cells to Infracted Heart

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Introduction:

Cardiovascular disease continues to be the leading cause of death, suggesting that new therapies are needed to treat the progression of heart failure post myocardial infarction. While acellular and cellular cardiac patches are applied surgically to the epicardial surface of the heart, injectable materials offers the prospective advantage of minimally invasive delivery directly into the myocardium. We have developed a unique heat based gel that can serve as an injectable scaffold for human induced pluripotent stem cells (hIPSC) for myocardium rejuvenation.

Materials and Methods:

Gels were prepared by solubilyzing decellularized porcine cardiac extra cellular matrix (pcECM) and studying its combination with polymers such as chitosan in different concentration and cross linker genipin. The gels were than characterized by scanning electron microscopy (SEM), and mass spectrometer. The mechanical properties were measured with plate reometer. Immunogenic potential of the gel were analyzed by measuring nitric oxide secretion by Griess method and TNF-α,IL-1β secretion by RT-PCR from macrophage cell exposed to lyophilized gel. hIPSC were cultivated within the gels and viability, proliferation and differentiation towards the cardiac linage were evaluated using Alamar Blue assay and Immunofluorescent staining.

Results:

Gels contained mostly collagen (more than 70%) were assemble in the form of thin fibers mesh (down to 5nm width). Mechanical strength of the gels elevated by increasing chitosan and genipin concentration and it is not immunogenic. All the gels showed support of cultivation of embryonic bodies derived from hIPSC , moreover the gels showed to effect cells differentiation process.

Conclusions:

Injectable material based on pcECM offers the potential for minimally invasive cells delivery to the heart. Furthermore the ability to cultivate hIPSC and their derivative within such construct may bring unique value to the cardiac engineering field of personalized medicine.