A Rapid Decellularization Technique for the Recellularization of Renal Organ Tissue

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Statement of Purpose: In recent years, as solid organ transplantation dramatically improved, the demand for transplantable organ grafts has increased further than the supply. Therefore, the gap between the number of patients who have received a transplant and those who are in the waiting list has become wider than ever; also, the mortality while on the waiting list is increasing. Tissue engineering combines cells and scaffolds to produce tissues and organs as an alternative to donated organs. In the current study we propose a rapid and effective decellularization technique for the kidney, which leaves an intact extracellular matrix (ECM). The kidney scaffold can support recellularization and achieve the long-term goal of bioengineering transplantable kidney organs.

Methods: Porcine and rat kidneys were obtained following euthanization (according to ACUC guidelines) and following cannulation of the renal artery [pigs] or the abdominala orta [rats] were perfused with ddH2O overnight then decellularized with a 1% SDS solution, followed by a washout with 1% Triton X-100 and 5-day rinsing with ddH_2O alone to remove excess detergents. The so-obtained renal scaffolds underwent intra-arterial fluorangiography in order to assess the patency and integrity of the vascular tree, or gamma irradiated for futher studies. Scaffolds were split into 0.5-inch pieces and either embedded in OCT for cryosectioning and histological analysis, or for seeding studies. Different cell types were seeded on the acellular matrices to investigate whether matrices enhance cell growth. Renal scaffolds were injected with murine MS1 endothelial cells [EC] thoughout the renal artery, in order to repopulate the luminal wall of the vascular tree.

Results: Porcine organs provided a model size and weight for human organs, with a timeframe for collection to complete decellularization of 7 days [figure 1 and 2]. Radiology imaging [figure 3] and the perfusion of FITC-labeled dextran beads confirmed the maintenance and patency of the main vessels of the vascular tree. The intra-arterial injection of EC resulted in the repopulation of the endothelial layer of the vessel lumen [figure 4].

Conclusions: These studies demonstrate the preparation of kidney ECM scaffolds by rapid decellularization of whole organs. Although the method for scaffold recellularization needs to be optimized, this technique provides a significant platform for the investigation of recellularization protocols. Ultimately, this approach can be adopted for applications of organ and tissue replacement and regenerative medicine studies.

Figures: