Breast Tissue Engineering: Decellularized Scaffolds Derived from Porcine Mammary Glands

Giorgio Giatsidis, MD[1,2,3]; Erica Dalla Venezia, MD[1]; Diego De Stefani, PhD[2]; Rosario Rizzuto, MD[2]; Franco Bassetto, MD[1]

[1] Clinic of Plastic Surgery, Padova University Hospital, Padova, Italy

[2] Department of Biomedical Sciences, Padova University, Padova, Italy

[3] PhD Program in Molecular and Regenerative Medicine, Padova University, Padova, Italy

Disclosure/Financial Support: None of the authors has a financial interest in any of the products, devices or drugs mentioned in this abstract.

Introduction: Decellularization of tissues provides inductive extra-cellular matrices (ECM) for effective organ reconstruction: this promising approach has not been translated to breast reconstruction yet.[1, 2] We investigated the effectiveness of different decellularization protocols applied to porcine mammary glands with the purpose of developing an inductive biological matrix for prospective breast tissue engineering.

Methods: We cut porcine mammary glands into homogeneous samples (10x10x2cm) and processed these according to three different decellularization protocols (A, B, C). All protocols combined multiple chemical treatments (A: 0.02% trypsin, 0.05% ethylenediaminetetraacetic acid-EDTA, 3% Triton X-100, 4% deoxycholic acid; B: collagenase 3mg/g, 0.02% trypsin, 0.05% EDTA, 10U/mL, 10U/mL lipase; C: collagenase 3mg/g, 0.05% EDTA, 4% sodium deoxycholate, 1% sodium dodecyl sulfate, 0.9% NaCl in TRIS-HCl containing protease inhibitors). We analyzed processed specimens by macroscopic (morphologic) and microscopic methods (Hematoxylin and Eosin staining, Immuno-fluorescent labeling with 4′,6-diamidino-2-phenylindole-DAPI, quantitative measurement of DNA and DNA fragment size) to assess quality of decellularization and structural preservation of the matrix.

Results: Harvested mammary glands could be molded to required shape; adjacent glands could be harvested together (up to 700grams). Maximal size of obtainable glands based on a single blood supply varied (average: 20x40x3cm). Blood supply was based on a single reliable vascular pedicle, potentially suitable for microsurgical anastomosis in vivo. Decellularization protocols had variable effectiveness: all samples showed macroscopic evidence of decellularization preserving original morphology at gross examination. DAPI, quantitative measurement of DNA (below 50 ng/mg dry tissue weight) and of DNA fragment size (below 200 base-pairs) showed effective reduction of immunogenic components in each protocol. At histological analysis (Hematoxylin and Eosin) protocol A provided a morphology more closely resembling native architecture of ECM and a more effective preservation of the vascular and ductal networks. Protocols B and C, instead, slightly damaged and altered histological structure of the matrix.

Conclusions: Decellularization of porcine mammary tissue represents a novel and reliable preliminary approach to develop a bio-inductive matrix for potential subsequent breast tissue engineering.

References:

1. Song JJ, Ott HC. Organ engineering based on decellularized matrix scaffolds. Trends Mol Med. 2011 Aug;17(8):424-32.

2. Crapo PM, Gilbert TW, Badylak SF. An overview of tissue and whole organ decellularization processes.

Biomaterials. 2011 Apr;32(12):3233-43.