Basic procedure of artificial tissue preparation

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Basic procedure of artificial tissue preparation

Tissue engineering is an interdisciplinary field that applies principles of biology and engineering to develop biological functional replacement for clinical use. It offers the possibility to help in case of regeneration of damaged tissue by trauma or disease or creating new tissues and replacing failing/malfunctioning organs. Tissue engineering includes prosthetic pr artificial replacement of tissue; tissue and/or organ transplantation; selective cell transplantation. Examples of artificial tissue: artificial pancreas, artificial bladder, skin, bone marrow, oral mucosa tissue engineering, and so on.

Steps to prepare artificial tissue

Tissue engineering procedure involves several steps, which start from cell selection, cell isolation, and culturing of primary (progenitor or stem) cells; inducing their differentiation to certain phenotypes; seeding and cultivation; design of adequate scaffolds, including selection of proper materials and routes to process, porosity, interconnectivity, surface characteristics, etc.

1) **BIOPSY** (donor-tissue extraction) - either from fluid tissue like blood using centrifugation or apheresis (easier process) or from solid tissue that involves more steps. Solid tissue is minced, then enzymes like trypsin or collagenase are used to remove the extracellular matrix, finally cells are free-floating and extracted again by use of centrifugation or apheresis. Lately, trend in donor-tissue extraction is emphasis on the non-invasive methods.

2) **CELL ISOLATION and CULTIVATION** (manipulation with cells) – it is safest to use autologous cells (primary cells extracted from the same person's own healthy tissues to which the artificial tissue will be transplanted), recently there has been trend to use mesenchymal stem cells from bone marrow that can differentiate into various tissue types. Other types of cells that can be used are allogenic (donor from the same species), heterologous (or xenogenic, donor is different species). In those cases, rejection of the host's immune system and possible disease transmission are risks that need to be considered.

3) **SCAFFOLDS, seeding, cultivation** – implantation or 'seeding' of cells into artificial structure that can support 3-D tissue formation; that resemble the extracellular matrix. There are certain requirements that scaffolds need to meet: biocompatibility (acceptable for cells, high porosity and adequate pore size), biodegradability and non-brittle nature (it is preferable for scaffold to be absorbed by surrounding tissues), can be functionalized with biomolecules, function as nutrition for cells, adequate properties.

4) **IMPLANTATION** (implantation into living body)

5) **DETECTION** (property analysis)

Assembly methods

Self-assembly – fabrication technique called micromasonry is used to self-assemble micrometric and sub-micrometric 3D units to larger structures - encapsulation of living cells in polymer cubes.

Liquid-based template assembly - in this case an air-liquid surface that is established by Faraday waves can be used as template for formation of 3D network.

Additive manufacturing – 3D printing of models of vascular system, organs. Successive layers of living cells are deposited on gel medium or sugar matrix and then slowly built up to form 3D structures – for example endothelial cells printed in sets of ring and then incubated and fused into tubes. It is predicted that in the future organs like kidneys and liver can be grown.

Scaffolding (see specifics subtopic)

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