Engineering tissue – Bacterial cellulose as a potential biomaterial

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Avhandlingen baseras på följande arbeten:

I. **Intravital fluorescent microscopic evaluation of bacterial cellulose as scaffold for vascular grafts.**
Esguerra, M., Fink, H., Laschke, M. W., Jeppsson, J., Delbro, D., Gatenholm, P., Menger M. D., Risberg, B.
J Biomed Mater Res A. 2010 Apr;93(1):140-9

II. **Engineering microporosity in bacterial cellulose scaffolds.**
Bäckdahl, H., Esguerra, M., Delbro, D., Risberg, B., Gatenholm, P.
J Tissue Eng Regen Med. 2008 Aug;2(6):320-30.

III. **In vivo evaluation of porous bacterial cellulose: A biocompatibility study.**
Esguerra, M., Johansson, B.R., Soussi, B., Risberg, B., Krettek, A., Delbro, D.S.,
Submitted

IV. **Vascular smooth muscle cells express markers of the non-neuronal cholinergic system.**
Esguerra, M., Novotny, A., Jeppsson, A., Risberg, B., Krettek, A., Delbro, D.S.,
Manuscript

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ABSTRACT

Cardiovascular diseases are still the predominant cause of death among the adult population in the Western world. Diseases such as myocardial infarction and stroke are caused by occluded blood vessels, as a result of atherosclerosis. Severely occluded vessels are preferably replaced with an autologous mammary artery or saphenous vein through by-pass surgery. Autologous replacement vessels are limited since many patients lack suitable vessels due to previous operations or have blood vessels that are inadequate for transplantation. Available synthetic vascular conduits function satisfactorily in large vessels. However, in small blood vessels (<6 mm), synthetic grafts are prone to thrombosis. Thus, there is a need for alternative vascular graft material of biological origin. The main aim of this Thesis was to evaluate whether bacterial cellulose (BC) can be used as a biomaterial for engineered blood vessels.

For an implant to be accepted in the host, it has to be biocompatible, i.e., be well integrated into the tissue and display appropriate properties. Biocompatibility studies of BC in hamster showed that the material does not induce inflammation and that both cells and microvessels grow into the BC. Thus, BC is well accepted in the tissue. Then, microporous BC was designed to further enhance biocompatibility. Smooth muscle cells (SMCs) cultured on porous BC migrated further into the material compared to cells grown on conventional BC. However, in contrast to conventional BC, porous BC elicited an inflammatory response characterized by macrophages, lymphocytes and myofibroblasts. Taken together, these results indicate that porous BC is inferior to conventional BC with regards to biocompatibility; nevertheless, microporosity improved cellular migration of SMCs in vitro.

Additionally, the presence of the non-neuronal cholinergic system was evaluated in the vascular wall of the saphenous vein and cultured venous and arterial SMCs. Components of the non-neuronal cholinergic system were found in the media of the blood vessels as well as in cultured SMCs. Its function in these cells remains to be determined.

This Thesis demonstrates that BC is biocompatible since it was found to be well integrated into surrounding tissues and therefore has good potential as a biomaterial for tissue engineering.

Keywords: Bacterial cellulose, biocompatibility, blood vessels, non-neuronal cholinergic system, smooth muscle cells, tissue engineering

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