Vascular tissue engineering: towards in-vivo implantation of porcine vascular grafts

Citation for published version (APA):

Document status and date:
Published: 01/01/2008

Document Version:
Publisher’s PDF, also known as Version of Record (includes final page, issue and volume numbers)

Please check the document version of this publication:
• A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher’s website.
• The final author version and the galley proof are versions of the publication after peer review.
• The final published version features the final layout of the paper including the volume, issue and page numbers.

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

• Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
• You may not further distribute the material or use it for any profit-making activity or commercial gain
• You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the “Taverne” license above, please follow below link for the End User Agreement:
www.tue.nl/taverne

Take down policy
If you believe that this document breaches copyright please contact us at:
openaccess@tue.nl
providing details and we will investigate your claim.

Download date: 18. Jun. 2019
Vascular Tissue Engineering
Towards in-vivo implantation of porcine vascular grafts
Maria Stekelenburg, Rolf Pullens, Irma Geenen, Geert Willem Schurink, Frank Baaijens, Mark Post

Introduction
The need for small diameter vascular grafts is large. These grafts are used in coronary and peripheral bypass grafting and as arterio-venous (AV) shunts in hemodialysis patients. Vascular tissue engineering represents a promising approach for the development of living small diameter blood vessels. In-vivo implantation of tissue-engineered vascular grafts in an animal model will elucidate the potential of these grafts. In the current study a protocol was developed to culture strong porcine grafts. In addition, a first feasibility experiment was performed which included in-vivo implantation as a interposition graft of the carotid artery in a porcine model.

Materials & methods
Myofibroblasts and endothelial cells (ECs) were harvested from porcine jugularis veins. Tubular and rectangular scaffolds were fabricated from PGA coated P4HB (Fig.1) and seeded using fibrin gel as a cell carrier.

Tissue strips were cultured to investigate the differences between culture protocols and between cells of different pigs. Tubular constructs were seeded and statically cultured to obtain vascular grafts. All constructs were seeded with 25*10^6 cells/ml. After 4 weeks of culture, ECs were seeded on the inside of the grafts. In a first in-vivo feasibility study cells were isolated from 9 pigs. Grafts were implanted as an interposition graft of the carotid artery.

Results

Strips - Culturing tissue strips (Fig.2a) with cells of different pigs revealed that large differences can exist in tissue formation. Figure 3 shows representative stress-strain curves and the corresponding hydroxyproline contents (as a measure of collagen) of 3-week cultured tissue strips with cells of 5 different pigs, illustrating the variance in tissue formation.

Conclusions
Strong porcine vascular grafts were successfully cultured and implanted into pigs. The grafts exhibited burst pressures ranging from 400 to 1000mmHg, indicating a relative strong variability in tissue formation. Preliminary results of the in-vivo feasibility study showed that at least the suturability of the grafts and the seeding of endothelial cells should be improved.

Introduction
The need for small diameter vascular grafts is large. These grafts are used in coronary and peripheral bypass grafting and as arterio-venous (AV) shunts in hemodialysis patients. Vascular tissue engineering represents a promising approach for the development of living small diameter blood vessels. In-vivo implantation of tissue-engineered vascular grafts in an animal model will elucidate the potential of these grafts. In the current study a protocol was developed to culture strong porcine grafts. In addition, a first feasibility experiment was performed which included in-vivo implantation as a interposition graft of the carotid artery in a porcine model.

Materials & methods
Myofibroblasts and endothelial cells (ECs) were harvested from porcine jugularis veins. Tubular and rectangular scaffolds were fabricated from PGA coated P4HB (Fig.1) and seeded using fibrin gel as a cell carrier.

Tissue strips were cultured to investigate the differences between culture protocols and between cells of different pigs. Tubular constructs were seeded and statically cultured to obtain vascular grafts. All constructs were seeded with 25*10^6 cells/ml. After 4 weeks of culture, ECs were seeded on the inside of the grafts. In a first in-vivo feasibility study cells were isolated from 9 pigs. Grafts were implanted as an interposition graft of the carotid artery.

Results

Strips - Culturing tissue strips (Fig.2a) with cells of different pigs revealed that large differences can exist in tissue formation. Figure 3 shows representative stress-strain curves and the corresponding hydroxyproline contents (as a measure of collagen) of 3-week cultured tissue strips with cells of 5 different pigs, illustrating the variance in tissue formation.

Conclusions
Strong porcine vascular grafts were successfully cultured and implanted into pigs. The grafts exhibited burst pressures ranging from 400 to 1000mmHg, indicating a relative strong variability in tissue formation. Preliminary results of the in-vivo feasibility study showed that at least the suturability of the grafts and the seeding of endothelial cells should be improved.