Culturing arterial segments under physiological conditions

Cultering arterial segments under physiological conditions

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Introduction

#1 cause of death in western society is heart disease, especially atherosclerosis of the coronary arteries. This disease, characterized by a narrowed arterial lumen can be treated by catheter-based interventions called PTCA. During PTCA, relative high mechanical loads are induced locally, thus injuring the wall. This may cause extreme proliferation of SMCs which results in renarrowing of the lumen, or restenosis. Intraluminal coronary radiation therapy (ICRT), a catheter-based β-radiation treatment, has shown good results in the prevention of restenosis [1]. The procedure, however, needs to be refined to get better reproducibility.

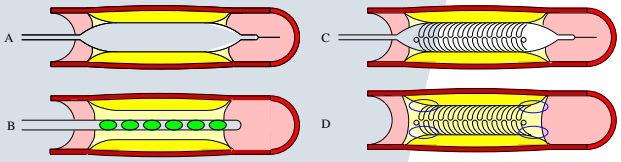

Figure 1 *A:PTCA B:ICRT C:stent D:restenosis sites*

Objective

The aim of this project is to study morphological and biochemical responses to interventions and the effects of β-radiation on (damaged) VCs.

Methods

To investigate the intervention responses an experimental setup is built in which arterial segments can be conditioned and perfused under physiological conditions.

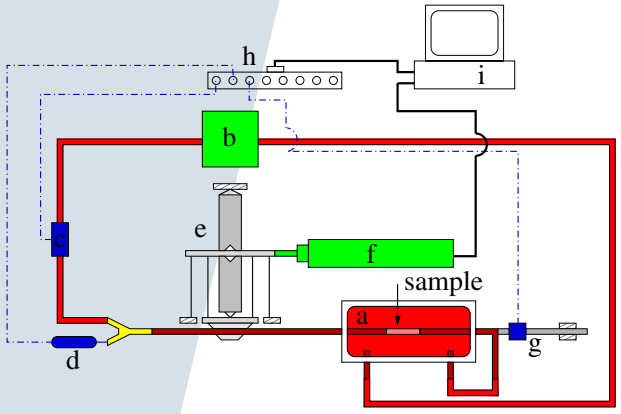

Figure 2 *Scheme of experimental setup*

In the setup, the arteries may be perfused instationarily with DMEM, complemented with serum and antibiotics, inducing physiological pressures ($\varepsilon_{\phi\phi}$) and shear stresses (τ_w). Simultanously, the specimens may be extended axially (ε_{zz}). During the experiments, the pressure inside and the flow through the vessel are monitored. Physiological loads are applied because they are necessary for VCs to maintain their functionality [2].

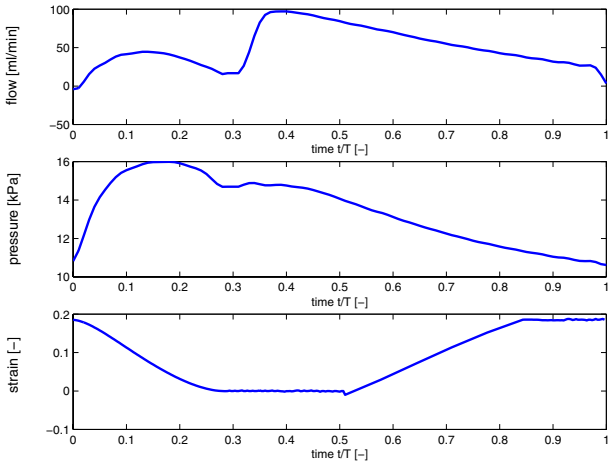

Figure 3 *Left coronary flow (a) [3], aortic pressure [3] (b) and coronary strain obtained from human heart simulation [4]*

The complete setup is put in an incubator to optimize temperature. The O_2-concentration can be regulated with an oxygenator.

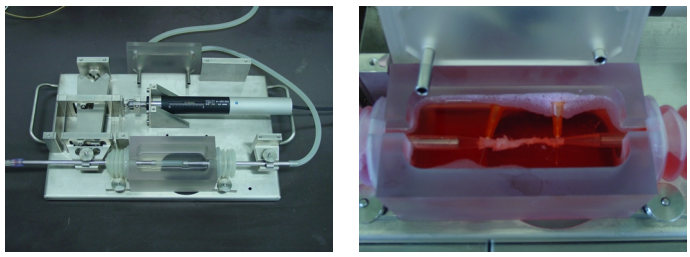

Figure 4 *Axial strain device (l) and a cultured porcine left circumflex coronary artery in organ bath*

Biochemical and morphological changes are determined using techniques for quantifying protein activities and labelling cell structures respectivily.

References:

[1] Teirstein, P. S.: *Three-year clinical and angiographic follow-up after intracoronary radiation: Results of a randomized clinical trial* (2000)

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[3] Berne, R. M. and Levy, M. N.: *Cardiovascular physiology* (1967)

[4] Kerckhoff, R. C. P.: *unpublished data* (2001)

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