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Effects of PTCA on *in vitro* cultured coronary arterial segments

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Introduction

Percutanous transluminal coronary angioplasty (PTCA) is an important procedure for restoring blood flow in stenosed coronary arteries. Although already applied clinically for more than 40 years the effects of PTCA on the behaviour of the arteries after the intervention are still unknown. Within 6 months after PTCA an exaggerated response to injury results in restenosis in 40% of the PTCA-treated arteries.

Aim

To determine the differences in viability, the number of proliferating cells and morphology in *in vitro* cultured coronary arterial segments treated with PTCA and untreated coronary arterial segments in the first week after treatment.

Methods

An *in vitro* model was developed in which coronary arterial segments can be conditioned and perfused under physiological conditions and mechanical loads, including an axial strain of 5% (Fig 1). The setup has been equipped with orifices to perform interventional procedures, like PTCA.

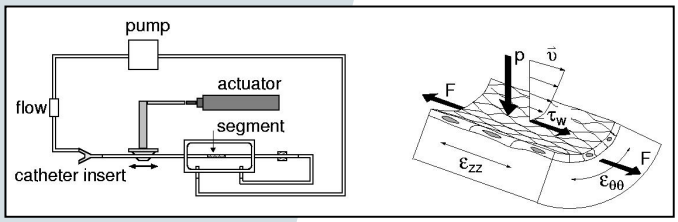

Figure 1 *The in vitro model (l): the arterial segment is emerged in culture medium and clamped to the axial actuator that, together with a pump, applies the in vivo mechanical loads; Pressure p, flow v and axial force F result in circumferential strain $\varepsilon_{\theta\theta}$, shear stress τ_w and axial strain ε_{zz} (r). The complete setup is placed in an incubator.*

Six segments of porcine left anterior descending coronary arteries (LAD) were processed for measuring viability and the number of proliferating cells directly after excision (t=0h) and after 168h of culturing in the *in vitro* model. One part of the cultured LAD was treated with PTCA. A balloon was inserted and inflated for 2 minutes at 1 MPa resulting a circumferential strain up to 20%. The other part of the LAD remained untreated. Viability was determined by measuring the mitochondrial activity using a MTT assay. Proliferating cells were identified by using BrdU incorporation in newly formed DNA. With immunohistochemistry techniques the cells with new DNA were visualized. Also, samples were collected for histological analysis using Masson's Trichrome Staining (MTS).

Results

The differences in viability, number of proliferating cells and morphology are shown in fig 2 and 3.

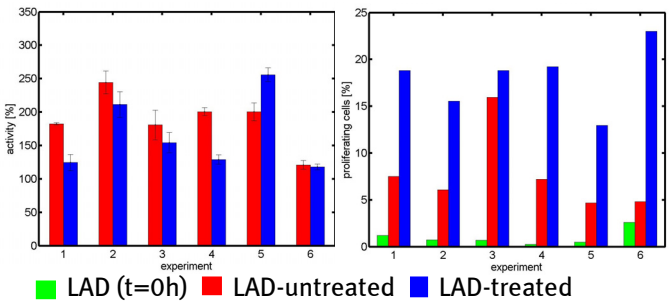

Figure 2 *Mitochondrial activity of the untreated and treated LAD coronary arterial segments t=168h proportional to t=0h (l) and the number of proliferating cells proportional to the total number of cells present in a cross section of the arterial segment (r).*

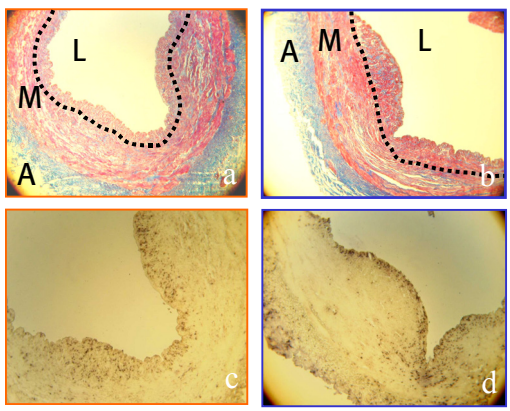

Figure 3 *Cross sections of untreated (a&c) and treated (b&d) arterial segments stained with MTS (a&b) with L=lumen, M=media and A=adventitia, and BrdU (c&d) with dark brown spots indicating new cells.*

Conclusions

- Treated LADs show signs of neo-intima formation
- The newly formed cells in the treated LADs are located in the boundary area of media and intima
- Treated LADs show significantly more proliferation than the untreated LAD
- Untreated LADs tend to have more mitochondrial activity than the treated LADs but not significantly