6 CONCLUSIONS

Using our newly developed bioreactor system, we fabricated a viable patch tissue construct *in vitro* with human smooth muscle cells for potential use in cardiovascular surgery. In this study, we demonstrated the feasibility of seeding SMCs and fibroblasts onto a P4HB scaffold to construct a TE patch.

In our bioreactor system, the seeded human vascular cells could migrate into, adhere well to, proliferate in, and differentiate in the porous P4HB scaffold to form viable, oriented and confluently layered tissue without any signs of contamination. Our study demonstrated that our new pulsatile flow system could provide biochemical and biomechanical signals to regulate human autologous patch tissue development *in vitro*. After conditioning in the bioreactor, each polymeric scaffold was partially absorbed and replaced with cells and extracellular matrix (collagen, elastin). The new bioreactor system has a beneficial impact not only on human smooth muscle cell function but also on the composition of extracellular matrix, and additionally facilitates the devlopment of new tissue and enhances tissue maturation. Staining for *a*-Smooth muscle actin and fibronectin revealed positive signals throughout the TE patches, indicating the establishment of cellular interactions with ECM.

In addition, the bioreactor system could maintain the integrity of the TE constructs. Our new pulsatile patch bioreactor is a compact, stable dynamic flow system and can be easily placed in a standard cell incubator, representing a highly isolated dynamic cell culture setting with maximum sterility, optimal gas supply and stable temperature conditions especially suited for long-term experiments in human cardiovascular tissue engineering.

Our early *in vitro* results appear promising but the results are still preliminary and numerous issues remain to be addressed. Further experiments are needed to optimize the culture conditions for human cardiovascular patch tissue formation *in vitro* before final implantation into patients suffering from congenital heart disease.