A NEW PULSATILE BIOREACTOR FOR VASCULAR CELLS

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ABSTRACT

A newly designed pulsatile bioreactor for vascular cell is described. Human cells are seeded on the inner surfaces of four silicon tubes that rotated during cultivation and could be subjected to different hydrodynamic settings.

METHODS

Tissue engineering techniques could lead to the formation of new functional autologous tissue. Biomechanical factors were shown to have a significant impact on cell growth and behavior in in vitro cell cultures. Our goal was the design of a new bioreactor in which vascular cells could be seeded and grown inside a cylindrical tube and be studied under various physiological pressures and flow conditions. The bioreactor has to meet several requirements: compact design, sterilizable, medium low volume. It has also to include the facilities to create an environment of mechanical stimuli such as pressure and shear stress, as well as the ability to mimic different hemodynamic conditions (Dumont, 2002). Silicone rubber was already determined as a suitable material for the building of artery models since it is compliant, highly transparent and easy to process. We have, therefore, carried a systematic study on cell adhesion on silicone rubber. We were able to demonstrate the feasibility to culture cells, using surface modification methods that were applicable to tube lumen and allowed reaching uniform cell distribution with no cell-cell contacts (Martinez, 2002).

RESULTS

The bioreactor consists of two major parts: 1) test chamber with DC motor, gear and elastic silicon tubes with seeded cells (Figure 1) and 2) computer controlled pulsatile flow loop with flow and pressure sensors. The test chamber fits in an incubator shelf. The following materials were used: Stainless steel, Teflon, polycarbonate and silicon tubes. Four arterial models, made from silicon, located in special containers each, were inserted into the test chamber with media, and rotated during cell growth process. Direction and speed of rotation during cells cultivation were controlled. This technology allowed even cells distribution along the entire silicon tube inner surface. After initial cell growth, the tubes in the same test chamber were connected to four small gear pumps for studying pulsatile flow. Pumps were computer controlled to ensure desired flow wave shape and pulse rate. Miniature sensors controlled the flow rate and pressures that were displayed on the PC monitor. Flow rate and pressure for each model could be regulated separately over a wide range of physiological values.

Figure 1. Test chamber

CONCLUSIONS

This bioreactor allows vascular cells cultivation and consequent hydrodynamic tests. It serves as basic equipment for the studies of vascular cell behavior in elastic vascular models under different hemodynamic conditions.

REFERENCES

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