Design of a Polymeric Replica of the Human Aortic Arch for in vitro Experimentation

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The aorta is the most important artery in the human body. Aortic aneurysms are the aorta's main disease, which affects 2-7% of men over 65 years. Current treatments for aneurysms are open surgery and endovascular repair. Nonetheless the last one is not available for aneurysms in the ascending aorta. The goal of this project is manufacturing an in vitro replica of the ascending aorta which could be used as an alternative treatment for aneurysms. It should possess physiological biomechanical characteristics and should be tailored to each patient. Therefore, this work has focused on building a biocompatible, biodegradable, flexible and porous scaffold where vascular cells could grow in a physiological configuration. In this project, I designed a procedure to shape a biomaterial (polycaprolactone, PCL) to build the aorta replicas combining 3D printing technologies and the salt leaching method to ensure pores homogeneity. To accomplish successful replicas, I found which solvents could remove the mold shaping the scaffold without affecting the polymer integrity. The last set of experiments verified, under the fluorescence microscope, that human dermal fibroblasts adhered functionally to the manufactured scaffolds. We can conclude that the PCL scaffolds could be shaped using adapted 3D printed molds that were solved a posteriori using a cheap dissolvent, ethanol. Homogeneous cell adhesion to the scaffold was observed in multiple experiments.