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ENDOTHELIAL CELL CULTURING IN A RANDOM POSITIONING MACHINE WITH A CULTURE CHAMBER

Abstract

People in space experience changes in their musculoskeletal system, sensory organs, and immune function. These changes prove that microgravity affects the body, so the most basic unit of the human body, the cellular unit, must be studied to understand microgravity effects; however, experiments in space are expensive. Recent studies have used devices simulating zero gravity environments on the ground using parabolic flights, drop towers, clinostats, and random positioning machines (RPM). Parabolic flights and drop towers are unsuitable for experiments because they maintain microgravity for short periods. Clinostats and RPMs, which rotate axes and form microgravity continuously, are suitable for testing. We conducted an experiment using an RPM that can better simulate microgravity environments by rotating on two axes. For this experiment, our team fabricated an RPM to test its effects on cells. Our RPM differs from previous RPMs since ours contains a chamber where cells can be cultured. Just like an incubator, the RPM's cell chamber maintained $5\%\ CO_2, 37°C$ and 95% humidity conditions, which is an environmental requirement for cell culturing. First, we compared the survival rate of the control group in the incubator with the cell experimental group cultivated in the RPM to verify the reliability of the chamber. The difference in the cell survival rate between the RPM culture chamber and the incubator was about 7%. Then, we divided the experimental groups into two speed cases, a slower and a faster one, and conducted the experiment. For each speed case, we divided the scaffold of PCL (polycaprolactone) material into collagen-coated and uncoated. Experiments with the slower speed case showed that the scaffold with collagen coating showed three times the survival rate of cells than the scaffold without collagen. In the faster speed case, the scaffold without collagen coating showed a near zero cell survival rate, and both speed cases of collagen coated scaffolds showed a 24% lower survival rate than the control group. These results confirm that microgravity affects cell proliferation, which is also an important factor in terms of mechanics to understand the effects of physical or mechanical forces on cells in antigravity environments. Since the collagen coating mitigated shear stress, further studies to improve scaffold-coating technology are required to counter the stress caused by the two rotating axes.