O8: Biorheology and Biotechnology-1

O8-1 Fabrication of Gradient Nanofibrous Scaffold for Interface Tissue Engineering

Li Yang, Peixing Chen, Yu Zhang,

Chongqing University, China

For the special biomolecular composition, microstructure and micromechanics in the interfacial region, surgical reconstruction of ruptured ligament/tendon with soft tissue grafts creates bone-graft interfaces within bone tunnels, where mismatched properties can result in poor osteointegration and increased rate of graft failure. Therefore, improvements in bone-graft integration are critical to allow for earlier and more aggressive rehabilitation with the hope of promoting a speedier return to normal daily activities. In the current study, we developed a nanofibrous scaffold based on silk fibroin to mimic the native interfacial region, which had a gradually increase of mineral content demonstrated with scanning electron microscope, energy-dispersive X-ray spectroscopy and fourier transform infrared spectroscopy analysis. Furthermore, human mesenchymal stem cells were cultured on different areas of the scaffold with gradual mineralization and the effects of scaffold structure and topography on cell morphology, proliferation, viability and differentiation were also investigated. The fabricated scaffold showed a high proliferative capacity, viability and biocompatibility and could direct osteogenic or tenogenic differentiation. In summary, the fabrication of gradient scaffold based on silk fibroin can improve the integration and has the potential application in the interfacial tissue engineering. [This work was supported by the National Natural Science Foundation of China (Nos. 11532004, 31270990), and Innovation and Attracting Talents Program for College and University (“111” Project) (No. B06023)]

O8-2 Tanshinone Can Inhibit Inflammation and Angiogenesis in Several Chondrocytic Cells

Li Yang, Yu Zhang, Peixing Chen

Base for Innovation and Talents Recruiting of Biomechanics and Tissue Repairing Engineering, Chongqing University, Chongqing 400044, China;
Key Laboratory of Biorheological Sciences and Technologies (MOE), College of Bioengineering, Chongqing, China

Objective:
To investigate the potential effects of tanshinone on oxidation, inflammation and angiogenesis in various kinds of chondrocytic cells.
Methods:
Various kinds of chondrocytic cells were used in this project such as human primary articular chondrocyte (PHC), SW1353 human chondrosarcoma cell line, C-28/I2 and T/C-28a2 human immortalized chondrocyte lines. Treatment of human TNF and IL1B polypeptides was used to stimulate inflammatory reaction. After the inflammatory response was activated, the authors evaluate the anti-inflammatory and anti-angiogenesis effects of 10mmol/L tanshinone treatment by merits of qRT-PCR and western blot which tested VEGF, PAK1, IL6 and IL10. The authors also tested the potential anti-oxidant effect of tanshinone on chondrocytic cells by BES-H_2O_2-Ac and AlamarBlue staining and flow cytometry.

Results:
After treatment of either TNF or IL1B polypeptides, PHC and other chondrocytic cell lines exhibited an upregulated inflammatory response by testing the expression of IL6 and IL10. The expression of interleukins had been suppressed after the following treatment of 10mmol/L tanshinone. Tanshinone treatment can also downregulate the expression of VEGF and PAK1 in TNF-treated and IL1B-treated PHC and other chondrocytic cells. After fluorescence analysis of BES-H_2O_2-Ac and AlamarBlue treated cells, authors found tanshinone can also play an antioxidant role.
Conclusion:
In human primary articular chondrocytes and other chondrocytic cell lines, tanshinone can inhibit angiogenesis, inflammation and oxidation after stimulation with TNF or IL1B. It gives an opportunity for tanshinone to take part in OA treating.
Grants:
Natural Science Foundation of China (11532004, 31270990); “111” project (B06023).

O8-3 The Preliminary Research of Mechanical Compress Damage on Neurons Induced by Hematoma

Wei Wang, Yin Yin, Jun Wang, Tieying Yin, Yazhou Wang, Guixue Wang

Key Laboratory for Biorheological Science and Technology of Ministry of Education, State and Local Joint Engineering Laboratory for Vascular Implants, Bioengineering College of Chongqing University, Chongqing, 400030, China

Hemorrhagic stroke is the most lethal and crippling cerebrovascular disease and with serious dysneuria among the survivors. Besides biochemistry damages, there are various mechanical factors in the process of cerebral hemorrhage. However, whether these mechanical factors play key roles in the occurrence and development of cerebral hemorrhage is rarely studied. In our studies, the primary process of neuron and tissue injury induced by hematoma is researched through brain slices and with the auxiliary proof of neuron culture. Brain slices were obtained through vibratome and cultured with Transwell, and then compressed by the mechanical compress system constructed by ourselves. The primary process of neuron damage is researched though lactate dehydrogenase detecting, fluorescent quantitative PCR, immunofluorescence and western-blot. The activity of neurons and glial cells declined rapidly after being compressed. The genes of ion channel proteins PIEZO and TRPV4 raised rapidly after being compressed, and continued to increase significantly and reach a peak value after 12 hours culture following stress removing. However, the PIEZO and TRPV4 protein expression increased after being compressed, but did not continue to rise. After being compressed, the intracellular Ca^{2+} concentration and the apoptosis promoting gene BAX increased rapidly while apoptosis restraining gene Bcl-2 decreased significantly, and the tendency continued after mechanical stress being removed. The high concentration of intracellular Ca^{2+} activates the expression of apoptosis promoting gene BAX and prevent Bcl-2, and ultimately accelerates cell apoptosis.

O8-4 Hemodynamic Analysis of Cerebral Aneurysms: Suggestions for Surgical Options

Shicheng He

Key Laboratory for Biorheological Science and Technology of Ministry of Education, State and Local Joint Engineering Laboratory for Vascular Implants, Bioengineering College of Chongqing University, China

Hemodynamic factors play a significant role in the development of cerebral aneurysms. Factors such as wall shear stress (WSS), blood velocity or pressure could change in time and may contribute to aneurysm growth and rupture. Now, computational fluid dynamics has become a popular tool for studying intracranial aneurysm hemodynamics and discriminating rupture status. In this study, we observed a rare case of a middle cerebral artery aneurysm in which a small aneurysm attaches to main aneurysm. We obtained the computed tomography angiography (CTA) data when the patient was admitted to the hospital, and calculated hemodynamic factors in this aneurysm. We found that there was an obvious vortex within the aneurysm, and the WSS in the small aneurysm was significantly lower, and high pressure occurs on the neck of the small aneurysm. Based on the calculation results, we recommend clamping the lateral aneurysm while the main aneurysm will not be treated for the time being. The patient's CTA data for three days after the surgery were further analyzed. And we found that the volume of the aneurysm after clipping significantly reduced, the blood flow within the aneurysm more stable, the WSS distribution of the aneurysm uniform, and the area of low shear stress significantly reduced, which indicated the surgery effect is good. Patient's CTA data for one-year post the surgery showed that the main tumor gradually shrank and the patient was in good condition. Overall, our study successfully assessed the hemodynamic environment of patients with cerebral aneurysms, and put forward a better surgery plan, which may be useful for clinical application. [Supported by the NKTR&DPC (2016YFC1102305), the NNSFC(11332003), the FRFCU (CDJXY230002, CDJZRPY0202, CDJQJ238814)]

O8-5 Development History, Progress and Future Prospects of Biorheology and Biomechanics in Chongqing University

Wang Guixue

Key Laboratory for Biorheological Science and Technology of Ministry of Education, State and local Joint EngineeringLaboratory for Vascular Implants, Bioengineering College of Chongqing University, Chongqing 400030, China

The study of biorheology and biomechanics at Chongqing University (CQU) began in the 1970s, which has always been guided and helped by Prof. YC Fung. With the endeavor of him, Prof. YP Wu founded the first Biomechanics Research Lab in China in the 1970s. Biomechanics of CQU was approved to set up the first program for master's degree in 1980, and one of the two doctoral programs in 1986, the first National Key Discipline, and got the first State Award for Inventions (1984) and Natural Science Award (1988) in the field of biomechanics and biorheology. The Open Lab on Biomechanics and Biorheology under the National Education Commission was set up in 1994. The College of Bioengineering of CQU was founded in 1998, which developed from Biomedical Electronics Teaching Lab and the Biomechanics Lab that were built in 1979. Since then over ten research bases were approved to establish such as National "111 project" Base on Biomechanics and Tissue Repair (2006) ; Key Lab for Biomechanics and Tissue Engineering of MOE(2008), the Chongqing Public

Experiment Center of State Bioindustrial Base (2008), Key Lab for Biorheological Science and Technology of MOE(2011）, State and Local Joint Engineering Lab for Vascular Implants(2015). Biomedical engineering based on biomechanics and biorheology was approved to be first-level national key discipline and also were supported by the National "211" and "985" projects. Currently the College has developed into one of the largest research teams and the most influential high-level talent training bases of biomechanics and biorheology in China. This review summarizes the history, progress and future prospects of biomechanics and biorheology in CQU to celebrate the Centennial of Prof. Y C Fung and encourage the later generations to go forward.

O8-6 Zebrafish caudal vein formation is flow sheer stress dependent

Lin Wen

Key Laboratory for Biorheological Science and Technology of Ministry of Education, State and Local Joint Engineering Laboratory for Vascular Implants, Bioengineering College of Chongqing University, Chongqing 400030, China

Hemodynamic factors play a very important role in the process of blood vessel development and remodeling through the regulation of mechanosensory proteins. The different mechanosensory proteins on endothelial cells that transmit mechanical signals to the cytoplasm through their respective mechanical mechanoreceptive effects, and activated downstream chemical signals, which ultimately allow the endothelial cells to line up in the direction of fluid shear forces.

Unlike mammals, zebrafish can be observed in vivo. Thus, we are interested in investigating functional roles of hemodynamics on zebrafish blood vessel development. And we utilize the zebrafish as a model system to investigate the cellular and molecular mechanisms that contribute to zebrafish caudal vein formation. We have successfully utilized the transgenic fish Tg (flk1: GFP) to gain new insights that the zebrafish caudal vein is formed at 60hpf under physiologic blood flow. However, the caudal vein formation was blocked at 60hpf at low flow sheer stress. We used the transgenic fish Tg (Bre: GFP; kdrl: Mchrry) to find strong expression of bmp signal in zebrafish caudal vein.