MCB, vol.16, supplemental 2, pp.150, 2019

Investigation on Energy Characteristic of RBCs Deformability: A Quantitative Analysis of Extending and Retracting Curves Based on AFM

Dong Chen[1], Xiang Wang[1, *], Fuzhou Tang[2] and Yajin Zhao[1]

[1]The state key Laboratory of Biorheological Science and Technology, Ministry of Education, College of Bioengineering, Chongqing University, Chongqing, 400030, China.

[2]Key Laboratory of Biology and Medical Engineering, Guizhou Medical University, Guiyang, 550025, China.

*Corresponding Author: Xiang Wang. Email: xwangchn@vip.sina.com.

Abstract: Deformability is a fundamental property of the cells and tissues of living organisms, which is commonly detected to indicate the state of the cells. And the cell deformability usually depends on the methods that we used, which is easy to be confused. The present research is designed to explore the energy characteristic of red blood cell deformability, based on a quantitative analysis of extending-retracting curves acquired from atomic force microscopy. ATP-depleted red blood cells are prepared by treatment with free-glucose Ringer solution. Our results clearly show that the Youngs' modulus of erythrocyte is closely depended on the concentration of intracellular ATP. Using the software of Matlab, we get the area between the extending and retracting curves. Analysis of the control and ATP-depleted RBC demonstrated that the area could clearly differentiate between normal and ATP-depleted, which imply that ATP-depleted cause the decrease of RBC deformability. Our measures unveil that cell deformability is closely related to the state of intracellular energy, which can be characterized by cell passive deformation and active deformation. This research also will provide the theoretical basis for study the erythrocyte senescence, and give the evaluating to the red blood cells apoptosis, and also provide the health indicator for clinical blood transfusion in storage of blood.

Keywords: Energy characteristic; red blood cell; deformability; atomic force microscopy

Acknowledgement: This work was funded by National Natural Science Foundation of China (11572065).