Faculty of Science and Technology
Tokushima University

Foundation of Biomedical Engineering Techniques with Biophysical Engineering

Associate Professor Kenichiro Koshiyama

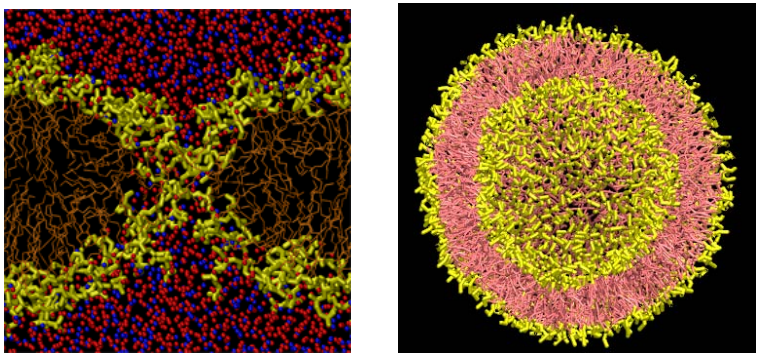

Fig. 1 Pore formation in cell membranes and nano-liposome formation. (*Physical review letters* 105 (1), 018105*, 2010, Scientific reports* 6, 28164, *2016.*)

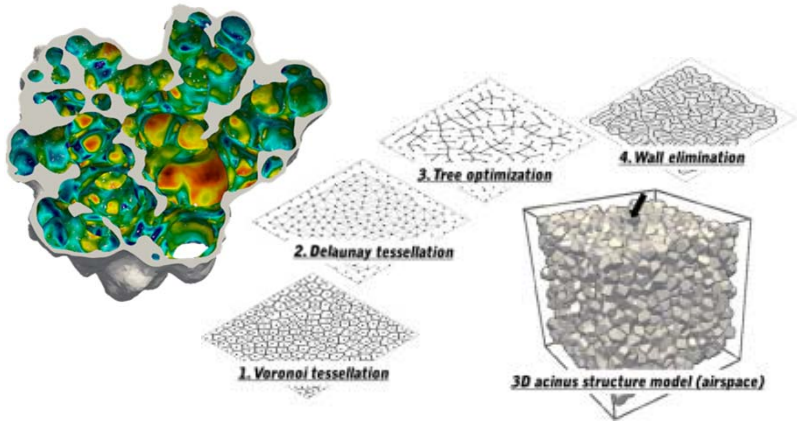

Fig. 2 Mathematical modeling of pulmonary acinus and its strain fields under static inflation with surface tension. (Computers in biology and medicine 62, 25-32,2015, Clinical Biomechanics, in press, 2018)

Content: Various medical engineering techniques such as ultrasound drug delivery systems, ventricular assist devices, and mechanical ventilation, have been developed and available these days. In such medical engineering techniques, non-physiological and non-equilibrium phenomena occur in vivo regardless of intention. For example, in drug delivery systems using physical methods (e.g., sound or electric fields), physical actions cause a non-equilibrium phenomenon of temporary permeability change in a cell membrane in an attempt to control pharmacokinetics intentionally. On the other hand, blood circulation pumps used for artificial heart and lithotripsy surgery using extracorporeal shock wave may induce erythrocyte membranes rupture, mechanical hemolysis, as blood is exposed to a non-physiological environment, e.g. high shear flows. Also, in mechanical ventilation, lung damage called ventilator-induced lung injury (VILI) may occur without appropriate settings of ventilation protocols. Physicians do not want to encounter these phenomena as much as possible when using medical engineering technology. The purpose of our study is numerically to understand the non-physiological and non-equilibrium phenomena occurring in living organisms associated with various medical engineering technologies to underlie the validity, safety, and efficiency of the technology. Our approaches are non-equilibrium molecular dynamics simulations, mathematical modeling of biological systems based on optimization, and mechanical analysis.

Keywords：Molecular Dynamics, Mathematical Modeling

E-mail: Koshiyama@tokushima-u.ac.jp
Tel. +81-88-656-9187
Fax: +81-88-656-9187
HP :https://sites.google.com/site/drkklab/