S2e2-3
Effects of Hydrostatic Pressure on Morphology of Cultured Bovine Aortic Endothelial Cells
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Endothelial cells are exposed to hemodynamic forces in vivo: shear stress, stretch, and hydrostatic pressure. Although these mechanical forces are important factors of remodeling in endothelial cell morphology, few studies have been reported to evaluate the effects of hydrostatic pressure. In this study, effect of hydrostatic pressure on morphology and expression of VE-cadherin of cultured bovine endothelial cells was investigated. After confluent endothelial cells were exposed to hydrostatic pressure of 50, 100 and 150 mmHg for 24 hours, F-actin filaments and VE-cadherin of endothelial cells were stained. Statically cultured endothelial cells formed a cobblestone pattern of contact-inhibited cells with thin, short F-actin filaments in monolayer. VE-cadherin was uniformly distributed at the periphery of cells. In contrast, endothelial cells exposed to hydrostatic pressure exhibited marked elongation without predominant orientation. Pressured endothelial cells also exhibited multilayered structure unlike monolayer under control conditions. Moreover, VE-cadherin was sparsely distributed at the periphery of cells, and its expression was lower than that of control. These results suggest that hydrostatic pressure could inhibit the expression of VE-cadherin, resulting in loss of contact inhibition followed by formation of multilayered structure.

S2e2-4
Nanobiomechanical approaches to studying human diseases
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It has been known that any deviation in the structural and mechanical properties of a living cell can not only affect its physiological functions but also lead to diseases. For example, red blood cells (RBC) transport oxygen to the various parts of the human body by squeezing their way through narrow capillaries. However, these cells are also highly coveted by the protozoan Plasmodium falciparum, the single-cell parasites that cause malaria. The parasite invades the RBC and releases proteins that interact with and induced changes to the membrane skeleton. These changes cause the cells to be stiffer and sticky. This results in impairment of blood flow which can possibly lead to coma and even death. This talk will first present the use of biophysical techniques such as micropipette aspiration and laser traps or optical tweezers to probe the progressive stiffening of malaria infected RBCs at the cellular level. Next, the talk will focus on probing the cytoskeleton and stickiness of the malaria infected red cells at the molecular level using atomic force microscopy. Some ligand-receptor pairs contributing to cytoskeleton will be identified and the interaction forces quantified.

S2e2-5
Mechanoelectric feedback in the heart
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Mechanoelectric feedback (MEF) is the process by which mechanical forces change the heart's electrical properties. MEF arises because of stretch sensitive (or mechano-sensitive) ion channels in the cell membrane of the cardiac myocytes. Two types have been demonstrated: a non-specific cation channel (SAC: conductance of 25 pS) and a potassium channel (conductance 100 pS). The gene coding for the SAC has not yet been identified but may be TRPC1. The gene for the potassium channel is likely to be TREK: we have recorded channels in isolated rat myocytes which have the properties of TREK channels expressed in heterologous systems. TREK mRNA is expressed heterogeneously in the rat ventricular wall, with 17 fold more expression in endocardial compared to epicardial cells. This difference is reflected in whole-cell TREK currents in isolated endocardial and epicardial cells. Consistent with this, we have also shown that stretching the ventricle in an intact heart produces action potential shortening which is more pronounced in endocardium (30% shortening at 40 mmHg) compared to epicardium (10% shortening at the same pressure). Computer models of the mechanics of the heart show pronounced spatial variations in strain in the myocardium with large transmural differences (in the left ventricle in particular) and also large differences between the base and apex of the ventricle. The importance of MEF and the non-homogeneous gene expression and strain distribution for arrhythmias is not yet clear for cardiac biomechanics.

S2f2-1
Stochastic dynamics of visual consciousness and global network of the brain
Tatsuo Murata

Generally speaking, macroscopic states of a system are determined not only by parameters of its environment but also by fluctuations of its elements holding a huge number of microscopic degrees of freedom. At unstable points the fluctuations influence how the macroscopic states are reorganized to different ones, and it looks like the changes occur spontaneously in the sense that the external parameters cannot control the whole process of the changes. To explore states of the brain, spontaneous changes of visual consciousness provide good experimental paradigms because these phenomena reflect the dynamic organization of the brain system. As the typical examples, ambiguous perception and binocular rivalry are known to include spontaneous alternations of conscious percepts without the stimulus changes. Our psychophysical studies have shown that the spontaneous alternations are driven by discrete stochastic process of the brain in common across the various kinds of ambiguous stimuli (Murata et al., 2003). To explore neural correlates of these spontaneous changes, we had an fMRI experiment using four kinds of ambiguous stimuli. The results showed that global cortical network consisting of frontal and parietal areas as well as visual areas was associated with the spontaneous conscious changes regardless of the kind of stimuli. Measurements of the activity of this network by means of high temporal-resolution modalities such as MEG will provide useful clue to understand the brain states and their spontaneous changes.