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Thrombosis, Inflammation, and Hematopoiesis Visualized by Multi-scale In Vivo 1P, 2P, and On-chip Imaging Systems

Satoshi Nishimura[1,2,3,4]

[1.] Center for Molecular Medicine, Jichi Medical University, Tochigi, Japan
[2.] Department of Cardiovascular Medicine, the University of Tokyo, Tokyo, Japan
[3.] Translational Systems Biology and Medicine Initiative, the University of Tokyo, Tokyo,
[4.] JST, PRESTO, Japan

We developed multi-scale imager to cover micro- and macro findings of living mice. Utilizing these imaging systems and light-manipulation technique, we revealed thrombotic and inflammatory processes in vessels in vivo.

First one is high resolution imaging system based on 2P optics. Real-time, multi-color XYZT multi-photon imaging was enabled using resonance (X), galvano (Y), and piezo (Z) scanning systems. Single cell behavior analysis elucidated the element of inflammatory and/or thrombotic reactions.
Second, macro imaging system for awake and free-moving mice was developed, and behavior monitoring revealed the tight association between metabolism and vascular reactions under daily stress.. Fluorescent imaging from body surface using 8K CMOS camera, image intensifier, and macro-lens enabled us to visualize cellular dynamics without anesthesia.
Third, wearable and implantable devices for long-time recording were developed using lens-less and on-chip technologies.

We utilized these system with light-manipulation technique, to induce thrombus or inflammation reactions. We induced thrombus formation by photo-chemical reactions in vein, and observed rapidly developing thrombi composed of discoid platelets, and elucidated the novel contributing factor; Endothelial cell disruption by laser irradiations induced inflammation and thrombus formation. Remarkable transient neutrophil accumulation was induced, which was followed by spontaneous cell death and monocyte recruitment. Artery contraction reactions were induced by ROS, and elucidated the dynamics NO/ROS balances.

We also visualized thrombopoietic process of megakaryocyte in living bone marrow, and elucidated the new and alternative platelet hematopoiesis.

In sum, we developed multi-scale imaging system which can evaluate the therapeutic strategies against thrombotic and inflammatory processes in adult-common disease.

Figure 1. Development of multi-scale imaging system from micro to macro

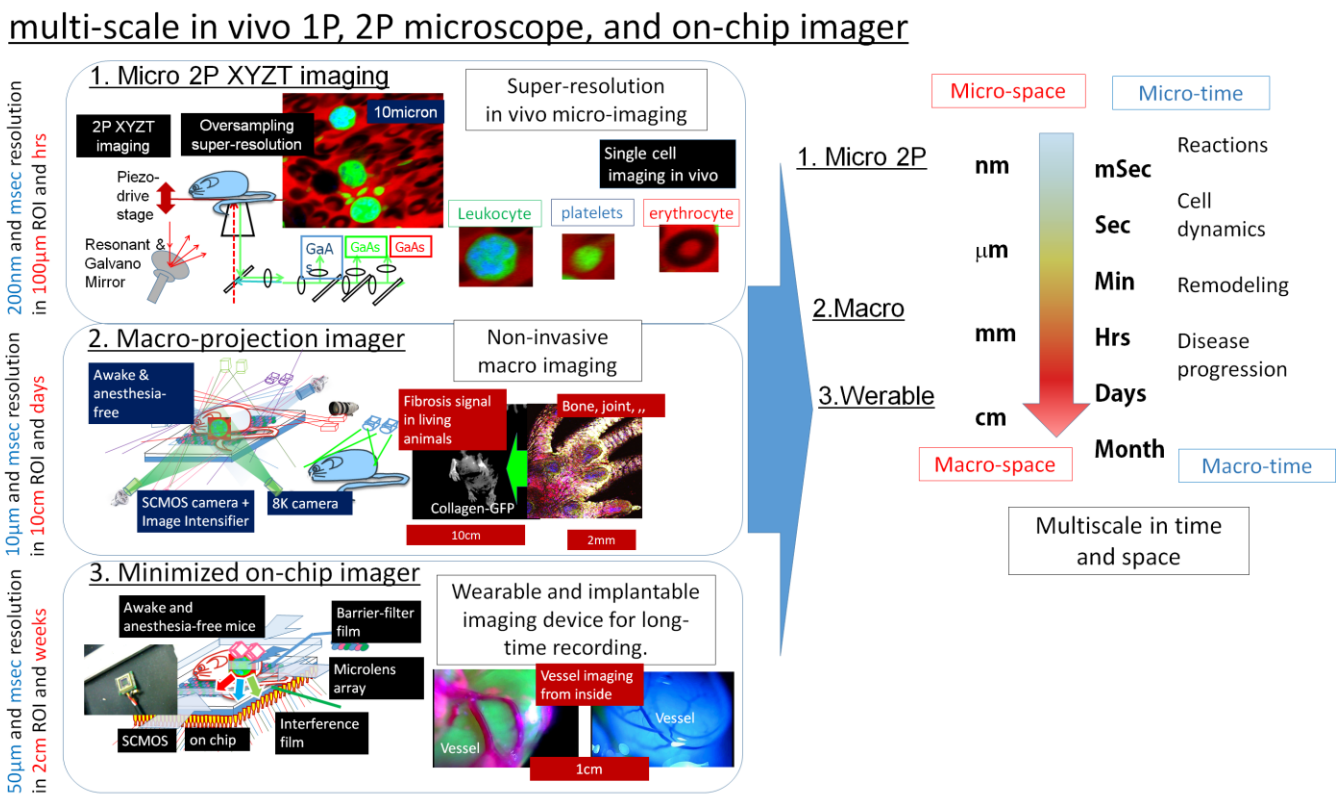
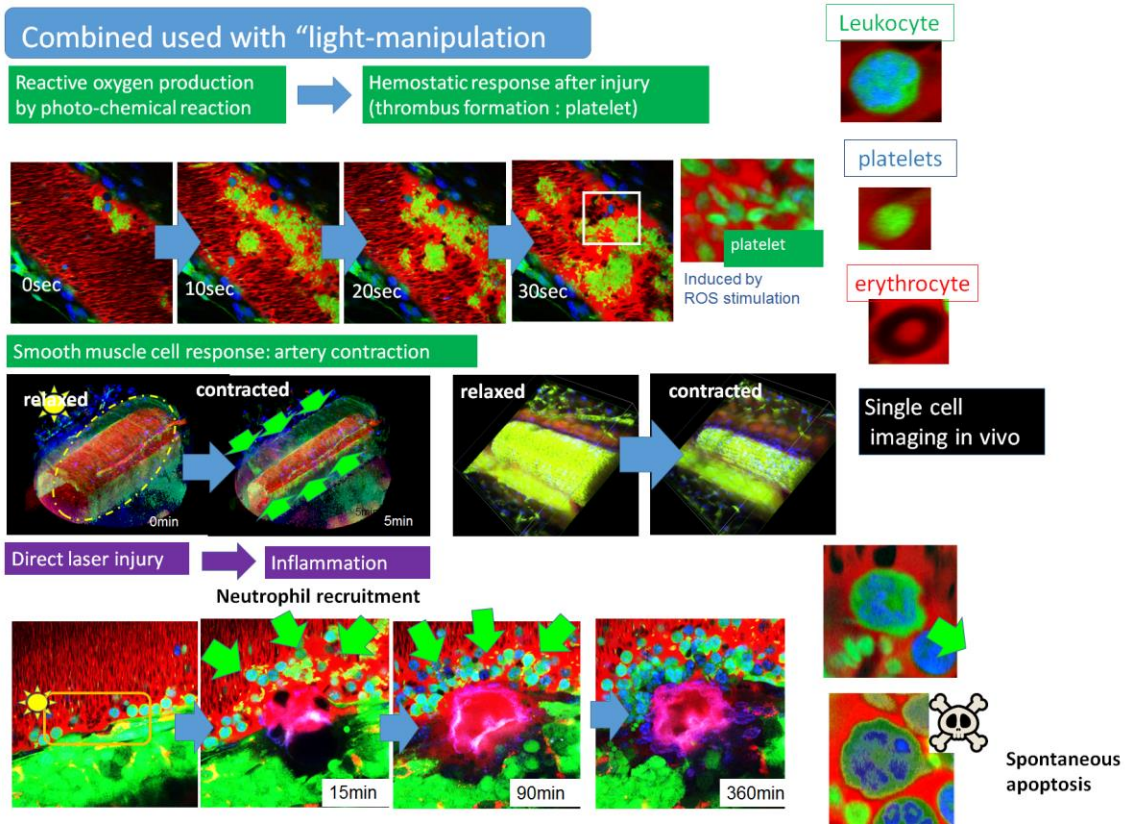


Figure 2. Light manipulation technique enables us to analyze biological reaction to stimulation



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