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VISUALIZATION OF VENOUS THROMBUS INITIAL FORMATION USING MICROCHANNEL FLOW

H. Shirouzu[1], Y. Yamamoto[1], S. Noguchi[1], *K. Tatsumi[1], H. Hirakata[2], N. Sugita[3], K. Inoue[4], R. Kuriyama[1] and K. Nakabe[1]

[1]Department of Mechanical Engineering and Science, Kyoto University
Kyotodaigaku-katsura, Nishikyo-ku, Kyoto 615-8540 Japan
*tatsumi@me.kyoto-u.ac.jp
[2]Anesthesiology, Kyoto City Hospital
[3]Psychiatry, Graduate School of Medicine, Kyoto University
[4]Emergency Medicine, Graduate School of Medicine, Kyoto University

ABSTRACT

Venous thrombosis is a significant issue in the blood circulatory system that can lead to serious symptoms such as deep venous thrombosis and pulmonary embolism (PE) which has large number of mortality. In the case of a venous thrombus, the activation of a platelet and its adherence to a vessel wall as well as the growth of the fibrin network play a significant role [1]. We have fabricated a microchannel, modeling the vein, with an area exposing the collagen layer to the blood flow, thus representing a condition that blood flow and a vein experience when injured (Fig. 1). The formation process of a thrombus can be measured directly in this system from the initial stage. Particularly, the fibrin network growing from the activated platelets that first adhered to the vessel wall could be visualized, and the correlation between the apparent mass diffusion from the platelets and the fibrin network pattern generated downstream were compared (Fig. 1). Figure 2 shows the pattern of the fibrin fibers developing from each platelet. The parabolic lines present the 95% confidence area of the fibrin network area modeled by an apparent diffusion coefficient, and the mass diffusion areas with the point of origin located at the coordinate origin in the cases of water and blood flow. The apparent diffusion coefficient is obtained from the probability density distribution of the direction and length of the fibrin fiber. Comparing the distributions, a reasonable correlation is observed between the mass diffusion area and the fibrin network. These results show that the flow can affect the thrombus formation significantly not only in terms of mechanical stress but also of mass transfer diffusion from each platelet.

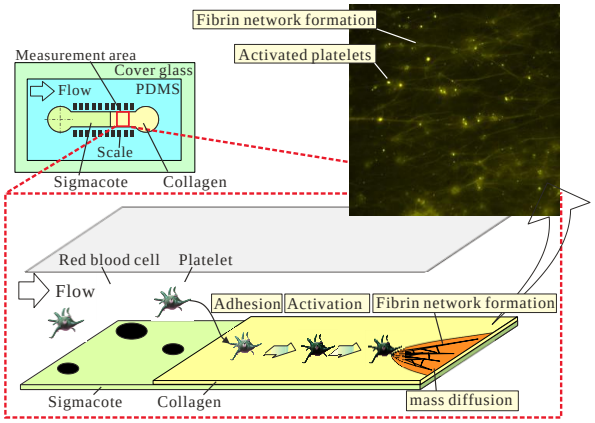

Fig. 1 Schematic of the microchannel and fibrin network formation in thrombus.

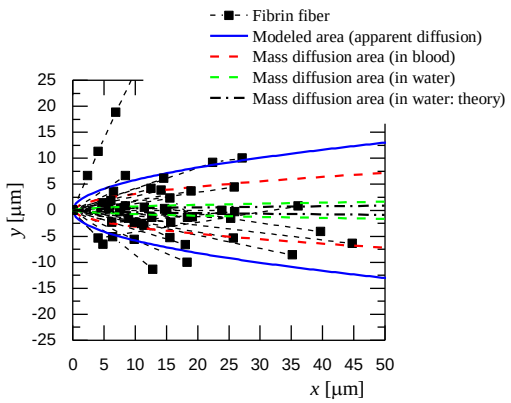

Fig. 2 Comparison of the areas of fibrin fiber development and mass diffusion.

REFERENCES

[1] Savage, B., et al., “Initiation of Platelet Adhesion by Arrest onto Fibrinogen or Translocation on von Willebrand Factor, Cell”, Vol. 84, 289-297, (1996).