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The Analysis of the Blood Clot Formation caused Stagnation of Bloodstream using MPS method

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The kind of blood clot has a white blood clot and a red blood clot. The white blood clot consists of a platelet mainly and is prone to formation at the artery. The red blood clot consists of red blood cells and is prone to formation at the vein. A blood clot formed by stagnation of the bloodstream is a red blood clot. In recent years, as for the economy-class syndrome becoming the problem, stagnation of the bloodstream occurs due to taking the same attitude for a long time, and it is thought that a blood clot grows up thereby. At first, in the study of the conventional blood clot formation analysis, the blood clot formation predicts the threshold of the shear stress, the threshold of the influence distance from a wall surface as a parameter in search of a transportation state of fibrinogen activated by numerical computation. But, their method is canft express a change to the solid from liquid continually. Therefore, at first, they solve the flow field and, secondly predict formation of the blood clot on the basis of flow field. But, in this method, the process of solve the flow field and predict formation of the blood clot are independent and so its difficult to perform coupled analysis. However, bloodstream and blood clot formation are closely related and very important. On the other hand, Moving Particle Semi-implicit (MPS) method can express a change to the solid from liquid continually. So, MPS method can perform coupled analysis. The analysis of a blood

clot formation using MPS method can consider influence on bloodstream by the blood clot formation and influence on blood clot formation by the change of the bloodstream. Moreover, MPS method doesn't need the mesh creation.

In this study, I built the blood clot formation model. In this study, I intend for the blood clot formation by the bloodstream stagnation. When bloodstream stagnated, the ninth factor of the blood coagulation factor is activated by the elastase which there is on the red blood cell film surface. The ninth activated factor activates the tenth factor and finally, it creates cross-linked fibrin mesh after having passed through the reaction of many stages. A red blood clot is formed by a red blood cells be taken in by this fibrin mesh. That is the blood clot formation mechanism caused by bloodstream stagnation. However, it is difficult to simulate all these reagency. Therefore I built the blood clot formation model based on following thoughts in this study. At first I modeled a phenomenon that a red blood cells were taken in by fibrin mesh as virtual gravitation acted on a red blood cell particles and it cohered. And secondly, I thought about what kind of gravitation triggered in a red blood cell particles. The elastase which becoming the trigger material of the blood clot formation exists on the surface of the red blood cells film and lets the ninth factor of the blood coagulation factor activate when stagnation of the bloodstream. Videlicet, the stagnation of the bloodstream is the stagnation of the red blood cell particles. In addition, the increase of the red count becomes the factor to promote the blood clot formation. If red counts increase, the mean distance between red blood cells shrinks. Now, therefore, if the lower the speed of the red blood cell particles the higher the gravitation to act on it, can model a formed element by stagnation of the bloodstream. I think about which particle I trigger this gravitation in. In this study, I assume mural thrombus which grows on a vessel wall surface. Therefore it was assumed that I triggered gravitation between the red blood cell particles-vessel wall surface particles as a general rule. However, I consider that the red blood cell particle which adhered to a wall surface became the wall and trigger gravitation between the red blood cell particles which adsorbed it and the drifting red blood cell particles. If gravitation do not trigger between them, blood clot growth will stop.

I describe the result. I examined dependence for the blood clot formation of the parameter of the blood clot formation model. The coefficient too big, red blood particles indicated unstable behavior. In addition, increase the coefficient, the particles which cohered decreased. And decrease the coefficient, the particles which cohered increased. I introduced a spring model to treat the collapse of the blood clot and to keep the shape of the blood clot stability. As a result, the thrombus kept stable shape and was able to confirm the collapse of the blood clot.