On the formation of arterial thrombus, observation was done in relation to the flow rate of blood. Mesenteric arterioles (about eighty micra or under in the inner diameter) of rabbits which were anesthetized with Nembutal were micro-punctured with a microscopic knife mounted on a micromanipulator. The dynamic morphology of the thrombus which was formed at the site of injury was observed and cine-photographed on 16mm. color films of which some pictures were analyzed by means of Film Motion Analyzer (Nac).

The experimental method was reported previously. It will, however, be necessary to mention here that the knife should be small enough and sharp enough not to give excessive damage to the vessel wall which introduces complex disturbance of the laminar flow of blood.

The primary hemostatic plug is sufficiently effective on hemostasis if the wound is small. The intravascular portion of the hemostatic thrombus grows downstream on account of the continuous clumping of thrombocytes from the circulating blood. When the intravascular thrombus has grown to some extent, it fractures usually before it occludes the vessel lumen if the blood flow is well maintained. After the fracture, the clumping of blood platelets build up there another mass which will also grow and then fracture in similar way.

In general, the thrombus grows more evidently and the fracture occurs more repeatedly in the vessels with rapid rate of flow than in those with slow rate in appearance.

One of the most representative patterns of the morphological variation in thrombus is seen when a small pore is successfully given at the marginal portion of an arteriole which appears to have rapid rate of flow. Then the intravascular portion of the thrombus is found to be formed into a conical shape after the extravasated blood has been washed out. A typical “cone” has a rather steeper incline upstream and it will be referred to as the aclivity. The growth of such a marginal thrombus begins in height. The aclivity of cone becomes convex and the cone increases in height as a whole until the tip of the cone nearly touches to the vessel wall at the opposite side of the injury, then the top portion of cone is slightly displaced downstream. On the aclivity which has become less steeper or concave, another “hill” is built up on account of the clumping of blood platelets. The whole figure of the thrombus at this stadium can be compared to a mountain with a saddle which will be soon filled plain by the displacement of the secondary hill. By further
clumping of thrombocytes on the acivity and succeeding displacements occurring here and there the thrombus develops into an irregular shape of complex outline with protuberances. Often the protruding portion at the utmost end of thrombus rotates towards the injured side of the vessel and unites to the thrombus at its bottom. By such rotations the thrombus increases in length.

The fracture of thrombus occurs, as a rule, in form of the ductile fracture and to the stump left at the site of the injury, blood platelets adhere to form a new cone which is to grow and then to fracture.

In general, the thrombus increases at first in height by clumping of blood platelets occurring mainly on the acivity and then increases in length by the downwards displacements or rotations of some portion of the thrombus.

Assuming that an arbitral point P on the intima of a given cylindrical vessel is injured, then the blood platelets which are distributed within a definite distance r from P, will aggregate to P. If there is no flow, the aggregation is limited to the blood platelets within the approximate hemisphere of radius r centering around P, and if there is any flow, all the blood platelets which are distributed in the blood passing through the approximate hemisphere may aggregate to P. Therefore, the more rapid the rate of flow, the more numerous the number of blood platelets to aggregate. This will explain the fact that the growth of thrombus is more evident in vessels with rapid rate of flow and that the clumping of blood platelets occurs mainly on the acivity of the thrombus of conical shape.

On the other hand, the thrombus which stands in blood stream, is exposed to the shear stress and hydrodynamic pressure according to the blood flow. The values of them are dependent on the rate of flow. Therefore, the deformation and fracture of thrombus is to occur more vigorously and more frequently in vessels with rapid rate of flow than in those with slow rate of flow, or the narrower the stenosis, the stronger the deformation.

It is concluded that the blood flow promotes, on the one hand, the growth of thrombus by supplying blood platelets to the surface of injury or of thrombus, and on the other hand, it exerts destructive effects to the thrombus by giving shear stresses on the surface of thrombus as well as hydrodynamic pressure to the whole body of thrombus.

Reference