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Kinetics and mechanics of clot contraction are governed by the molecular and cellular composition of the blood

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Abstract

© 2016 by The American Society of Hematology.Platelet-driven blood clot contraction (retraction) is thought to promote wound closure and secure hemostasis while preventing vascular occlusion. Notwithstanding its importance, clot contraction remains a poorly understood process, partially because of the lack of methodology to quantify its dynamics and requirements. We used a novel automated optical analyzer to continuously track in vitro changes in the size of contracting clots in whole blood and in variously reconstituted samples. Kinetics of contraction was complemented with dynamic rheometry to characterize the viscoelasticity of contracting clots. This combined approach enabled investigation of the coordinated mechanistic impact of platelets, including nonmuscle my osin II, red blood cells (RBCs), fibrin(ogen), factor XIIIa (FXIIIa), and thrombin on the kinetics and mechanics of the contraction process. Clot contraction is composed of 3 sequential phases, each characterized by a distinct rate constant. Thrombin, Ca2+, the integrin αIIbβ3, myosin IIa, FXIIIa cross-linking, and platelet count all promote 1 or more phases of the clot contraction process. In contrast, RBCs impair contraction and reduce elasticity, while increasing the overall contractile stress generated by the platelet fibrin meshwork. A better understanding of the mechanisms by which blood cells, fibrin(ogen), and platelet-fibrin interactions modulate clot contraction may generate novel approaches to reveal and to manage thrombosis and hemostatic disorders.

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Keywords

A new dynamic quantitative clot contraction assay can reveal novel aspects of formation and evolution of hemostatic clots and thrombi, And various blood components, Clot contraction has 3 phases differentially affected by platelet and fibrin mechanics, RBC compaction