Not All Thrombi Are Created Equal: Understanding Thrombus Structure on the Time–Space Continuum

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The formation of arterial thrombi is the key event leading to myocardial infarction (MI) and ischemic stroke. In vitro and in vivo animal studies have been fundamental to our mechanistic understanding of thrombosis and yielded a range of antiplatelet, anticoagulant, and thrombolytic therapies that remain the cornerstone of cardiovascular treatment today, albeit with an inherent bleeding risk.[1] With the recent adoption of high-resolution imaging techniques and thrombus-extraction technologies, the architecture/composition of human thrombi has come into sharp focus.[2,3]

In this edition of *Thrombosis and Haemostasis*, Maly and colleagues[1] use scanning electron microscopy to analyze the composition of thrombi aspirated from 34 patients with ST-elevation MI. Thrombi from "early presenters" (<2 hours) exhibited a homogenous structure and were rich in platelets with less fibrin and red blood cells (RBCs). In contrast, thrombi from "late presenters" (>12 hours) were predominantly composed of RBCs, with significantly less platelets and fibrin. Moreover, thrombi displayed a heterogeneous architecture, with platelet-rich areas at the seeding portion of the thrombus in contrast to the propagating (often proximal) portion that was composed almost entirely of RBCs. It is noteworthy that the RBCs contained within the core of late thrombi had a dense-packed, polyhedral morphology and thicker fibrin stands.

These detailed analyses from Maly et al and others afford important clinical implications. First, the structure of older thrombi helps explain why these thrombi are more resistant to fibrinolysis and the potential benefit of mechanical thrombus extraction. Second, the architecture of pathological thrombi appears to be distinct to "hemostatic clots,"[3] raising the prospect that important differences in the processes that govern thrombosis and hemostasis can potentially be exploited therapeutically. Third, these findings highlight the potential benefits of targeting thrombolytics to components of thrombi, such as platelets, fibrin, and RBCs, and suggest that employing specific reperfusion strategies according to thrombus composition may provide clinical benefit.

Conflict of Interest
None declared.

References

1 Maly M, Riedel T, Stikarova J, et al. Incorporation of fibrin, platelets, and red blood cells into a coronary thrombus in time and space. Thromb Haemost 2022;122(03):434–444
2 McFadyen JD, Schaff M, Peter K. Current and future antiplatelet therapies: emphasis on preserving haemostasis. Nat Rev Cardiol 2018;15(03):181–191
3 Tomaiuolo M, Matzko CN, Poventud-Fuentes I, Weisel JW, Brass LF, Stalker TJ. Interrelationships between structure and function during the hemostatic response to injury. Proc Natl Acad Sci U S A 2019;116(06):2243–2252

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