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CLOT CHARACTERIZATION IN ACUTE ISCHEMIC STROKE

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Background: In the treatment of acute ischemic stroke (AIS) with mechanical thrombectomy, revascularization depends upon integration of the thrombus into the retrieval device. The histologic and mechanical characteristics of thrombi are key determinants of effective thrombus-device interaction. Thrombi with greater calcium and fibrin content have been associated with more challenging thrombus retrievals.

Objective: To develop thrombus analogs with histologic and mechanical characteristics similar to those of challenging clinical thrombi for thrombectomy device testing.

Methods: Fifty thrombi were retrieved from twenty-nine patients with AIS. Clinical thrombi underwent histologic analysis to determine erythrocyte and fibrin content. Nine clinical thrombi underwent dynamic mechanical analysis to determine thrombus stiffness, which was defined as a function of stress variation at low and high strains. Results from the clinical thrombi were used to determine the key mechanical characteristics of the challenging thrombus analogs, the calcium apatite-rich and fibrin-rich thrombus analogs.

Results: Of the twenty-nine AIS cases, fifteen required multiple pass attempts. The average histologic composition of the challenging clinical thrombi was 26% erythrocyte, 54% fibrin, and 20% mixed. The average stiffness of the challenging clinical thrombi was found to be similar to that of the fibrin-rich thrombus analogs. Addition of calcium apatite increased the stiffness of the thrombus analogs at low strain approximately five-fold.

Conclusions: Thrombus analogs with mechanical characteristics similar to those of challenging clinical thrombi were successfully developed. The calcium apatite-rich thrombus analogs were found to be stiffer than the fibrin-rich red thrombus analogs.

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