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Abstract Book

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Changes of Mechanical and Ultrastructural Characteristics of In-vitro Human Hematomas Over Time

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In the context of biological tissue susceptibility to histotripsy liquefaction, stiffness and ultrastructure of large clotted blood volumes in vitro were investigated over time.

Naturally clotted (55mL) and recalcified with 25 mmol/L of CaCl2 solution at 37°C human blood samples (55mL and 200mL) served as large-volume hematoma models. Shear moduli were measured by shear wave elastography (SWE, Aixplorer Supersonic Imagine, SL7-14 probe) during clotting for 120 min, and then once a day during 8-day storage of the formed clots by SWE and with a custom-built indentometer. Ultrastructural analysis was performed using scanning electron microscopy (SEM, Camscan Series 4).

For recalcified hematomas, the shear modulus reached a stationary value of 0.53 ± 0.17 kPa (averaged across all samples) within 20–25 min after the onset of clotting at 37°C and remained unchanged till the end of observations. Both SWE and indentometer measurements demonstrated that the shear modulus values do not change significantly over 8 days, regardless of the method of blood clotting. Scanning electron microscopy has not revealed any apparent ultrastructural changes of the fibrin fibers over 8 days (Fig. 1).

The results demonstrate that once the large-volume hematoma in vitro model is formed (20–25 min after coagulant is added at 37°C) its shear modulus and ultrastructure of the fibrin network remain unchanged for the next 8 days, which arguably should not directly affect hematoma sensitivity to ultrasound exposure.

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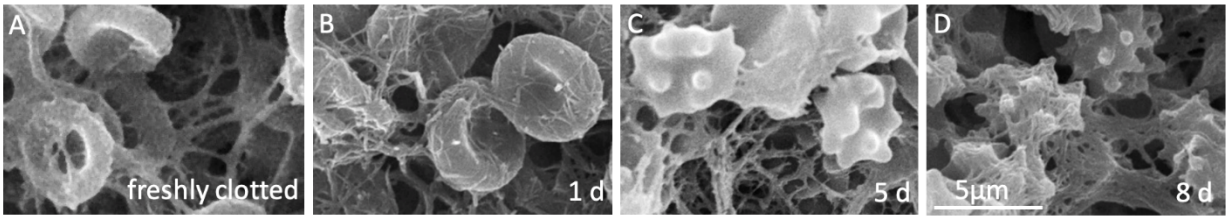

Figure 1: SEM images of the formed hematoma content over time.