WIRELESS MECHANICAL AND HYBRID THROMBUS FRAGMENTATION WITHIN A CEREBRAL VASCULAR MODEL

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1. Introduction

Thrombosis, the formation of blood clots within blood vessels, contributes to high mortality rates and long-term disability.[1] Revascularization is important to restore the blood flow in the diseased region.[2] However, in a complex vascular structure, thrombi are unreachable by tethered systems, disabling catheter-based approaches.[3]

2. Objectives

Our objective is to treat thrombosis in currently unreachable areas using an untethered approach. This study investigates the feasibility of using untethered magnetic robots (UMRs) as a method for thrombus fragmentation.

3. Methods

Blood with 36% haematocrit and varying fibrinogen concentrations was left to clot overnight.[4] Thrombi were cut to 10 mm in length and placed within a cerebral vascular model. A no-intervention trial assessed thrombus stability, followed by a UMR engagement trial, a chemical lysis trial with Urokinase (10,000 IU/L), and a hybrid trial combining UMR engagement with chemical lysis. CBCT reconstructions were taken to monitor thrombus evolution throughout each trial of 30 minutes.

4. Results

The no-intervention trial showed fragmentation rates of 0.15 mm^3/min without and 0.13 mm^3/min with added fibrinogen. For UMR engagement, the fragmentation rate dropped from 0.88 mm^3/min to 0.51 mm^3/min with added fibrinogen. The chemical lysis trial showed fragmentation rates of 1.04 mm^3/min without and 0.86 mm^3/min with fibrinogen. In the hybrid trial, additional fibrinogen demonstrated higher fragmentation rates from 0.54 mm^3/min to 0.93 mm^3/min.

5. Conclusion

This study demonstrates the use of UMRs to degrade thrombi within a complex vascular network. For fibrin-rich clots, a hybrid approach is recommended to weaken the clot's fibrin structure.

6. References

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