The Development of Helicoid-Shaped Model for Increasing Flow Rate of Removing Blood Clots in Medical Treatments

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Mechanical Thrombectomy is an interventional procedure for removing blood clots in patients with Venous Thrombosis using a circular-helicoid device as usual. The removal of blood clots is important as the blood flow rate depends on the values of pitch and surface area of helicoid device. This project develops 2 types of helicoid-shaped models, namely paraboloidal and conical helicoid models, with the aim of finding the most effective type for removing blood clots. These two types of models for the head part have been developed using surface integral to derive the relationship between surface area and pitch for finding the optimal combination. The simulation of blood clot removal shows that there is an inverse relationship between pitch and surface area of the model. Furthermore, for the two helicoid-shaped models with the same pitch, the blood flow rates in the paraboloidal and conical helicoid models were 1.006 and 0.961 ml/s, respectively. While for the two helicoid-shaped models with the same surface area, the blood flow rates in the paraboloidal and conical helicoid models were 1.098 and 1.012 ml/s, respectively. To summarize, our results demonstrate that the most effective model for removing blood clots is the paraboloidal helicoid model with the surface area of 6.73 mm2 and 0.3581 mm pitch. In comparison with the circular helicoid-shaped model with the same surface area which yields the flow rate of 0.911 ml/s, the proposed model has a 20% higher flow rate of 0.187 ml/s at a significance level of 0.01.