Predicting Pulsations: A Comprehensive Study to Determine the Effect of Grouping Patterns on Cassiopea xamachana

Biddinger, Allison

Current methods in pediatric hemodialysis are associated with a heightened risk of hemolysis, as the standard peristaltic pump can be damaging at slow flow rates. Rather than using a peristaltic pump, incorporating a pulsatile pump in the dialysis process could improve clearing rates for pediatric patients. The purpose of this research was to determine the effect of various grouping patterns on Cassiopea xamachana and to visualize the flow pattern to better understand efficient mechanics in a living organism as a pulsatile model. It was hypothesized pulsation frequency would differ among individual jellyfish when arranged into varying groups; furthermore, the pulsation frequency of smaller jellyfish would fluctuate at a greater rate due to energy conservation. For the control, nine jellyfish of sizes 2, 4, and 6 cm were recorded pulsing on two cameras perpendicular to the tank for ten complete pulsing cycles of the bell margin. Ten arranged groups of three jellyfish were recorded for the experimental tests. Dye visualization tests for flow patterns were implemented using fluorescein dye below the substrate, allowing the dye to disperse as the jellyfish pulsed. Videos were analyzed in MATLAB software by tracking points along the bell margin, center, and oral arm of each jellyfish. Pulsation frequency and fineness ratio were calculated from the tracked points. Calculated results supported the hypothesis, as the smallest jellyfish's pulsation frequency slowed when placed in groups with larger jellyfish. Understanding its efficiency and behavior serves as a promising model for small pulsatile pumps to be used for pediatric dialysis.

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