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Measurements and simulations of the tubular hearts of sea squirts

When the embryonic heart first forms, it has a tubular shape without valves or chambers. Fluid is pumped via peristaltic contractions, impedance pumping, or some hybrid of these two mechanisms. Tunicates also possess tubular hearts that are in some ways similar to the early embryonic heart. In this paper, the tubular heart of the sea squirt is investigated. Sea squirts are tunicates that are aquatic filter feeders that have the ability to regenerate. The heart of the sea squirt has a C shape with pace makers on both ends which allows the heart to pulse in one direction for a period of time and reverse in the opposite direction.

The heart beat in a transparent species was observed using dissecting and compound microscopes. By filming the hearts, the frequency, reversal times and amplitude of pulsing of sea squirts' hearts were measured. Frequency and time reversal measurements were determined through frame counts of recorded videos of the valveless pumping. Amplitude measurements were determined using a video analysis program written and run on MATLAB to scale the videos to actual physical measurements. These measurements were used as inputs for numerical simulations of tubular heart pumping.