JOHNS HOPKINS
BIOMEDICAL ENGINEERING

CerebroGate

REDESIGNING THE VENTRICULAR CATHETER

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BACKGROUND

Hydrocephalus occurs when excess fluid builds up in the brain's ventricles causing increased pressure. The standard of care is a shunt with three main components: a **ventricular catheter**, a **shunt valve**, and a **distal catheter**.

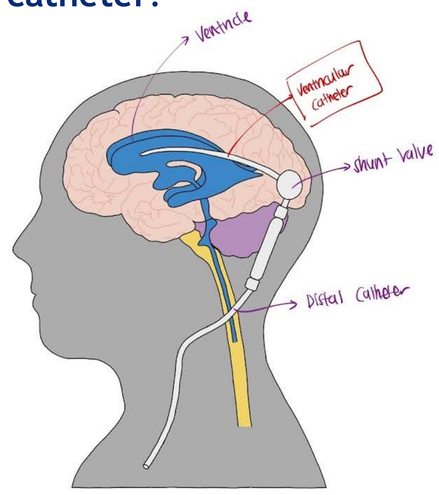

Fig 1. Physiological location of a CSF shunt and its three main components.

98% of shunts malfunction within 10 years[1].

34% of shunts malfunction due to ventricular catheter obstruction[2].

NEED

Neurosurgeons need a method to **allow unobstructed cerebrospinal fluid flow** in hydrocephalus patients to **minimize ventricular obstruction** following shunt insertion.

MODEL

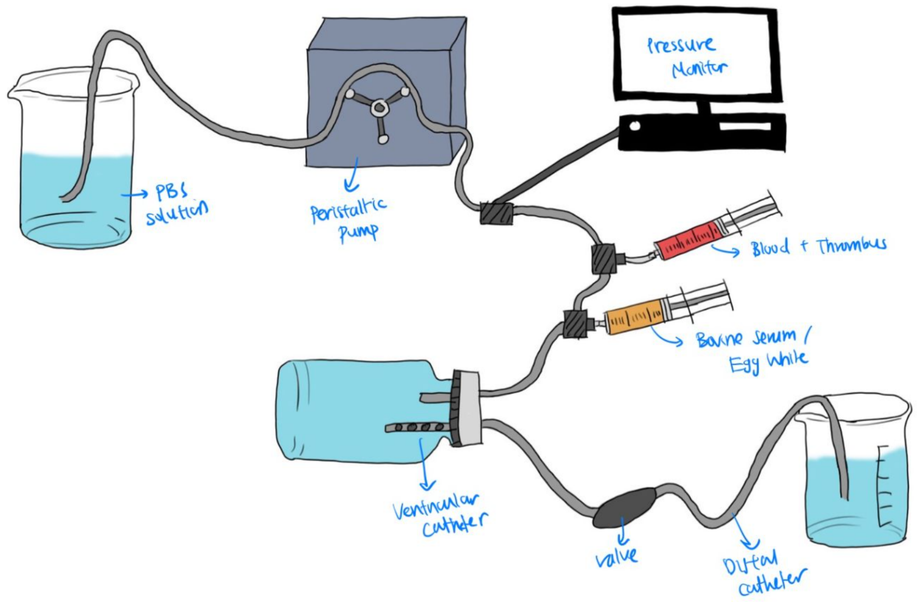

Fig 2. Proposed ventricular obstruction model simulating protein and blood obstruction, with inflow pump and outflow shunt valve.

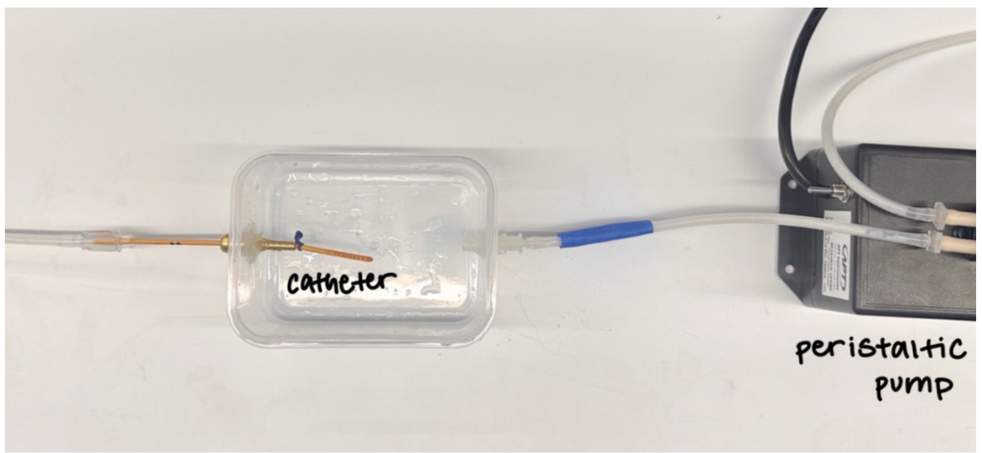

Fig 3. Most recent model prototype, with input flow of 0.6 mL/min.

HOW DOES IT WORK?

1. Peristaltic pump generates variable flow into the ventricular box
2. Pig blood and egg whites are used to cause obstruction of the catheter
3. Tubing height is varied to generate physiological flow out of box

INITIAL RESULTS

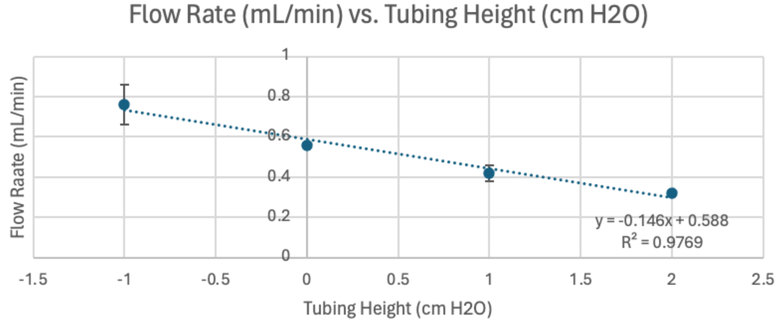

Fig 4. Verification of model to identify tubing height necessary to achieve equal inflow and outflow.

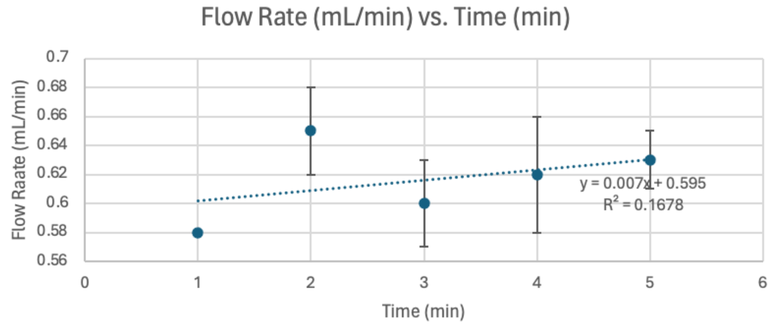

Fig 5. Verification of constant flow through model over five-minute time period.

REFERENCES

1. Ferras M, McCauley N, Stead T, Ganti L, Desai B. Ventriculoperitoneal Shunts in the Emergency Department: A Review. *Cureus*. Published online February 3, 2020. doi:https://doi.org/10.7759/cureus.6857
2. Albugami SM, Alwadi KW, Alrugaib AK, Alsuwailim AM, Aljared T. Prevalence and characteristics of shunt malfunction without ventricular size change at King Abdulaziz Medical City in Riyadh. *Neurosciences*. 2021;26(1):31-35. doi:https://doi.org/10.17712/nsj.2021.1.20200099