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New invention could improve treatment for children with 'water on the brain'

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Van Andel Research Institute (VARI) scientists participated in a study with researchers from the University of Utah that could help find ways to improve shunt systems used to treat the neurological disorder hydrocephalus, or "water on the brain," the leading cause of brain surgery for children in the United States. Researchers studied the shunt systems under a variety of conditions by creating a bioreactor that mimics the environment inside patients.

Hydrocephalus is an excessive accumulation of cerebrospinal fluid (CSF) in the brain and is one of the most common birth defects, affecting approximately one in 500 children every year. Another 6,000 children annually develop hydrocephalus during the first two years of life. The pressure created by too much CSF can affect mental ability, balance, personality, and vision, result in headaches and seizures, and even lead to death.

"This paper is a very valuable contribution to the field of hydrocephalus research," said Pat McAllister, Ph.D., Professor and Director of Basic Hydrocephalus Research and Adjunct Professor of Physiology and Bioengineering at University of Utah School of Medicine. "Tragically, practically all patients with hydrocephalus are at risk for shunt malfunctions, which invariably produce more brain injury, and most of these patients must undergo multiple surgeries to remove obstructed catheters. These studies represent significant advancements in our attempts to prevent cells from blocking shunt catheters, and we look forward to continuing our work with Dr. Resau and his colleagues."

Hydrocephalus is typically treated by implanting shunt systems in the brain that can divert the flow of CSF to other areas of the body where it can be absorbed into the circulatory system. However, complications due to blockage occur in up to 61% of patients, and an estimated 50% of shunts need to be replaced within two years. University of Utah researcher Carolyn Harris, a Ph.D. candidate in bioengineering, designed the hydrocephalus shunt catheter bioreactor to study shunt systems under a variety of conditions to find ways to improve the treatment.

The bioreactor mimics the conditions inside the patient's body more closely than growing cells in a Petri dish. Cells suspended in fluid are pumped through tubing connected to catheters used in shunt systems, oriented both horizontally and vertically. Researchers can study and control factors such as flow rate, pressure changes, and pulsation frequency, which can vary from patient to patient, and determine how each affects cells' adhesion to the catheters.

VARI researchers provided imaging and flow cytometry to determine the number of cells that adhered to the catheters and the characteristics of those cells.

"This project grew out of a collaboration to see if we could develop a material that would resist the growth of cells," said VARI Distinguished Scientific Investigator Jim Resau, Ph.D., one of the authors of the study. "So actually our part was to image and quantify the effect of certain components to inhibit the build-up of scar-like cells. This approach could also be applied to other instruments inserted into the body, such as electrodes."

Provided by Van Andel Research Institute