Return of Flow in a Nonflowing Shunt using a Noninvasive Bioinspired Retrograde Flushing Device: Demonstration by Thermal Flow Detection

Elsa Arocho-Quinones, Joseph R Madsen, Mustafa Hameed, Scellig Stone
Department of Neurosurgery, Boston Children's Hospital
Harvard Medical School, Boston, MA, USA
Nothing to disclose
Introduction:

• Cerebrospinal fluid (CSF) shunts are implantable devices used to treat hydrocephalus.

• Over half of the patients with implanted shunt systems will suffer from shunt failures within two years, requiring repeated revision surgeries leading to significant morbidity.

• The ReFlow ventricular system is a non-invasive device recently cleared by the US Food and Drug Administration (FDA), for management of hydrocephalus which offers options to unblock occluded inlet holes or open a relief membrane to restore or increase CSF flow in a non-flowing shunt.

• We utilized this new non-invasive method for the management of an acute shunt obstruction and sought to evaluate the efficacy of this non-invasive device by using a thermal flow detection system.
Case details:

• The patient was an 18-year-old female with a history of hydrocephalus, previously treated with a ventriculoperitoneal shunt using the ReFlow ventricular system and a programmable valve. She presented with a severe exacerbation of problematic migraine headaches.

• Ventricular imaging studies showed stable ventricular size.

• A shunt series revealed an intact shunt system without kinks

• A decision was made to activate her ReFlow device to alleviate the suspected shunt obstruction

• A thermal flow monitoring system was used to evaluate the CSF flow through her shunt before and after activation of the ReFlow device
Materials:

**ShuntCheck**

- ShuntCheck uses non-invasive thermal dilution to detect fluid flow in CSF shunts.

**ReFlow Flusher and Ventricular System**

- Since FDA clearance, 22 such devices have been implanted in the U.S.

If blockages are severe and not flushable, the ReFlow Membrane may be deployed.

Flusher dome is pressed to send a retrograde pulse of fluid into the ventricular catheter.

ShuntCheck: [https://neurodx.com/shuntcheck/](https://neurodx.com/shuntcheck/)

Methods:

• A baseline thermal flow test was completed prior to activation of the retrograde flusher device.
• The ReFlow device was activated by flushing the dome sequentially and the CSF flow was measured using the thermal flow test after each flush to document changes in temperature.
• Once the flow appeared to be re-established, the opening pressure of the patient’s programmable valve was adjusted to allow increased flow through the now unobstructed shunt, and this was confirmed via the thermal flow test.
Return of Flow in a Nonflowing Shunt using a Noninvasive Bioinspired Retrograde Flushing Device: Demonstration by Thermal Flow Detection

Baseline evaluation with no temperature change suggestive of absence of flow.

After the first flush there was still no temperature change.

After the second flush a 0.15-degree drop was noted.

Reprogramming of the shunt valve from 2.5 to 1.0 resulted in a 0.25-degree drop, indicating a more robust flow.
Results:

• A baseline thermal flow test showed no temperature change suggestive of absence of flow.

• The ReFlow flusher chamber was compressed twice.
  • There was no temperature change after the first flush
  • A 0.15-degree drop was noted after the second flush suggesting flow was re-established

• To confirm flow, the opening pressure of the programmable shunt valve was adjusted from performance level 2.5 to 1.0, resulting in a bigger temperature drop suggesting a more robust flow

• Though the headache resolution was not immediate, the patient was discharged the following day without the need for surgery or other invasive procedures.
Conclusion

• This is the first reported case of a ventriculoperitoneal shunt obstruction with documented resolution of failure to flow after using the new FDA-cleared retrograde flushing device.

• Non-invasive thermal flow evaluation may have a role in evaluating the efficacy of this new device.