

## **Thermal Flow Detection Improves Diagnostic Accuracy of Shunt Malfunction: Prospective, Multicenter, Operator-Blinded Study**

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### **Introduction**

We evaluated the diagnostic value of ShuntCheck® thermal flow detection in ventriculoperitoneal shunts to determine whether ShuntCheck plus neuroimaging improved diagnostic precision over imaging alone.

### **Methods**

Thermal flow detection and neuroimaging were obtained in 263 symptomatic patients <29 years at ten centers. Clinicians, blinded to the results of the ShuntCheck, recorded whether radiographic studies showed ventricular enlargement, and whether surgery was performed within one week. The positive and negative predictive values (PPV and NPV) of imaging-alone, and ShuntCheck-plus-imaging, were calculated. Before imaging, patients were classified by an Attending physician as Unlikely or Somewhat/Likely to require surgery.

### **Results**

Imaging-alone had PPV of 71.0% (44/62 cases, 95% C.I. 58.7-80.8%). ShuntCheck, when concordant and positive (flow-not-confirmed, ventricular enlargement) showed PPV of 88.6% (39/44, 95% C.I. 76-95%). Of 91 patients with both studies negative (flow-confirmed, no ventricular enlargement), none had surgery (NPV 100%, 95% C.I. 95.9-100.0%). For imaging-alone, the NPV was 92.5% (186/201, 95% C.I. 88.1-95.4%). The improvement in PPV of 17.7% (95% C.I. 8.1-27.2%) and NPV of 7.46% (95% C.I. 3.83-11.1%) is significant. The 91 concordant negative patients had 25 admissions for observation, 5 lumbar punctures, 3 shunt taps, and 2 radionuclide flow studies—but no shunt revisions.

Of the 56% of patients clinically pre-designated “Unlikely to require surgery”, 91% indeed did not. ShuntCheck (NPV 100%) was not inferior to neuroimaging (NPV 97.6%) in confirming this clinical judgment (risk difference 2.3%; 95% C.I., 0.997 to 1.052).

**Conclusion:**

The combination of neuroimaging and ShuntCheck improves shunt malfunction diagnostic accuracy and may diminish the need for hospital admission or additional testing.

ShuntCheck was not inferior to neuroimaging for ruling out shunt malfunction in children assessed as “Unlikely to require surgery” and may obviate the need for neuroimaging among these patients.

Support: NIH-NINDS R44NS067772