Abstract

**Introduction:** Children whose ventricles do not change during shunt malfunction are a diagnostic dilemma. This study identifies risk factors for unchanged ventricular size at shunt malfunction.

**Methods:** This retrospective 1:1 age-matched case-control study identified children with shunted hydrocephalus who underwent shunt revision with intraoperative evidence of malfunction at one of the three participating institutions from 1997-2019. Cases were defined as patients with a change in the frontal-occipital horn ratio (FOR) between malfunction and baseline of < 0.05, while controls included FOR changes ≥ 0.05. The presence of infection, abdominal pseudocyst, pseudomeningocele, wound drainage, and lack of baseline cranial imaging at the time of malfunction warranted exclusion.

**Results:** Of 450 included patients, 60% were male, 73% were Caucasian, 67% had an occipital shunt, and median age was 4.3 [IQR 0.97, 9.21] years at malfunction. On univariable analysis, unchanged ventricles at malfunction were associated with: frontal shunt (41% vs 28%, p<0.001), programmable valve (17% vs 9%, p=0.011), non-siphoning shunt (85% vs 66%, p<0.001), larger baseline FOR (0.44 ± 0.12 vs 0.38 ± 0.11, p<0.001), no prior shunt infection (87% vs 76%, p=0.003), and no prior shunt revisions (68% vs 52%, p<0.001). On multivariable analysis with collinear variables removed, patients with a frontal shunt (OR 1.67 [95% CI: 1.08, 2.70], p=0.037), programmable valve (OR 2.63 [95% CI: 1.32, 5.26], p=0.007), non-siphoning shunt at malfunction (OR 2.76 [95% CI: 1.63, 4.67], p<0.001), larger baseline FOR (OR 3.13 [95% CI: 2.21, 4.43], p<0.001), and no prior shunt infection (OR 2.34 [95% CI: 1.27, 4.30], p=0.007) were more likely to have unchanged ventricles at malfunction.

**Conclusion:** In a multicenter cohort of children with shunt malfunction, those with a frontal shunt, programmable valve, non-siphoning shunt, baseline large ventricles, and no prior shunt infection were more likely than others to have unchanged ventricles at shunt failure.