41462 - Dural Inversion for Pediatric Moyamoya Disease: 20-Year Experience

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Disclosures

The authors of this poster have no conflicts of interest to disclose.
Introduction

- Moyamoya disease is a progressive arteriopathy characterized by bilateral stenosis of the internal carotid artery, which can lead to strokes.
- Indirect revascularization procedures such as encephaloduroarteriosynangiosis (EDAS) are most commonly used to treat pediatric cases of moyamoya disease.
- Dural inversion, a technique in which large dural flaps centered around the middle meningeal artery (MMA) are created and inverted, allowing increased surface area of contact between the outer dural layer and the ischemic brain.
- We describe the outcomes of dural inversion performed hemispheres in 102 pediatric patients with moyamoya disease.

Figure 1. Diagram of the dural inversion technique utilized in this study.
Methods

• Retrospective review of pediatric patients undergoing dural inversion +/- EDAS for moyamoya between 1997- 2016

• Uni- and multivariate logistic regression and Kaplan-Meier analyses were performed to assess:
  - Incidence and risk of post-operative stroke
  - Functional outcome using the modified Rankin Scale (mRS)
    • A favorable outcome was defined as ≤2 on the mRS scale

• Revascularization was evaluated on angiography using the Matsushima grading scale.
  • Matsushima grade A denotes the greatest revascularization while grade C denotes the least.
Results

- Dural inversion was performed on 169 hemispheres in 102 patients
  - Dural inversion + EDAS – 115 hemispheres (68%)
  - Dural inversion only - 54 hemispheres (32%)
- Median age at time of first procedure: 9.9 years
  - Median follow-up: 4.3 years
- Mortality rate – 1.0% (1 case)
- Moyamoya secondary to an underlying syndrome was present in 60 patients (60%).
Results

- The incidence of post-operative strokes was 4.9%
  - Ischemic stroke – 5 cases total
  - One patient with a delayed stroke died from ischemic complications related to a systemic vasculitis
  - Hemorrhagic stroke – 1 case

<table>
<thead>
<tr>
<th>Post-operative ischemic stroke</th>
<th># of cases</th>
<th>% procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>5</td>
<td>4.9</td>
</tr>
<tr>
<td>Within 30 days</td>
<td>3</td>
<td>1.8</td>
</tr>
<tr>
<td>&gt;30 days</td>
<td>2</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Table 1. Incidence of post-operative ischemic stroke.

Figure 2. The cumulative 5-year Kaplan-Meier risk of a stroke event was 6.4%.
Results

A majority (97%) of patients demonstrated stable or improved functional status

- Good functional outcome (mRS ≤2) was observed in 90 patients (88%)
- Mean mRS decreased from 1.8 pre-operative to 0.9 post-operative
- Only 3 cases had progressive neurological deficits (worse mRS score) post-operatively

Figure 3. Differences in mRS score from time of surgery to follow-up. Negative changes in mRS score reflect functional improvement.
Results

• 68% of hemispheres achieved Matsushima grade A revascularization post-operatively
  • Only 14% were graded as Matsushima grade C
  • Patients with secondary moyamoya syndrome were more likely to have poor angiographic outcome (Matsushima grade C)

• Few post-operative complications were observed
  • Epidural/ subdural hematoma at operative site – 3 cases
  • Chronic subdural hematoma – 2 cases
  • Post-operative hydrocephalus – 1 case
Discussion

- The outer periosteal dural layer has angiogenic potential, but vessels cannot penetrate the inner meningeal dural layer. The dural inversion technique allows neovascularization from the periosteal dura to brain parenchyma.

- In 20 years of using dural inversion to treat moyamoya disease in pediatric patients, we observed few post-operative complications and a low incidence of post-operative stroke.

- The 5-year stroke risk was 6.4%, which is comparable to the reported stroke rates for other indirect revascularization procedures.

- We observed stable or improved functional outcomes in 97% of patients in our series, which is in accordance with outcomes reported in other large pediatric series.
Summary Points

• Dural inversion is a useful revascularization technique in pediatric cases of primary or secondary moyamoya disease.

• Our experience with pediatric cases over the past 20 years demonstrates a relatively low rate of post-operative strokes and good functional outcomes, supporting the safety and efficacy of the dural inversion technique.