Occipital Artery to Middle Cerebral Artery Bypass in Pediatric Moyamoya Disease: Rescue Therapy After Failed Revascularization
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Disclosure

• No disclosures
Introduction

• Patients with pediatric moyamoya disease (PMMD) showing recurrent symptoms or decreased cerebral flow after initial revascularization therapy may require additional revascularization to improve their clinical condition.

• Our aim was to evaluate the clinical and hemodynamic benefits of an occipital artery (OA)-to-middle cerebral artery (MCA) bypass for patients with PMMD, who have undergone an initial anterior circulation revascularization procedure.
Methods

• From March 2013 to December 2017, we retrospectively identified 9 patients with PMMD who underwent OA-MCA bypass and had a previous superficial temporal artery to MCA bypass (STA-MCA bypass) (Figure 1). We collected the following clinical data: initial revascularization procedure, symptoms (presence or recurrence), pre- and post-operative cerebral blood flow (CBF) and cerebrovascular reactivity (CVR) changes, posterior cerebral artery (PCA) stenosis, PCA-related and non-related symptoms, and latest follow-up.
## Results

Table 1 shows patient’s demographics.

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age (IR/AR)</th>
<th>Sex</th>
<th>Side of Operation</th>
<th>Suzuki Grade</th>
<th>Initial Symptoms</th>
<th>Onset PCA Stenosis/Progression of PCA Stenosis</th>
<th>Recurrent Symptoms</th>
<th>Latest 1-year follow up symptoms</th>
<th>Bypass Flow grade</th>
<th>Follow up period (month) After AR surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3/4</td>
<td>M</td>
<td>Right</td>
<td>4</td>
<td>TIA</td>
<td>+/-</td>
<td>+/-</td>
<td>No change</td>
<td>II</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>3/5</td>
<td>M</td>
<td>Left</td>
<td>3</td>
<td>TIA</td>
<td>+/-</td>
<td>+/-</td>
<td>No change</td>
<td>II</td>
<td>19</td>
</tr>
<tr>
<td>2</td>
<td>3/5</td>
<td>M</td>
<td>Right</td>
<td>4</td>
<td>Infarction</td>
<td>+/+</td>
<td>+/+</td>
<td>Disappeared</td>
<td>I</td>
<td>37</td>
</tr>
<tr>
<td>3</td>
<td>2/7</td>
<td>F</td>
<td>Right</td>
<td>4</td>
<td>TIA</td>
<td>+/-</td>
<td>+/-</td>
<td>Improved</td>
<td>II</td>
<td>21</td>
</tr>
<tr>
<td>4</td>
<td>5/7</td>
<td>F</td>
<td>Right</td>
<td>4</td>
<td>Infarction</td>
<td>+/+</td>
<td>+/+</td>
<td>Improved</td>
<td>I</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>8/9</td>
<td>F</td>
<td>Right</td>
<td>4</td>
<td>Infarction</td>
<td>+/+</td>
<td>+/+</td>
<td>Improved</td>
<td>N/A</td>
<td>35</td>
</tr>
<tr>
<td>6</td>
<td>6/9</td>
<td>F</td>
<td>Left</td>
<td>3</td>
<td>TIA</td>
<td>+/-</td>
<td>+/-</td>
<td>Improved</td>
<td>II</td>
<td>20</td>
</tr>
<tr>
<td>7</td>
<td>8/11</td>
<td>M</td>
<td>Right</td>
<td>4</td>
<td>TIA</td>
<td>+/-</td>
<td>+/-</td>
<td>Disappeared</td>
<td>II</td>
<td>8</td>
</tr>
<tr>
<td>8</td>
<td>10/13</td>
<td>M</td>
<td>Left</td>
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<td>+/-</td>
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<td>Improved</td>
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<tr>
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<td>+/-</td>
<td>+/-</td>
<td>Improved</td>
<td>II</td>
<td>5</td>
</tr>
</tbody>
</table>

IR: Initial revascularization (STA-MCA bypass)  
AR: Additional revascularization (OA-MCA bypass)
Results

- All (n=9, 100%) patients had non-PCA related recurrent symptoms and four of them had PCA related symptoms.
- All the patients underwent direct OA-to-MCA bypass.
- At 1-year follow-up, all patients with PCA related symptoms showed complete resolution of their PCA symptoms.
- Eight (89%) of the patients with non-PCA related symptoms experienced disappearance or improvement of their symptoms.
- Among all, only one (11%) patient showed no improvement after the surgical procedure.
- Two (22%) patients experienced headaches after the OA-MCA bypass.
- Pre and post-operative CVR of the MCA territory had a mean of 14.8 and 31.3 respectively, whereas the pre and post-operative CVR of the PCA territory had a mean of 22.8 and 40.0 respectively. (Figure 2)
Results

Figure 3. a) and b) Blood flow from STA graft supplying the middle portion of MCA territory after initial revascularization surgery. c) CVR of whole left hemisphere decreased on $^{123}$I-IMP-SPECT. d), and e), OA graft supplying the posterior portion of MCA territory on conventional angiography after additional revascularization surgery. f) CVR of MCA and PCA territory improved significantly after additional revascularization surgery.
Discussion

• After failed revascularization procedures (STA-MCA bypass or indirect techniques) and in the presence of persistent and recurrent symptoms related to distal MCA or PCA territories, OA-MCA bypass provides the possibility to improve the CBF and CVR among both arterial territories.\(^3\)\(^4\)\(^5\)

• MMD patients with PCA stenosis are considered to suffer TIAs causing visual disturbances and lower extremity paresis.\(^1\)\(^2\)\(^5\) Motor deficits (Non-PCA related symptoms) apparently correspondent to a decreased perfusion among the ACA territory, which is supplied by collateral flow from the PCA through the posterior pericallosal arteries (leptomeningeal anastomosis). This could be possible due to a flow reduction from the PCA to the MCA territory or due to decreased MCA CBF related to progression of the MMD.\(^1\)\(^2\)\(^5\)

• Therefore, an OA-MCA bypass is a reasonable option to improve the flow among these territories. As demonstrated in our series, where 89% of MMD patients with non-PCA-related symptoms showed marked clinical improvement after performing the bypass.

• The OA-MCA bypass is an effective rescue therapeutic option to improve clinical condition and hemodynamic changes of pediatric patients with MMD who experienced recurrent symptoms after an initial revascularization procedure.
References