The Impact of Unilateral Versus Bilateral Antegrade Cerebral Perfusion on Surgical Outcomes Following Aortic Arch Replacement: A Propensity Analysis

Zierer A¹, El-Sayed Ahmad A¹, Risteski P¹, Moritz A¹, Diegeler A², Urbanski PP²

¹ Division of Thoracic and Cardiovascular Surgery, Johann-Wolfgang-Goethe University Frankfurt/Main, Germany

² Cardiovascular Clinic Bad Neustadt, Bad Neustadt, Germany
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Dr. Urbanski:
The following relationship exists related to this presentation:

InterVascular, MAQUET Cardiovascular, Inc, Consultant
SELECTIVE ANTEGRADE CEREBRAL PERFUSION (ACP) DURING MILD SYSTEMIC HYPOTHERMIA (MSH) HAS BEEN SUCCESSFULLY EMPLOYED IN AORTIC ARCH REPLACEMENT.

THE CLINICAL IMPACT OF DIFFERENT MODES OF ACP (UNILATERAL VS. BILATERAL) ON NEUROLOGIC MORBIDITY AND MORTALITY HAS TO BE DEFINED.

THUS, THE PURPOSE OF THE CURRENT STUDY WAS TO ANALYZE WHETHER UNILATERAL ACP IS LESS EFFECTIVE THAN BILATERAL ACP WHEN USED DURING ELECTIVE AORTIC ARCH SURGERY.
PATIENT DATA

- Two Centers: Frankfurt & Bad Neustadt
- 12-year Period: 2000 to 2012
- Overall Patients: n = 1097
- Exclusion Criteria:
  - Acute Type A Dissection
  - Carotid Artery Surgery
  - Previous Aortic Surgery
  - Conversion unilateral to bilateral ACP
Unilateral ACP (UACP; n=477)  Bilateral ACP (BACP; n=261)

- AGE
- CORONARY ARTERY DISEASE
- DIABETES
- RENAL FAILURE
- HISTORY OF STROKE
- SELECTIVE ACP TIME
- CARDIOPULMONARY BYPASS TIME
- PARTIAL VERSUS TOTAL ARCH REPLACEMENT
- AORTIC VALVE REPLACEMENT

UACP n = 246  BACP n = 246
All perioperative data were collected prospectively.

Study end points were operative outcomes including early mortality and neurologic morbidity.

Transient neurologic deficit (TND):
Presence of reversible postoperative motor deficit, confusion, agitation, or transient delirium.
Computed tomography findings were required to be normal, with resolution of all symptoms before discharge.

Permanent neurologic deficit (PND):
Presence of either new focal (stroke) or global (coma) permanent neurologic dysfunction.
SURGICAL PROTOCOL

FRANKFURT

- ACP: Right Axillary Artery
- 28-30°C core temperature
- Perfusion pressure ~ 80 mmHg
- Perfusate temperature: 28-30°C
- Blocked left subclavian artery
- Snared left carotid artery
- Left carotid artery for bilateral ACP
- Near-infrared spectroscopy

BAD NEUSTADT

- ACP: Right Common Carotid Artery
- 28-30°C core temperature
- Perfusion pressure ~ 80 mmHg
- Perfusate temperature: 28-30°C
- Blocked left subclavian artery
- Snared left carotid artery
- Left carotid artery for bilateral ACP
- Near-infrared spectroscopy
"A drop of brain oxygen saturation to 70% of the baseline can be considered a threshold value for sufficient cerebral cross perfusion...."
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>UACP</th>
<th>BACP</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years ± SD)</td>
<td>66 ± 9</td>
<td>65 ± 11</td>
<td>&gt;0.99</td>
</tr>
<tr>
<td>Male (N/%)</td>
<td>164 (67%)</td>
<td>156 (63%)</td>
<td>0.63</td>
</tr>
<tr>
<td>Diabetes (N/%)</td>
<td>20 (8%)</td>
<td>18 (7%)</td>
<td>0.65</td>
</tr>
<tr>
<td>Chronic renal failure (N/%)</td>
<td>13 (5%)</td>
<td>13 (5%)</td>
<td>&gt;0.99</td>
</tr>
<tr>
<td>Previous stroke (N/%)</td>
<td>22 (9%)</td>
<td>20 (8%)</td>
<td>0.73</td>
</tr>
<tr>
<td>COPD (N/%)</td>
<td>22 (9%)</td>
<td>26 (11%)</td>
<td>0.68</td>
</tr>
</tbody>
</table>
### RESULTS: OPERATIVE DATA

<table>
<thead>
<tr>
<th>Characteristic</th>
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<th>BACP</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPB time (min ± SD)</td>
<td>164 ± 41</td>
<td>157 ± 37</td>
<td>0.81</td>
</tr>
<tr>
<td>Crossclamp time (min ± SD)</td>
<td>99 ± 36</td>
<td>95 ± 41</td>
<td>0.70</td>
</tr>
<tr>
<td>Isolated ACP time (min ± SD)</td>
<td>41 ± 19</td>
<td>43 ± 21</td>
<td>&gt;0.99</td>
</tr>
<tr>
<td>Hemiarch replacement (N/%)</td>
<td>155 (63%)</td>
<td>153 (62%)</td>
<td>0.59</td>
</tr>
<tr>
<td>Total arch replacement (N/%)</td>
<td>91 (27%)</td>
<td>93 (28%)</td>
<td>0.71</td>
</tr>
<tr>
<td>Concommitant AVS (N/%)</td>
<td>79 (32%)</td>
<td>71 (29%)</td>
<td>0.69</td>
</tr>
</tbody>
</table>
### RESULTS: OPERATIVE OUTCOME

<table>
<thead>
<tr>
<th>Characteristic</th>
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<th>BACP</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensive care unit stay (days ± SD)</td>
<td>2 ± 7</td>
<td>3 ± 11</td>
<td>0.81</td>
</tr>
<tr>
<td>Prolonged ventilation (&gt; 7 days) (N/%)</td>
<td>12 (5%)</td>
<td>14 (6%)</td>
<td>0.83</td>
</tr>
<tr>
<td>Reexploration for bleeding (N/%)</td>
<td>17 (7%)</td>
<td>22 (9%)</td>
<td>0.64</td>
</tr>
<tr>
<td>ARF requiring hemofiltration (N/%)</td>
<td>13 (5%)</td>
<td>9 (4%)</td>
<td>0.52</td>
</tr>
<tr>
<td>Early mortality (N/%)</td>
<td>9 (4%)</td>
<td>11 (4%)</td>
<td>0.84</td>
</tr>
</tbody>
</table>
There was no difference regarding early mortality with UACP (9/246; 4%) vs. BACP (11/246; 4%) ($p = 0.84$).

Looking specifically at patients undergoing total arch replacement there was also no difference regarding early mortality with UACP (6/91; 7%) vs. BACP (8/93; 8%) ($p = 0.63$).
Transient Neurologic Deficit (TND)

All Patients

UACP: 12 / 246 (5%)
BACP: 10 / 246 (4%)

Total Arch Replacement

UACP: 6 / 91 (7%)
BACP: 5 / 93 (5%)

p = 0.7
p = 0.6
Permanent Neurologic Deficit (PND)

- **All Patients**
  - UACP: 5 / 246 (2%)
  - BACP: 14 / 246 (6%)

- **Total Arch Replacement**
  - UACP: 2 / 91 (3%)
  - BACP: 9 / 93 (9%)

Statistical significance: $p = 0.06$
There was no case of paraplegia in either group.

In all but one of the 14 / 246 (6%) BACP patients suffering a PND computed tomography scan revealed a lesion in the left cerebral hemisphere (additional perfusion for BACP).
CONCLUSIONS

- Employing the surgical protocols described herein UACP provides a safe and non-inferior protection strategy in comparison to BACP, at least for the reported duration of ACP.

- Caution is warranted when manipulating on the arch vessels for establishment of BACP.
CONCLUSIONS

- Differing perfusion and temperature management protocols as well as prolonged selective ACP times may impact current findings.

- A prospective randomized multicenter trial would be of interest.