UNIVERSITY HOSPITAL UDINE/ITALY

A SINGLE CENTRE EXPERIENCE IN STROKE TREATMENT WITH EMBOTRAP II.
TECHNOLOGY BASED ON CLOT RESEARCH

Massimo Sponza, Vladimir Gavrilović
Table 2. Design of the Five Recent Randomized Controlled Trials of Endovascular Therapy in Acute Ischemic Stroke

<table>
<thead>
<tr>
<th></th>
<th>MR CLEAN</th>
<th>ESCAPE</th>
<th>EXTEND IA</th>
<th>SWIFT PRIME</th>
<th>RECAVSCAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td>Best medical care vs.</td>
<td>Best medical care vs.</td>
<td>IV rtPA vs.</td>
<td>IV rtPA vs.</td>
<td>Best medical care vs.</td>
</tr>
<tr>
<td></td>
<td>Best medical care +</td>
<td>Best medical care +</td>
<td>IV rtPA + EVT</td>
<td>IV rtPA + EVT</td>
<td>Best medical care +</td>
</tr>
</tbody>
</table>

Scientific Statement Oversight Committee and the American Heart Association/American Stroke Association Manuscript Oversight Committee (MOC). Strict adherence to the American Heart Association conflict of interest policy was maintained throughout the consensus process. Recommendations follow the American Heart Association/American Stroke Association methods of classifying the level of certainty of the treatment effect and the class of evidence. Prerelease review of the draft guideline was performed by 6 expert peer reviewers and by the members of the Stroke Council Scientific Statement Oversight Committee and Stroke Council Leadership Committee.

**Results**—Evidence-based guidelines are presented for the selection of patients with acute ischemic stroke for endovascular treatment, the endovascular procedure and for systems of care to facilitate endovascular treatment.

**Conclusions**—Certain endovascular procedures have been demonstrated to provide clinical benefit in selected patients with acute ischemic stroke. Systems of care should be organized to facilitate the delivery of this care.
Intraovenous thrombolysis rtPA (recombinant tissue Plasminogen Activator)

Intrarterterial mechanical thrombectomy:
- Catheter aspiration
- Stent-retrivers/stentrievers
- Aspiration cathetere + stent retriever ricanalization (“Solumbra”)

- These are the currently available therapies for patients with acute ischemic stroke that drastically improves neurological symptoms and prognosis.
A Direct Aspiration first Pass Technique (ADAPT)

Recent development of the large bore catheter (5, 6,…F) for distal access with high flexibility at the tip and high navigability to reach the distal sites.

- 8-6F Neuron Max or 6F Arrow sheath into CCA (better cervical ICA) or dominant vertebral artery.
- Directly up to distal occluded vessel with DAC (ACE 68, Sofia/Plus, Catalyst)
- Microguidewire (0.14/0.18) + Microcatheter (0,21inch) guidance to occluded branch
The stent retrievers are self-expandable thrombectomy stents that are deployed past the occlusion site with the use of an appropriate microcatheter, usually between 0.021-0.027 inch. Once expanded, the Stent-Retriever captures the thrombus by immediately restoring flow and increasing the effectiveness of thrombolytic agents, if already in circulation. After a maximum of 10 minutes (generally 3-5 minutes depending on the position of the thrombus), the stent can be recovered by pulling the stent back into the guiding catheter, with possible contemporaneous aspiration of the thromboembolic material.
Effect of Endovascular Contact Aspiration vs Stent Retriever on Revascularization in Patients With Acute Ischemic Stroke and Large Vessel Occlusion
The ASTER Randomized Clinical Trial

Bertrand Lapergue, MD, PhD; Raphael Blanc, MD, MSc; Benjamin Gory, MD, PhD; Julien Labreuche, BST; Alain Duhamel, PhD; Gautier Marnat, MD; Suzana Saleme, MD; Vincent Costalat, MD, PhD; Serge Bracard, MD; Hubert Desal, MD, PhD; Mikael Mazighi, MD, PhD; Arturo Consoli, MD; Michel Piotin, MD, PhD; for the ASTER Trial Investigators

- Randomized, open-label, blinded end-point clinical
- Conducted in 8 comprehensive stroke centers in France (October 2015-October 2016)
- Patients with ischemic stroke, with occlusion of the large vessels in the anterior circulation within 6 hours of the onset of symptoms.

Two group of patients: contact aspiration (ADAPT) [n = 164] vs stent retriever [n = 157].

Theoretically the aspiration thrombectomy (ADAPT) should show better mTICI scores compared to the stent retriever group due to the fact that the use of stent retriever requires passage through the thrombus and therefore a greater risk of distal embolization but no statistically significant differences were observed in the two groups.

- The results TICI 2B/3, are similar in both group, ADAPT vs stent retriever: 85.4% vs Stent retriever 83.1%
- ADAPT wasn’t showed as a superior treatment, even if the median times from groin puncture to mTICI 2b-3 reperfusion were shorter for ADAPT (median 31 min vs. 44 min), which was related to a significantly faster time from thrombus contact to reperfusion (median 13 min vs. 23 min; P=0.02).

- The only significant difference is in favor of Stentriever related to mRS at 3 months: 0-2: Aspiration 45% vs Stentriever 50% (NS)
  0-1: Aspiration 33% vs Stentriever 43% (p=0.04)
  0: Aspiration 13% vs Stentriever 22% (p=0.03)

BOTH METHODS WORKS EXCELLENT!
The current reference standard for the technical success of endovascular procedures is the mTICI (modified treatment in Cerebral ischemia) 2b-3, reperfusion over 50% of the target ischemic territory)\(^1,2\)

- grade 0: no perfusion
- grade 1: antegrade reperfusion past the initial occlusion, but limited distal branches, little or slow distal reperfusion
- grade 2
  - grade 2a: antegrade reperfusion of less than half of the occluded target artery ischemic territory (e.g. in one major division of the middle cerebral artery (MCA) territory)
  - grade 2b: antegrade reperfusion of more than half of the previously occluded territory (e.g. in two major divisions of the MCA and their territories)
- grade 3: complete antegrade reperfusion of the previously occluded target artery territory, with absence of visualized occlusion in all distal branches

The “Epic”/ “Solumbra” technique, which uses two devices simultaneously, in particular with partial capture of the stent-retriever (“pinning technique”).

Challenges to Clot Retrieval: Clot Properties can Influence Results

“Futile recanalization”
- Patient selection: infarct size, collateral status, time
- Procedure / clot: Too many passes, friable clot

Failed Recanalization
- Patient selection: access difficulties, tortuous intracranial anatomy
- Procedure / clot: Resistant clot, friable clot, ICAD

Histopathologic Composition of 100 Retrieved Clots

- RBC
- WBC
- Fibrin

Liebeskind et al

Cline et al

Boeckh-Behrens et al
The latest revascularization devices

Albert J. Yoo et al: Thrombectomy in Acute Ischemic Stroke: Challenges to Procedural Success
Journal of Stroke 2017;19(2):121-130
Fibrin rich clots have higher coefficient of friction => inherently more difficult to remove
Clot Compression increases Friction

Thrombectomy in Acute Ischemic Stroke: Challenges to Procedural Success

Albert J. Yoo, Tommy Andersson
Department of Neuroradiology, Karolinska University Hospital, Stockholm, Sweden
Department of Clinical Neuroscience, Karolinska Institutet, Stockholm, Sweden
Department of Medical Imaging, AZ Groeninge, Kortrijk, Belgium

Manipulation of clots further increases friction => first thrombectomy pass is easiest
## Table: Correlation of Imaging and Histopathology of Thrombi in Acute Ischemic Stroke with Etiology and Outcome

<table>
<thead>
<tr>
<th>Question</th>
<th>Articles</th>
<th>Cor?</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Histology and etiology</td>
<td>9</td>
<td>No</td>
<td>Conflicting RBC – A-fib, large-artery</td>
</tr>
<tr>
<td>Histology and angio outcomes</td>
<td>4</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Imaging and histology</td>
<td>8</td>
<td>Yes</td>
<td>HAS -&gt; RBC SVS -&gt; RBC</td>
</tr>
<tr>
<td>Imaging and angio outcomes</td>
<td>8</td>
<td>Yes/No</td>
<td>HAS -&gt; better outcomes - 5 positive, 1 no, 1 negative SVS -&gt; better outcomes - 2 positive</td>
</tr>
<tr>
<td>Imaging and etiology</td>
<td>7</td>
<td>No</td>
<td>Conflicting. Meta-analysis said no.</td>
</tr>
</tbody>
</table>
METHODS

Inclusion criteria:

• 112 Pt Jan 2015-Dec 2017
• Age > 18
• CT+ CTA; Large vessel occlusion of anterior and posterior circulation;
• CT Perfusion was not mandatory
• ASPECT score > 7 (anterior circulation)

• NIHSS (National Institutes of Health Stroke Scale) > 10
• 6h from symptoms onset for anterior and 8h for posterior circulation
• GCS > 5
• Endovenous rTPA was done in eligible patients
METHODS

Technique:
• Direct thromboaspiration (ADAPTA) as first-line intervention in a large vessel occlusion
• Aspiration catheter + stent retriever ricanalization ("epic/solumbra/pinning tch.") as a rescue therapy
• Only stent retriever was used in a difficult situations:
  ❖ very tortuous artery
  ❖ occlusion of a distal segment: M2/3, A2/3.
  ❖ stenotic segment proximal to the occlusion
• Interventions were preferably done by Conscious Sedation, weather the General Anesthesia.

Exclusion criteria:
• Absolut contraindications for angiography/contrast media (CM-allergy, high grade of renal insufficiency)
• ASPECT score < 7
• Thrombocytopenia < 55 000
• Pre/stroke mRS > 2
• ICH
• life expectation <12 months - serious internal diseases with organ dysfunction
<table>
<thead>
<tr>
<th>Patients treated:</th>
<th>112 (100%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior circulation</td>
<td>89 (79.5%)</td>
</tr>
<tr>
<td>Posterior Circulation</td>
<td>17 (15.6%)</td>
</tr>
<tr>
<td>Technical success:</td>
<td>106pz (94.6%)</td>
</tr>
<tr>
<td>ADAPT recanalization:</td>
<td>36 (32.1%)</td>
</tr>
<tr>
<td>Aspiration catheter + stentriever recanalization:</td>
<td>49 (43.8%)</td>
</tr>
<tr>
<td>Stentriever/revascularization device recanalization:</td>
<td>14 (12.5%)</td>
</tr>
<tr>
<td>Stentriever/revascularization device used:</td>
<td></td>
</tr>
<tr>
<td>Revive 19</td>
<td></td>
</tr>
<tr>
<td>Trevo 2</td>
<td></td>
</tr>
<tr>
<td>Tiger 2</td>
<td></td>
</tr>
<tr>
<td>CatchMini 1</td>
<td></td>
</tr>
<tr>
<td>Embotrap 26</td>
<td></td>
</tr>
<tr>
<td>Stenting in fail thrombectomy (TICI 0-1):</td>
<td>23 Enterprise (21.7%)</td>
</tr>
<tr>
<td>Group IA</td>
<td>54Pt (48.2%)</td>
</tr>
<tr>
<td>Group IA+EV</td>
<td>58Pt (51.8%)</td>
</tr>
<tr>
<td>NIHSS pre-trattamento:</td>
<td></td>
</tr>
<tr>
<td>group IA</td>
<td>15.8±7.7</td>
</tr>
<tr>
<td>group IA+EV</td>
<td>16.3±5.6</td>
</tr>
<tr>
<td>NIHSS at dimission:</td>
<td></td>
</tr>
<tr>
<td>group IA</td>
<td>9.6±8.1</td>
</tr>
<tr>
<td>group IA+EV</td>
<td>3.6±4.5</td>
</tr>
<tr>
<td>mRS ≤2 at dimission:</td>
<td></td>
</tr>
<tr>
<td>Group IA</td>
<td>20 Pt (37.0%)</td>
</tr>
<tr>
<td>Group IA+EV</td>
<td>28 Pt (48.3%)</td>
</tr>
<tr>
<td>Tot</td>
<td>48 Pt (45.3%)</td>
</tr>
<tr>
<td>Intrahospital death:</td>
<td>14pz (13.2%)</td>
</tr>
<tr>
<td>Year</td>
<td>Stent</td>
</tr>
<tr>
<td>------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Group A</td>
<td>20 (71%)</td>
</tr>
<tr>
<td>2015/2016</td>
<td>Revive, Trevo, Tiger CatchMini</td>
</tr>
<tr>
<td>Group B</td>
<td>3 (12%)</td>
</tr>
<tr>
<td>2016/2017</td>
<td>EmboTrap</td>
</tr>
</tbody>
</table>

Stenting in failed thrombectomy (TICI 0-1): Group A 71% vs Group B 12% chi-square p≤0.01
DISCUSSION

• We have analyzed 106 consecutive cases and observed the outcome in two different time frames (205/2016 vs 2016/2017): before and after the introduction of EmboTrap.

• Stentriever / revascularization device was used in 43.8% of all pt. The device was used as a rescue therapy in combined technique, in distal segments in M2/3 and A2/3 recanalization, or in presence of ICAD where we couldn’t use large bore catheters.

• Overall, the reduction of the NIHSS score, of $6.2 \pm 3.1$ in the IA group, and of $12.6 \pm 6.5$ in the IA + EV group, demonstrates the efficacy of the treatment and it’s positive impact on the autonomy of patients affected by ischemic stroke. In total 45.3% with mRS≤2.

• The data also show a better outcome in those patients who before the intra-arterial treatment received the rtPA ev. 48.3% vs. 37.0%, despite the recanalization was achieved later.
DISCUSSION

• Not all stent-retrievers/revascularization devices are the same.

• In our practice, the EmboTrap resulted with higher patency, and reduced the need of primary stenting, in failed thrombectomy (3 stents vs 20 stents in tot. ET 26 vs vs others 28, p≤0.0001).

• The percentage of patients died 13.2% (14Pt) at 30 days is in line with literature data (9-21%) and demonstrates the safety of the procedure.
Reperfusion therapies are effective and safe. The neurological symptoms and prognosis are drastically improved.

Usage of modern revascularization devices result in higher primary patency, and more imaging informations about the clot may increase the successful rate of clot retrieval.
A SINGLE CENTRE EXPERIENCE IN STROKE TREATMENT WITH EMBOTRAP II.
TECHNOLOGY BASE ON CLOT RESEARCH

Massimo Sponza, Vladimir Gavrilović