**Mechanical thrombectomy for basilar artery occlusion: efficacy, outcomes and futile recanalization in comparison with the anterior circulation**

**Running title: Thrombectomy in posterior circulation large vessel occlusion**

***ONLINE SUPPLEMENT***

***Supplementary Tables***

**S Table 1 –** BEYOND-SWIFT overview

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| **Center** | N | Time period | LVO Posterior Circulation (VA, BA, P1, P2) | Lost to follow-up (mRS day 90) | ASPECTS available (LVO anterior circulation) | pcASPECTS available (LVO posterior circulation) | % MRI as initial imaging modality | ASPECTS grading | Admission and 24h NIHSS | mRS at 90 days | mTICI grading | EC approval | Responsible EC |
| Inselspital Bern, University Hospital Bern, University of Bern, Bern, Switzerland | 966 | 2010-2017 | 7.8% (75/966)  BAO 62 | 5.6% (54/966) | 863/888 | 80% (60/75) | 50.6% (487/963) | Research fellow blinded to clinical data | Board certified stroke neurologists | Stroke neurologists on scheduled clinical visits.  Structured telephone interviews if the patient was unable to attend (either by physician or mRS certified stroke nurse). | Operator-measured | Yes | Kantonale Ethik Kommission Bern |
| Toronto Western Hospital - University Health Network, University of Toronto, Toronto, Canada | 60 | 2014-2017 | 11.7% (7/60)  BAO 7 | 0% (0/60) | 53/53 | 0% (0/7) | 1.7% (1/60) | Prospective, by  neuroradiologist | Board certified stroke neurologists | Clinical visits at the university hospital. For patients still in rehabilitation facilities, a mRS certified nurse schedules telephone interviews. | Operator-measured | Yes | IRB Toronto |
| Klinikum rechts der Isar, Technical University Munich, Munich, Germany | 206 | 2009-2017 | 24.8% (51/206)  BAO 46 | 18.4% (38/206) | 151/153 | 0% (0/51) | 2.4% (5/206) | Rerospective by neuroradiologist | Board certified stroke neurologists | mRS was evaluated either by face-to-face assessments (by stroke neurologists) or standardized telephone interviews (by certified study nurses). | Operator Measured | Yes | Ethikkommission der medizinischen Fakultät der Technischen Universität München |
| University Hospital Vall d'Hebron, Barcelona, Spain | 419 | 2010-2017 | 11.0% (46/418)  BAO 34 | 20.0% (84/419) | 319/360 | 0% (0/46) | 0% (0/491) | Prospective, by neurologist/neuroradiologist on call | Board certified stroke neurologists | Stroke neurologists on scheduled clinical visits.  Structured telephone interviews if unable to attend. | Operator Measured | Yes | CEIC H. Vall d‘Hebrond |
| CHUV, Lausanne University Hospital, Lausanne, Switzerland | 139 | 2012-2017 | 10.1%(14/139)  BAO 2 | 26.6% (37/139) | 113/124 | 0% (0/14) | 0.1% (1/139) | Consensus stroke neurologist and neuroradiologist (not blinded) | Board certified stroke neurologists | mRs was assessed by Rankin-certified physicians at 3 months in the outpatient clinic, or alternatively through a structured telephone interview by Rankin-certified personnel. | Operator-measured | Yes | Commission Ethique de Recherche, Canton de Vaud |
| Montpellier CHU, University Hospital Montpellier, Montpellier, France | 149 | 2015-2017 | 2.7% (4/149)  BAO 4 | 4.0% (6/149) | 109/145 | 0% (0/4) | 82.1% (96/117) | Operator-measured | Board certified stroke neurologists | Stroke neurologists on scheduled clinical visits.  Structured telephone interviews if unable to attend. | Operator-measured | Yes | CNIL Comité National Informatique et Liberté |
| CHU Reims, University Hospital Reims, Reims, France | 108 | 2013 - 2017 | 9.3% (10/108)  BAO 10 | 0% (0/108) | 96/98 | 0% (0/10) | 92.6% (100/108) | Retrospective, certified neuroradiologist | Board certified stroke neurologists | Stroke physician on clinical visits at university hospital or remote outpatient center. | Retrospective, certified neuroradiologist | Yes\* | IRB Reims University Hospital, Champagne-Ardenne University. |
| **Total** | **2046** | | | | | | | | | | | | |
| \*Ethics committee votum was waived due to the entirely retrospective nature of data collection | | | | | | | | | | | | | |

**S Table 2** – Outcome data comparing patients with basilar artery occlusion and patients with large vessel occlusion in the anterior circulation.

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| --- | --- | --- | --- |
| **Outcome at day 90** | **MT of BAO (n=165)** | **MT of anterior circulation LVO (n=1574)** | **P** |
| Modified Rankin Scale |  |  |  |
| 0 | 19 (12.5%) | 147 (10.4%) |  |
| 1 | 19 (12.5%) | 237 (16.8%) |  |
| 2 | 17 (11.2%) | 220 (15.6%) |  |
| 3 | 15 (9.9%) | 195 (13.8%) |  |
| 4 | 16 (10.5%) | 184 (13.1%) |  |
| 5 | 11 (7.2%) | 82 (5.8%) |  |
| 6 | 55 (36.2%) | 344 (24.4%) |  |
| Other outcomes |  |  |  |
| Mortality at three months | 55 (36.2%) | 344 (24.4%) | 0.002 |
| NIHSS at 24 hours | 9 (3-30) | 9 (3-17) | 0.083 |
| Non hemorrhagical worsening | 16 (17.6%) | 102 (8.6%) | 0.008 |

LVO: large vessel occlusion, mTICI: Modified treatment in cerebral ischaemia, sICH: symptomatic intracranial hemorrhage according to European Co-operative Acute Stroke Study-II defition

**S Table 3** – Baseline differences of patients with good and bad outcomes (only BAO, iICA, Carotid-T and M1)

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| --- | --- | --- | --- |
|  | **mRS 0-2 (N=659)** | **mRS 3-6 (N=902)** | **P** |
| Clinical items |  |  |  |
| Age (years) | 68 (57-77) | 76 (65-83) | <0.001 |
| Transfer from another hospital | 217 (33.0%) | 339 (37.6%) | 0.061 |
| Sex (female) | 328 (49.8%) | 451 (50.0%) | 0.959 |
| NIHSS on admission | 15 (9-18) | 18 (14-22) | <0.001 |
| Pre stroke independence | 649 (99.2%) | 788 (88.2%) | <0.001 |
| Blood pressure systolic (mmHg) | 147 (SD 26) | 153 (SD30) | <0.001 |
| Blood pressure diastolic (mmHg) | 83 (SD 20) | 82 (SD 21) | 0.416 |
| Admission glucose (mmol/L) | 6.4 (5.7-7.5) | 6.9 (5.9-8.5) | <0.001 |
| Noticed symptom onset | 567 (86.0%) | 699 (77.5%) | <0.001 |
| Wake up | 43 (7.1%) | 73 (8.8%) | 0.281 |
| In hospital stroke | 18 (2.7%) | 21 (2.3%) | 0.626 |
| Medication |  |  |  |
| Antiplatelet  - mono - dual | 159 (26.2%) 10 (1.6%) | 262 (31.5%) 12 (1.4%) | 0.095 |
| Statin | 145 (27.0%) | 230 (31.3%) | 0.093 |
| Anticoagulation  - none  - VKA  - NOAC | 528 (87.1%) 53 (8.7%) 25 (4.1%) | 698 (83.6%) 103 (12.3%) 34 (4.1%) | 0.095 |
| Risk factors |  |  |  |
| Diabetes | 76 (11.6%) | 179 (20.1%) | <0.001 |
| Arterial Hypertension | 403 (61.8%) | 608 (68.2%) | 0.011 |
| Dyslipidemia | 332 (51.1%) | 430 (48.6%) | 0.353 |
| Smoking | 211 (33.3%) | 209 (24.4%) | <0.001 |
| Previous stroke | 65 (9.9%) | 131 (14.7%) | 0.005 |
| Coronary artery disease | 83 (17.3%) | 153 (23.6%) | 0.012 |
| TOAST etiology  - large-artery - cardioembolic - other - unknown | 96 (14.8%) 284 (43.7%) 52 (8.0%) 218 (33.5%) | 127 (14.3%) 423 (47.5%) 51 (5.7%) 289 (32.5%) | 0.232 |
| Imaging |  |  |  |
| Type of imaging  - MRI - CT | 275 (42.6%) 371 (57.4%) | 294 (33.1%) 593 (66.9%) | <0.001 |
| Collaterals - 0 (bad) - 1 (moderate)  - 2 (good) | 19 (10.3%) 64 (34.8%) 101 (54.9%) | 79 (28.9%) 101 (37.0%) 93 (34.1%) | <0.001 |
| Dissection | 29 (4.4%) | 30 (3.3%) | 0.285 |
| Treatment |  |  |  |
| IVT use | 365 (55.4%) | 406 (45.0%) | <0.001 |
| Time from onset of symptoms to IVT needle (min) | 120 (85-165) | 135 (90-180) | 0.110 |
| Time from onset of symptoms to admission (min) | 126 (69-227) | 161 (79-274) | <0.001 |
| Time from onset of symptoms to groin puncture (min) | 213 (160-302) | 240 (174-338) | <0.001 |

**S Table 3 -** Baseline characteristics comparing patients with favourable outcome (mRS 0-2) and patients with unfavourable outcome (mRS 3-6).

NIHSS: National Institute of Health Stroke Scale, , TOAST: Trial of ORG 10172 in Acute Stroke Treatment, VKA: vitamin K antagonist, NOAC: non-vitamin K antagonist oral anticoagulants, VA: vertebral artery, BA: basilar artery, P1: first segment of posterior cerebral artery, P2: second segment of posterior cerebral artery, IVT: intravenous thrombolysis

**S Table 4** – Outcome in BAO patients according to recanalization success.

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|  | **Unsuccessful recanalization (mTICI 0, 1 or 2a, N=16)** | **Successful recanalization (mTICI 2b, 2c or 3, N=149)** | **P** |
| Mortality | 11/15 (73.3%) | 44/137 (32.1%) | 0.003 |
| sICH ECASS II | 4/16 (25%) | 4/149 (2.7%) | 0.003 |
| Median NIHSS improvement at 24 hours | 0 (0-8) | 2 (-1-10) | 0.876 |
| mRS 0-1 at 3 months | 0/15 (0%) | 38/137 (27.7%) | 0.023 |
| mRS 0-2 at 3 months | 3/15 (20%) | 52/137 (38%) | 0.258 |
| mRS 0-3 at 3 months | 3/15 (20%) | 67/137 (48.9%) | 0.053 |
| Non-hemorrhagic neurological worsening | 0 (0%) | 16/82 (19.5%) | 0.352 |

Outcome parameters comparing patients with successful recanalization and patients with unsuccessful recanalization of basilar artery occlusion. Unadjusted chi squared testing of group differences. Mann-Whithney-U-Test for difference in NIHSS improvement.

sICH: symptomatic intracranial hemorrhage according to European Co-operative Acute Stroke Study-II defition, NIHSS: National Institute of Health Stroke Scale, mRS: modified Rankin Scale

**S Table 5 -** Criteria for performing MT in PC and estimate of rate of included BAO patients

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| **Center** | **Criteria for performing MT in PC (and AC)** | **De facto or estimated ratio of patients in the registry as compared to total number of patients with BAO during the study period.** |
| Bern | PC: (1) diagnosis of BAO was established; (2) baseline NIHSS score was 4 points or hemianopia was present; (3) hemorrhage on cranial CT or MRI was excluded; (4) BAO as seen on digital subtraction angiography correlated with the neurological deficit; (5) symptom duration was not >24 hours; and (6) no individual clinical or premorbid conditions or laboratory findings advised against thrombolysis.  Exclusion: we perform MRI in most cases and if severe brainstem damage is present on DWI (bilateral pyramid tract infarctions) we do not perform MT. | ~ 90% of 62 |
| Montpellier | PC: Patients were selected based on visual interpretation of the DW Imaging at Baseline, for example if only a few region of midbrain was affected , neuroradiologist do thrombectomy. BSS score was used in the departement:  (Reference Diffusion-Weighted Imaging Score of the Brain Stem: A Predictor of Outcome in Acute Basilar Artery Occlusion Treated with the Solitaire FR Device , Isabelle Mourand & al .) AC: NIHSS admission, Ischaemic core volume, Penumbra volume++ ( Perfusion), Good medical case | 2/4 (50%) |
| Reims | PC: Basically all patients with evidence of basilar artery occlusion undergo MT at our institution in absence of prolonged coma (>6h) or complete infarction of the mesencephalon and the thalamus | 10/18 (56%) |
| Barcelona | The treatment indication is done based on clinical severity (baseline NIHSS), parenchyma status measure by CT (we rarely use MRI or CT-P in posterior circulation) and time from onset. For anterior circulation we use similar criteria, using CT-P beyond 6 hours from symptom onset. | 46/79 (66%) |
| Munich | Special exclusion criteria for thrombectomy in BA thrombosis (no fixed time window):  - Coma > 6 h and / or clinical signs of irreversible brain stem damage (pupils far without LR, lack of CR,respiratory disorder, circulatory dysregulation) > 6 h after onset of symptoms  - infarction of the whole pontomesencephal cross section in FLAIR / CT | 46/161 (29%) |
| Lausanne | Anterior circulation:  a. NIHSS ≥ 4 or major neurological deficit, Rankin ≤ 2 and ASPECTS ≥ 5 or core infarct ≤ 100cc for ≤ 8 hours from symptom onset.  b. NIHSS ≥ 10 or major neurological deficit, Rankin ≤ 2 and ASPECTS ≥ 7 or core infarct ≤ 50cc for 8-24 hours from symptom onset.  Posterior circulation:  a. NIHSS ≥ 4 or major neurological deficit, Rankin ≤ 2, pc-ASPECTS ≥ 7, no irreversible brainstem ischemia for ≤ 8 hours from symptom onset.  b. NIHSS ≥ 10 or major neurological deficit, Rankin ≤ 2, pc-ASPECTS ≥ 8, no irreversible brainstem ischemia for 8-24 hours from symptom onset | 8/34 (24%) |
| Toronto | PC: We have a low threshold to proceed with EVT and overall give patients 'the benefit of the doubt'. We decided posterior circulation strokes on CT/CTA. Few cases were decided up on MRI when CT/CTA was unclear and we used DWI/flair mismatch criteria. We do not use posterior circulation ASPECTS or other standardize methods for core definition.  Time window is 24h and we also analyze endovascular feasibility and access based on CTA.  Certainly, baseline mRS >3, signs of bleeding, severe ICAD or difficult/impossible access, significant cerebellar infarction, imaging signs of hydrocephalus, compression of the 4th ventricle or tonsillar prolapse are excluding factors. | 7/25 (28%) |