Acute Thrombectomy for Cerebral Infarction: Comparative Study between Patients over 85 Years Old and Those below 85 Years Old

Yuki Oichi, Makoto Hayase, Akinori Miyakoshi, Kohichi Go, Takeshi Kawauchi, Noritaka Sano, and Hiroki Toda

Objective: We retrospectively compared the results of treatment between patients aged ≥85 years and those aged <85 years among those who underwent thrombectomy for acute cerebral infarction in our hospital.

Methods: Of patients with acute cerebral infarction who underwent thrombectomy in our hospital during October 2014 and September 2017, the subjects were those with an interval of ≤8 hours from onset until arrival, a diffusion-weighted imaging-alberta stroke program early CT score (DWI-ASPECTS) of ≥6, and occlusion of the internal carotid (IC) artery, middle cerebral artery M1/M2, basilar artery (BA), or posterior cerebral artery P1.

Results: The subjects consisted of 12 patients aged ≥85 years and 27 aged <85 years, with mean ages of 88.5 and 72.3 years, respectively. The rate of patients who had taken antithrombotic drugs before onset was significantly higher in the latter. There were no significant differences in the diagnosis, risk factors, modified Rankin Scale (mRS) score before onset, National Institute of Health Stroke Scale (NIHSS) score on arrival, DWI-ASPECTS, or site of occlusion. Concerning treatment results, the mRS score on discharge was significantly higher in those aged ≥85 years, but there were no significant differences in the recanalization rate or incidence of hemorrhagic complications between the two groups.

Conclusion: In those aged ≥85 years, the mRS score on discharge was significantly higher. However, the recanalization rate was relatively high, and an improvement in the NIHSS score was achieved. Although the indication of thrombectomy should not be restricted based on the age alone, acute cerebral infarction patients aged ≥85 years must be accumulated to evaluate whether the procedure should be indicated.

Keywords: over 85 years old, mechanical thrombectomy, acute ischemic stroke, acute cerebral infarction

Introduction

In Japan, it is recommended that thrombectomy should be performed in addition to medical treatments, including intravenous thrombolysis with recombinant tissue plasminogen activator (rt-PA), for acute cerebral infarction patients with an interval of ≤6 to 8 hours from onset until arrival.13 With the rapid aging of society, the incidence of acute cerebral infarction at ≥85 years of age is not low, and we have often encountered patients with cerebral infarction during admission due to other diseases or those who developed cerebral infarction in the presence of a reduction in activities of daily living (ADL). Under such circumstances, no study has clarified the efficacy of thrombectomy in patients aged ≥85 years; it is difficult to evaluate whether thrombectomy should be indicated in many cases. In this study, we retrospectively compared the results of treatment between patients aged ≥85 years and those aged <85 years among those who underwent thrombectomy for acute cerebral infarction in our hospital.

Subjects and Methods

Of patients with acute cerebral infarction who underwent thrombectomy in our hospital between October 2014 and
September 2017, the subjects were those with an interval of ≤8 hours from onset until arrival, a diffusion-weighted imaging-Alberta Stroke Program Early CT Score (DWI-ASPECTS) of ≥6, and occlusion of the internal carotid artery (IC), middle cerebral artery (MCA) M1/M2, basilar artery (BA), or posterior cerebral artery P1. The site of occlusion was evaluated using MRI/MRA. We compared the modified Rankin Scale (mRS) score before onset, National Institute of Health Stroke Scale (NIHSS) score on arrival, DWI-ASPECTS, site of occlusion, presence or absence of intravenous thrombolysis with rt-PA (IV-tPA), interval from onset until arrival (from onset to door: O2D), interval from arrival until puncture (from door to puncture: D2P), interval from puncture until recanalization (from puncture to recanalization: P2R), therapeutic instruments, Thrombolysis in Cerebral Infarction (TICI) scale score, NIHSS score on discharge, mRS score on discharge, and incidence of hemorrhagic complications between patients aged ≥85 years and those aged <85 years. For statistical analysis, the Mann–Whitney U-test was used to compare the age, mRS score, NIHSS score, DWI-ASPECTS, and interval. The other parameters were compared using Fisher’s exact test. This article was approved by the Ethics Review Board of our hospital (as of January 9, 2018).

Results

The subjects consisted of 12 patients aged ≥85 years and 27 aged <85 years, with mean ages (standard deviation) of 88.5 (±2.36) and 72.3 (±7.66) years, respectively. The rate of patients who had taken antithrombotic drugs before onset was significantly higher in the latter (P <0.05). There were no significant differences in the sex, diagnosis, risk factors, mRS score before onset, NIHSS score on arrival, DWI-ASPECTS, or site of occlusion (Table 1).

Concerning the contents/results of treatment, there were no significant differences in the presence or absence of combined IV-tPA, interval until puncture/recanalization, or therapeutic instruments between the two groups (Table 2). However, the interval from arrival until puncture and that from puncture until recanalization in the patients aged ≥85 years were slightly longer than in those aged <85 years. The rates of TICI 2b or higher patients in the former and latter were 83 and 93%, respectively; there was no significant difference between the two groups. The mRS scores on discharge (median) were 4 (1–5) and 3 (0–6), respectively, showing a significant difference (P <0.05). There was no significant difference in the incidence of hemorrhagic complications/symptomatic hemorrhage between the two groups.
The changes in the mRS score before onset and on discharge in each group are shown in Fig. 1. The mRS score before onset was higher in those aged ≥85 years although there was no significant difference. However, the rate of patients with an mRS score of ≤2 on discharge in those aged ≥85 years was 8.3%, being significantly lower than in those aged <85 years (48.1%) (P = 0.028).

We present two patients, aged ≥85 years, in whom the results of thrombectomy were favorable and one patient with a hemorrhagic complication.

Case 1: An 85-year-old, right-handed female. The mRS score before onset was zero. Medical history: Hypertension and diabetes mellitus. Consciousness disorder and paralysis of the left upper/lower limbs occurred, and she was taken to a local clinic by ambulance. After IV-tPA, she was referred to our hospital. The NIHSS score on admission was 16 points. MRI-DWI showed a high signal intensity in the right MCA region (DWI-ASPECTS: 8 points). MRA revealed occlusion of the distal right M1 area. Thrombectomy with a Penumbra system (Penumbra Inc., Alameda, CA, USA) (a direct aspiration, first pass technique [ADAPT] using a Penumbra 5MAX ACE) was performed, and TICI 3 was achieved (Fig. 2). The O2D, D2P, and P2R were 155, 41, and 48 minutes, respectively. Red thrombi were collected, and cardiogenic cerebral embolism was considered, but Holter’s electrocardiography did not show atrial fibrillation. Treatment with Warfarin was started. The NIHSS scores on arrival and discharge were 16 and 7, respectively, showing an improvement. She was referred to a recovery-phase rehabilitation hospital 22 days after admission, with an mRS score of 3.

Case 2: A 91-year-old, right-handed female. The mRS score before onset was zero. Medical history: Hypertension. She consulted the Emergency Outpatient Unit of our hospital with aphasia and paralysis of the right upper/lower limbs. On arrival, the NIHSS score was 9 points. MRI-DWI showed a high signal intensity in the left MCA region.
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Representative case 1: 85-year-old female, M1 occlusion. (A) Preoperative MRI DWI, (B) preoperative DSA, and (C) postoperative DSA (TICI 3). DWI: diffusion-weighted imaging; TICI: thrombolysis in cerebral infarction

(DWI-ASPECTS: 9 points). MRA revealed occlusion of the left M2 region. After IV-tPA, thrombectomy with a Penumbra system (ADAPT using a Penumbra 5MAX ACE) was performed, and TICI 2b was achieved (Fig. 3). The O2D, D2P, and P2R were 42, 112, and 60 minutes, respectively. Electrocardiographic monitoring the day after admission showed atrial fibrillation. Under a diagnosis of cardiogenic cerebral embolism, treatment with rivaroxaban was started. The NIHSS score decreased from 9 to 1, and the patient was discharged 18 days after admission, with an mRS score of 1.

Case 3: An 87-year-old, right-handed male. The mRS score before onset was zero. Medical history: Hypertension, atrial fibrillation, and chronic myelogenous leukemia. He had taken rivaroxaban, but it had been discontinued due to persistent hematuria for 2 months. He underwent surgery for inguinal hernia; he was admitted to the Department of Surgery of our hospital. During admission, consciousness disorder, right hemiplegia, and left conjugate deviation were observed, and he was referred to the Department of Neurosurgery. The NIHSS score was 22 points. MRI-DWI showed a high signal intensity in the left MCA region (DWI-ASPECTS: 6 points). MRA revealed occlusion of the left M1 region. As there was a decrease in the platelet count, IV-tPA was not performed. Thrombectomy with a Penumbra system (ADAPT using a Penumbra 5MAX ACE) was conducted, and TICI 3 was achieved (Fig. 4). The D2P and P2R were 105 and 22 minutes, respectively.

After surgery, the NIHSS score transiently decreased to 13 points, but CT the day after surgery revealed a hematoma in the left Sylvian fissure and subarachnoid hemorrhage (SAH) (Fig. 4D). This may have been associated with mechanical hemorrhage related to catheter/guidewire operations during thrombectomy. After confirming the absence of an increase in the hemorrhagic site, the oral administration of rivaroxaban was resumed on the 5th postoperative day. However, subsequently, brain edema around the hematoma and exacerbation of cerebral infarction were noted, and the NIHSS score again increased to 22 points. He was referred to another hospital on the 18th postoperative day, with an mRS score of 5.

Discussion

The results of this study showed that the recanalization rate after thrombectomy in the patients aged ≥85 years was relatively high (TICI 2b or higher: 83%). Furthermore, intracranial hemorrhagic complications were noted in 4 (33%) of the 12 patients. However, symptomatic hemorrhage was observed in only one patient (8.3%), and there was no increase in its risk in comparison with those aged <85 years. However, in Case 3, the course was unfavorable; it is necessary to evaluate/perform indications/procedures carefully. Furthermore, the mRS score on discharge was ≤2 in only one patient (8.3%), and the percentage was significantly lower than in those aged <85 years.
Son et al. divided patients who underwent thrombectomy in a single institution between July 2013 and June 2016 into two groups (age: <80 years, ≥80 years), and examined the effects of thrombectomy in elderly patients. They indicated the safety and efficacy of current thrombectomy in elderly patients. However, the clinical outcome in elderly patients was poorer than in young patients (the rate of patients with an mRS score of ≤2 after 90 days was significantly lower in those aged ≥80 years), as demonstrated by the results of this study. This result may have been influenced by the age, NIHSS score, and interval until reperfusion in the elderly group. The age, NIHSS score, and interval until reperfusion have been established as risk factors for an unfavorable outcome after stroke. In Europe, the results of a registration observational study (Safe Implementation of Treatment in Stroke International...
Table 3  Recent randomized trials of mechanical thrombectomy

<table>
<thead>
<tr>
<th>Study</th>
<th>Age, years (mean ± SD)</th>
<th>NIHSS (median and IQR)</th>
<th>ASPECTS (median and IQR)</th>
<th>NIHSS (median and IQR)</th>
<th>ASPECTS (median and IQR)</th>
<th>mRS 0–2 (N/A) (%)</th>
<th>D2P (25th, 75th)</th>
<th>P2R (25th, 75th)</th>
<th>mTICI ≥2b, 3 (N/A) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MR CLEAN</td>
<td>65.8 ± 11.1</td>
<td>17 (15–19)</td>
<td>9 (7–10)</td>
<td>17 (15–19)</td>
<td>9 (7–10)</td>
<td>87.5 (13.6)</td>
<td>2,200 (1,089)</td>
<td>2,400 (1,314)</td>
<td>93.6 (7.4)</td>
</tr>
<tr>
<td>EXTEND-IA</td>
<td>69.6 ± 11.2</td>
<td>19 (17–21)</td>
<td>11 (9–13)</td>
<td>19 (17–21)</td>
<td>11 (9–13)</td>
<td>87.5 (13.6)</td>
<td>2,200 (1,089)</td>
<td>2,400 (1,314)</td>
<td>88.2 (11.8)</td>
</tr>
<tr>
<td>SWIFT PRIME</td>
<td>65.0 ± 11.0</td>
<td>17 (15–19)</td>
<td>9 (7–10)</td>
<td>17 (15–19)</td>
<td>9 (7–10)</td>
<td>93.6 (7.4)</td>
<td>2,400 (1,314)</td>
<td>2,400 (1,314)</td>
<td>98.7 (1.3)</td>
</tr>
<tr>
<td>REVASCAT</td>
<td>65.7 ± 11.1</td>
<td>17 (15–19)</td>
<td>9 (7–10)</td>
<td>17 (15–19)</td>
<td>9 (7–10)</td>
<td>100 (0)</td>
<td>2,400 (1,314)</td>
<td>2,400 (1,314)</td>
<td>80.9 (19.1)</td>
</tr>
<tr>
<td>Present study (65)</td>
<td>65.8 ± 11.1</td>
<td>17 (15–19)</td>
<td>9 (7–10)</td>
<td>17 (15–19)</td>
<td>9 (7–10)</td>
<td>93.6 (7.4)</td>
<td>2,400 (1,314)</td>
<td>2,400 (1,314)</td>
<td>98.7 (1.3)</td>
</tr>
<tr>
<td>Present study (65)</td>
<td>72.3 ± 11.3</td>
<td>18 (16–20)</td>
<td>9 (7–10)</td>
<td>18 (16–20)</td>
<td>9 (7–10)</td>
<td>85 (5)</td>
<td>2,400 (1,314)</td>
<td>2,400 (1,314)</td>
<td>93.6 (6.4)</td>
</tr>
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</table>

* mRS: Modified Rankin Scale; NIHSS: National Institute of Health Stroke Scale; ASPECTS: Alberta Stroke Program Early CT Score; DWI: Diffusion-Weighted Imaging; mTICI: Thrombolysis in Cerebral Infarction; D2P: Door to Puncture; P2R: Puncture to Recanalization; 25th: Lower quartile; 75th: Upper quartile.

Of the above studies, five studies, excluding the THRACE, were unified, and a meta-analysis was performed (Highly...
Effective Reperfusion evaluated in Multiple Endovascular Stroke trials [HERMES]15. A sub-analysis indicated the efficacy of thrombectomy in patients aged ≥80 years. However, in Japan, the rapid aging of society is more advanced than in other countries; we have often encountered patients aged 85–99 years. It remains controversial whether thrombectomy should be positively performed for those aged ≥85 years. Furthermore, stent retrievers were primarily used in these studies; it was necessary to examine the selection of instruments for thrombectomy in elderly patients. In 2016, a randomized comparative study (The Randomized, Concurrent Controlled Trial to Assess the Penumbra System’s Safety and Effectiveness in the Treatment of Acute Stroke [THERAPY])16 using a Penumbra system was published. In 2017, another randomized comparative study (Contact Aspiration vs Stent Retriever for Successful Revascularization [ASTER] trial17) compared ADAPT18 using a Penumbra system with treatment using a stent retriever. In this trial, there was no significant difference in the results of treatment between the two first-line instruments. In this trial, there was no upper limit of age, suggesting that thrombectomy with a stent retriever/ Penumbra system is effective in elderly patients.

In 2017, the Diffusion-weighted Imaging Or Computerized Tomography Perfusion Assessment with Clinical Mismatch in the Triage of Wake up and Late Presenting Strokes Undergoing Neurointervention with Trevo (DAWN) trial19 indicated the efficacy of thrombectomy with a Trevo (Stryker, Kalamazoo, MI, USA) in clinical-core-mismatched patients with occlusion of the ICA to MCA M1 within 6–24 hours after onset. In this trial, there was no upper limit of age; in the future, thrombectomy may be indicated for patients with occlusion of the ICA to MCA M1, including those with wake-up stroke, within 24 hours after onset.

In this study, the rate of patients in whom a Penumbra system (ADAPT with a Penumbra 5MAX ACE) was used was higher than in the other studies, and that of patients in whom a stent retriever was used was lower. This may have been related to surgeons’ evaluation. The D2P and P2R were relatively long, possibly because a specific duration was required to evaluate whether thrombectomy should be indicated due to an advanced age, and because a specific interval was required for tortuous-blood-vessel-mediated approaching. However, TICI 2b or higher recanalization was achieved in 83% of the patients. As a result, there was an improvement in the NIHSS score. However, only one patient (8.3%) showed an mRS score of ≤2 on discharge; the percentage was markedly lower than the rate of patients with an mRS score of ≤2 after 90 days in the other studies.

Thus, in this study, the efficacy of thrombectomy in patients aged ≥85 years was not demonstrated, but the results suggest that a high recanalization rate is achieved even at an advanced age, and that treatment can be performed relatively safely. Although careful evaluation is required, patients for whom thrombectomy is indicated should not be restricted based on age alone.

### Conclusion

After thrombectomy, the mRS score on discharge was slightly high in patients aged ≥85 years. However, the recanalization rate was relatively high even in these patients (TICI 2b or higher: 83%). The median NIHSS score decreased from 16 on arrival to 5 on discharge. Although patients for whom thrombectomy is indicated should not be restricted based on age alone, acute cerebral infarction patients aged ≥85 years must be accumulated to evaluate whether it should be indicated.

### Disclosure Statement

There is no conflict of interest for the main author and coauthors.

### References


