Effectiveness of endovascular thrombectomy in patients over 80 years of age

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Objective: Endovascular thrombectomy (EVT), with or without intravenous thrombolysis, has become the standard treatment for acute ischemic stroke, especially in large vessel occlusions. This study provides valuable insights about the effectiveness of EVT in these patients.

Methods: We retrospectively reviewed patients who underwent EVT for acute ischemic stroke at age 80 or over between 2014 and 2022. Procedural and functional outcomes were assessed with the thrombolysis in cerebral infarction (TICI) score and National Institutes of Health Stroke Scale (NIHSS) after EVT, in comparison with the initial NIHSS. We divided patients into the improved NIHSS group, the non-improved group, and the expired group.

Results: Eighty patients who underwent EVT from 2014 to 2022 were analyzed. Fifty-seven patients improved, whereas 23 patients did not improve or expired after EVT. Successful recanalization (TICI IIb or III) was reported in 88.7% of cases. The locations of occlusion differed among the groups. The most frequently discovered location of occlusion was the sphenoidal segment of middle cerebral artery (M1), and occlusions were most frequently discovered in the internal carotid artery in the group without NIHSS improvements.

Conclusion: This study revealed that EVT in elderly patients was effective, and occlusion of a distal vessel could be a good prognostic factor. Reducing puncture time was also identified as the most important factor in elderly patients. Lastly, if TICI IIb reperfusion is discovered during the procedure, additional reperfusion attempts should be avoided.

Keywords: Aged; Cerebral infarction; Reperfusion

Introduction

Endovascular thrombectomy (EVT) with or without intravenous thrombolysis (IVT) has been considered the standard treatment for acute ischemic stroke, especially for patients with large vessel occlusions [1].

However, the effectiveness of EVT in patients over the age of 80 has not been established. They have been excluded from major clinical trials. A meta-analysis from previous clinical trials indicated that EVT was significantly more beneficial than IVT alone at this age as well [2–4].

The purpose of this study is to investigate the effectiveness of EVT in acute stroke, caused by larger vessel occlusion for elderly patients over 80.

Material and Method

Patient selection

This study was approved by the Institutional Review Board of Kangdong Sacred Heart Hospital (IRB No. 2022-08-018) which waived the requirement for informed consent due to the respective nature of the study.

We retrospectively analyzed patients between 2014 and 2022. Patients included those who: (1) underwent EVT for acute ischemic stroke; (2) had large vessel occlusion; (3) were 80 years of age or older at the time of treatment. Among the inclusion criteria described above, large vessel occlusion includes ICA, sphenoidal segment of middle cerebral artery (M1), insular segment of middle cerebral artery (M2), pre-communicating segment of posterior
cerebral artery (P1), and basilar artery (BA). All patients were treated by experienced neuro-interventionalists.

The data of the patient’s age, gender, and comorbid conditions such as atrial fibrillation, diabetes mellitus, and dyslipidemia were collected. Puncture time from symptom onset and baseline National Institutes of Health Stroke Scale (NIHSS) was also confirmed.

**Outcome measures**
The procedural outcome was measured by thrombolysis in cerebral infarction (TICI) score. The criteria for successful recanalization as TICI IIb or III were determined by digital subtraction angiography.

The functional outcome was assessed with the NIHSS score after EVT, compared to the initial NIHSS score. Patients were divided into 3 groups; improved NIHSS group, not improved group, and expired group. One with improvements in NIHSS, another without any improvements in NIHSS, and the other who expired.

**Results**

**Patient demographics**
A total of 80 patients were analyzed who performed EVT from 2014 to 2022. The median age was 85.32 years (range, 80–99), and 66.3% of the patients were women. The median initial NIHSS score was 14.67 (range 2–27). The most dominant occlusion location was the M1 segment (58.8%). Furthermore, the most common comorbid disease of patients was hypertension. In 88.8% of patients, the procedure was started within 6 hours after symptoms. Lastly, 72.5% of patients received IVT before EVT (Table 1).

**Functional outcomes**
Fifty-seven patients were improved, and 23 patients were not improved or expired after EVT. There was no statistically significant difference among groups in age, gender, and comorbid conditions such as hypertension, diabetes, etc.

Successful recanalization, TICI IIb or III, was reported in 88.7% of all cases. TICI IIb or III was achieved in 96.5% of the improved NIHSS group and 83.3% of the not improved NIHSS group. On the other hand, in the expired group, 45.5% of the cases did not show any sufficient reperfusion.

The puncture time was shorter in the group with improved NIHSS compared to the other groups. Ninety-three percent of patients could initiate EVT within 6 hours of symptom onset, while the percentages of the other groups were 75.0% and 81.8%.

The locations of occlusion were also different depending on the groups; in the group with improvements in NIHSS, the most frequently discovered location of occlusion was M1 (71.9%), and it was ICA that the greatest number of occlusions is discovered in the group without any improvements in NIHSS (50.0%) (Table 2).

**Discussion**

Previous studies concerning the impact of age on outcomes after thrombectomy have consistently shown that age is an independent predictor of functional independence and mortality at 90 days [5– 8]. Subsequent follow-up studies after that studied the change in outcome according to age, and the age of 80 was designated as the

| Table 1. Characteristics of the patients treated with endovascular thrombectomy |
|---|
| Characteristic | Patients (n = 80) |
| Age (yr) | 85.32 (80–99) |
| Sex | |
| Male | 27 (33.8) |
| Female | 53 (66.3) |
| Premedication | |
| Anticoagulation | 13 (16.3) |
| Antiplatelet | 19 (23.8) |
| Puncture time < 6 hours | 71 (88.8) |
| Initial NIHSS | 14.67 (2–27) |
| Postprocedural NIHSS | 7.8 (0–33) |
| TICI | |
| I | 1 (1.3) |
| IIa | 8 (10.0) |
| IIb | 12 (15.0) |
| III | 59 (73.8) |
| Comorbid conditions | |
| Hypertension | 61 (76.3) |
| Diabetes (%) | 17 (21.3) |
| Coronary artery disease | 22 (27.5) |
| Hyperlipidemia | 12 (15.0) |
| Atrial fibrillation | 43 (53.8) |
| Stroke history | 16 (20.0) |
| Location of occlusion | |
| ICA | 19 (23.8) |
| M1 | 47 (58.8) |
| M2 | 7 (8.8) |
| P1 | 1 (1.3) |
| BA | 6 (7.5) |
| IVT | 58 (72.5) |

Values are presented as median (range) or number (%).
NIHSS, National Institutes of Health Stroke Scale; TICI, thrombolysis in cerebral infarction; ICA, internal carotid artery; M1, sphenoidal segment of middle cerebral artery; M2, insular segment of middle cerebral artery; P1, pre-communicating segment of posterior cerebral artery; BA, basilar artery; IVT, intravenous thrombolysis.
age at which a rapid decline in outcome occurred from then on [9,10]. However, several reports argue that despite the reduced efficacy of EVT in patients over 80 years of age, they still have significant rates of functional independence [6,11].

These differences are made because of performing the same treatment in young and old aged patients. Compared with younger people, aged patients have a comorbid condition [12]. Because of this, even if there were no problems during the EVT procedure, there are many cases where problems occur after the procedure. Hilditch et al. [9] reported that elderly people have relatively higher postprocedural symptomatic intracranial hemorrhage (8%) and complication (11%). Therefore, a treatment strategy slightly different from that of young people is required and one example of this could be avoiding continuous reperfusion attempts. A previous study showed that a TICI score is highly associated with functional independence in younger patients [13]. However, in elderly people, the difference in results according to TICI seems to be relatively small. In the expire group, the rate of insufficient reperfusion rate was high. But there was no difference in TICI between the improved NIHSS group and the not improved NIHSS group.

These data suggest that elderly people need a different treatment strategy from younger people. Continuous reperfusion attempts can be made in younger patients to achieve TICI III. However, in the elderly, an acceptable intra-procedural outcome should be considered as TICI IIb, not TICI III. A study by Loh et al. [14] analyzed intra-arterial therapy in elderly stroke patients, the authors reported that there were no significant differences in the TICI II–

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**Table 2. Comparison according to changes in the NIHSS**

| Characteristic                  | Improved NIHSS (n = 57) | Not improved NIHSS (n = 12) | Expired (n = 11) | P-value |
|--------------------------------|-------------------------|-----------------------------|-----------------|---------|
| Age (yr)                       | 85.3 (80–98)            | 87.4 (81–99)                | 83.5 (80–86)    | 0.044   |
| Sex                            |                         |                             |                 |         |
| Male                           | 22 (38.6)               | 4 (33.3)                    | 4 (36.4)        |         |
| Female                         | 35 (61.4)               | 8 (66.7)                    | 7 (63.6)        |         |
| Premedication                  |                         |                             |                 |         |
| Anticoagulation                | 9 (15.8)                | 3 (25.0)                    | 1 (9.1)         | 0.627   |
| Antiplatelet                   | 15 (26.3)               | 3 (25.0)                    | 1 (9.1)         | 0.587   |
| Puncture time < 6 hours        | 53 (93.0)               | 9 (75.0)                    | 9 (81.8)        | 0.059   |
| Initial NIHSS                  | 14.6 (4–24)             | 12.8 (7–20)                 | 16.4 (7–26)     | 0.290   |
| Post NIHSS                     | 5.9 (0–22)              | 16.8 (13–33)                |                 | <0.001  |
| TICI                           |                         |                             |                 |         |
| I                              | 0 (0)                   | 1 (8.3)                     | 0 (0)           | <0.001  |
| IIa                            | 2 (3.5)                 | 1 (8.3)                     | 5 (45.5)        |         |
| IIb                            | 6 (10.5)                | 4 (33.3)                    | 2 (18.2)        |         |
| III                            | 49 (86.0)               | 6 (50.0)                    | 4 (36.4)        |         |
| Comorbid conditions            |                         |                             |                 |         |
| Hypertension                   | 42 (73.7)               | 10 (83.3)                   | 8 (72.7)        | 0.765   |
| Diabetes                       | 9 (15.8)                | 4 (33.3)                    | 3 (27.3)        | 0.350   |
| Coronary artery disease        | 17 (29.8)               | 4 (33.3)                    | 2 (18.2)        | 0.709   |
| Hyperlipidemia                 | 7 (12.3)                | 2 (16.7)                    | 3 (27.3)        | 0.066   |
| Atrial fibrillation            | 32 (56.1)               | 6 (50.0)                    | 4 (36.4)        | 0.407   |
| Stroke history                 | 14 (24.6)               | 0 (0)                       | 2 (18.2)        | 0.178   |
| Location of occlusion          |                         |                             |                 | <0.001  |
| ICA                            | 7 (12.3)                | 6 (50.0)                    | 6 (54.5)        |         |
| M1                             | 41 (71.9)               | 2 (16.7)                    | 4 (36.4)        |         |
| M2                             | 5 (8.8)                 | 2 (16.7)                    | 0               |         |
| P1                             | 1 (1.8)                 | 0 (0)                       | 0               |         |
| BA                             | 3 (5.3)                 | 2 (16.7)                    | 1 (9.1)         |         |
| IVT                            | 48 (84.2)               | 8 (66.7)                    | 5 (45.5)        |         |

Values are presented as median (range) or number (%). NIHSS, National Institutes of Health Stroke Scale; TICI, thrombolysis in cerebral infarction; ICA, internal carotid artery; M1, sphenoidal segment of middle cerebral artery; M2, insular segment of middle cerebral artery; P1, pre-communicating segment of posterior cerebral artery; BA, basilar artery; IVT, intravenous thrombolysis.
III reperfusion rates in elderly people. If reperfusion of TICI IIb is seen, additional trials do not significantly affect the patient's outcome.

EVT can be performed with general anesthesia or local anesthesia. Anesthesia modality for EVT can be an important variable. The advantages of general anesthesia include control of respiration and patient movement, which, in turn, facilitates navigating the catheters through the vascular anatomy and reaching the occlusion site. However, local anesthesia allows the shorter door to puncture times [15]. Puncture time is one of the most important factors considering the prognosis of young and elderly groups of patients. Although there was no statistical significance when the patients in this study were divided into 3 groups in this regard. However, significant results were obtained when we divided the patients into 2 groups. Ninety-three percent of the improved NIHSS group underwent EVT less than 6 hours from symptom onset, whereas the percentage of the other group was 78.3% (Table 3). Therefore, EVT should be done with local anesthesia in elderly patients, if possible.

Our study has a few limitations. We assessed functional outcomes by post-EVT NIHSS. However, if long-term outcomes such as the 90-day modified Rankin Scale were also confirmed, comparison with other studies would have been easier. The study by Alawieh et al. [13] reported 21% of patients had a favorable 90-day outcome. This is quite different from our classification of 71% of patients into the improved group. However, this prevented the exclusion of expired patients from the study and helped to exclude factors that could deteriorate the patient's functional outcome after the procedure, such as in-hospital infection.

Conclusion

Our findings suggest that EVT in elderly patients is effective. Occlusion of the distal vessel could be a good prognostic factor. In addition, reducing puncture time is the most important factor in the elderly. Lastly, if reperfusion of TICI IIb is observed during the procedure, continuous reperfusion attempts should be avoided.

Table 3. Comparison between the improved NIHSS group and others

| Characteristic         | Improved NIHSS (n = 57) | Not improved NIHSS and expired (n = 23) | P-value |
|------------------------|------------------------|----------------------------------------|---------|
| Age (yr)               | 85.3 (80–98)           | 85.4 (80–99)                           | 0.824   |
| Puncture time < 6 hours| 53 (93.0)              | 18 (78.3)                              | 0.019   |

Values are presented as median (range) or number (%).

NIHSS, National Institutes of Health Stroke Scale.

Conflicts of interest

No potential conflict of interest relevant to this article was reported.

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