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Original Article

Current Status of Treatment for Acute Large Vessel Occlusion Stroke in Awaji Island Area after the Introduction of Endovascular Treatment

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Objective: We retrospectively analyzed the current status of treatment for anterior circulation large vessel occlusion (LVO) in island areas with a high population aging rate.

Methods: We investigated 62 consecutive patients with ischemic stroke due to acute anterior circulation LVO between October 1, 2017 and June 30, 2019.

Results: In all, 26 (41.1%) patients underwent endovascular treatment (EVT). The successful recanalization rate of EVT was 88.5% (23/26). There was a significant difference in the age (median, 75.5 years vs. 81 years, respectively, P = 0.0411) and the rate of intravenous tissue plasminogen activator (tPA) therapy (53.5% vs. 11.1%, respectively, P <0.001) between the EVT group and the non-EVT group. Patients in the EVT group achieved a favorable outcome more frequently than those in the non-EVT group (50% vs. 11.1%, respectively, P = 0.0012). In the analysis based on the place of onset among the three cities comprising Awaji Island and the four groups with in-hospital onset, there was no significant difference in the rate of EVT, and the outcome of the in-hospital onset group was poor. Among the EVT group, there was a significant difference in the pre-treatment National Institutes of Health Stroke Scale score (median, 15 vs. 19, respectively, P = 0.0237) and time from onset to recanalization (O2R; median, 240 min vs. 323 min, respectively, P = 0.0128) between the favorable outcome group and the unfavorable outcome group.

Conclusion: Even in an island area, it is possible to complete the treatment of ischemic stroke due to LVO within the regional medical area.

Keywords ▶ acute ischemic stroke, large vessel occlusion, endovascular treatment

Introduction

The results of a randomized study regarding endovascular treatment (EVT) for large vessel occlusion (LVO) within 6 hours of onset were published in 2015.[1–5] In 2016, its efficacy was established through a meta-analysis.[6] Additionally, the efficacy of EVT has been demonstrated under specific conditions even in patients undergoing EVT >6 hours after onset.[7,8] This treatment has been increasingly indicated. According to the Recovery by Endovascular Salvage for Cerebral Ultra-acute Embolism (RESCUE) Japan Project,[9] EVT was performed in 6.06/100000 Japanese individuals in 2016 and for 9.82/100000 Japanese individuals in 2018, exhibiting an increased incidence. Awaji Island has a population of approximately 130000 persons, and individuals aged ≥65 years account for approximately 34% of the total population (national mean, approximately 27%). The Awaji area comprises three cities (**Fig. 1**)—Sumoto City, where our hospital is located; Minami Awaji City; and Awaji City. It is an elongated island area located in the east of the Seto Inland Sea, with a north–south distance of 55 km and east–west distance of 28 km. Its east area is adjacent to the Osaka Prefecture/Wakayama Prefecture through the Osaka Bay and Kitan Channel. Its south area is adjacent to the Tokushima

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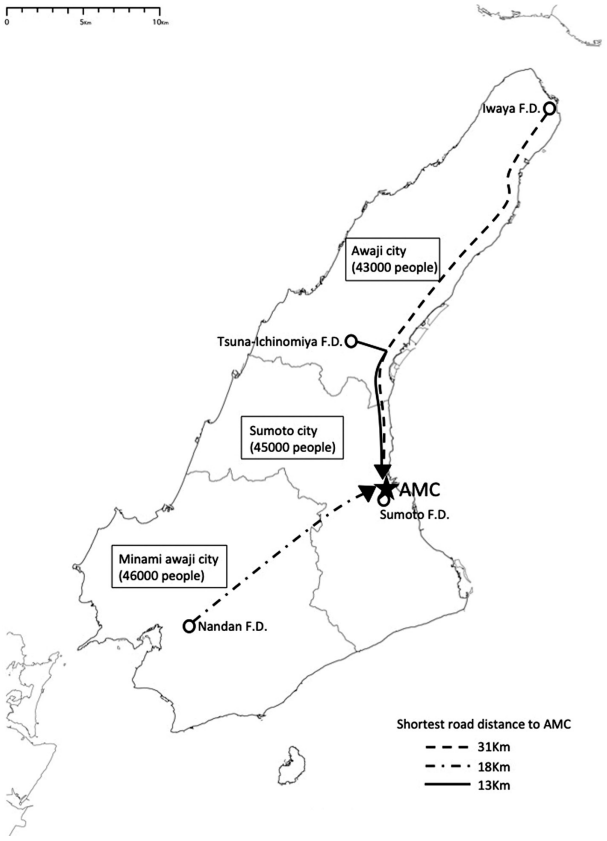

Fig. 1 Locations of Awaji Medical Center (AMC), three cities, and main fire department

Prefecture via the Ōnaruto Bridge. Its north area is adjacent to Kobe City via the Akashi-Kaikyo Bridge. At our hospital, two specialists certified by the Japan Neurosurgical Society (including the main author, the only specialist certified by the Japanese Society for Neuroendovascular Therapy [neuroendovascular specialist] in the Awaji medical area) and one resident, as full-time workers, are responsible for emergency neurosurgical care through a 24-hour system. Emergency patients are transported by ambulance, managed by the Awaji broad area municipal association for firefighting, to the medical institutions located in the control area. Therefore, we retrospectively examined acute-phase treatment for anterior circulation LVO after the introduction of EVT at our hospital in this island area.

Subjects and Methods

The subjects included 62 patients with acute-phase ischemic stroke who were transported to our hospital within 24 hours of last known normal between October 1, 2017 and June 30, 2019; they were admitted due to anterior circulation LVO on imaging. The study period reflects the time when the neuroendovascular specialist was employed full time at our hospital. The neurological severity was evaluated using the National Institutes of Health Stroke Scale (NIHSS). The severity of ischemic stroke on images was evaluated using the Alberta Stroke Program Early CT Score (ASPECTS), and patients with intracranial hemorrhage were excluded. The intra-/extracranial internal carotid artery (ICA) and M1/M2 middle cerebral artery were defined as anterior circulation LVO. For image assessment, computed tomography (CT) or magnetic resonance imaging (MRI) was performed. As a rule, occluded blood vessels were identified using magnetic resonance angiography (MRA). However, when MRA could not be performed because a pacemaker should be inserted, occluded blood vessels were identified using CT angiography. No age limit was established. The selection criteria for EVT included (1) patients within 6 hours of onset (before March 2018) or within 24 hours of onset (after March 2018),[10] (2) those with an NIHSS score of ≥6 and neurological symptoms, and (3) those with infarction involving ≤1/3 of the middle cerebral artery perfusion area and an ASPECTS of ≥5. Regarding the recanalization rate after EVT, MRA or CT angiography was performed to confirm the absence of early reocclusion related to residual atherosclerotic stenosis or dissection after recanalization. Patients with a Thrombolysis in Cerebral Infarction score of ≥2b on postprocedural angiography in whom recanalization was maintained on MRA or CT angiography 12–24 hours after procedure achieved successful recanalization. The outcome was evaluated using the modified Rankin Scale (mRS) 3 months after onset. Patients with a mRS score of 0–2 had a favorable outcome, whereas those with a mRS score of 3–6 had an unfavorable outcome. However, when the pre-stroke mRS score was 3–5, patients with a return to the original mRS score had a favorable outcome. Patients with a hemorrhage-related ≥4-point increase in the NIHSS score experienced symptomatic intracranial hemorrhage as a postoperative complication.

EVT was performed via the transfemoral approach after systemic heparinization under local anesthesia. A 9-Fr introducer sheath was inserted into the femoral artery, and a 9-Fr balloon-tip guiding catheter was inserted into the common or ICA. In patients with intracranial lesions, combined procedure using a stent retriever with aspiration catheter was considered as the first-line procedure. To treat atherosclerotic stenosis at the site of occlusion, percutaneous transluminal angioplasty or stenting was performed if necessary.

For statistical analysis, continuous variables were compared using the Mann–Whitney U or Kruskal–Wallis test.

Table 1 Baseline characteristics and clinical outcomes

	All (N = 62)	EVT group (N = 26)	Non-EVT group (N = 36)	P value
Age: yr.-med.	79	75.5	81	0.0411
Pre-stroke mRS				
≤2	55	22	33	–
>2	7	4	3	–
Vascular risk factor: no./total no. (%)				
HT	42/62 (67.7%)	16/26 (61.5%)	26/36 (72.2%)	NS
HL	20/62 (32.3%)	9/26 (34.6%)	11/36 (30.6%)	NS
DM	13/62 (21%)	4/26 (15.4%)	9/36 (25%)	NS
Af	26/62 (41.9%)	11/26 (42.3%)	15/36 (41.7%)	NS
Smoking	20/62 (32.3%)	10/26 (38.5%)	10/36 (27.8%)	NS
NIHSS score-med.	17	17	16.5	NS
IV-tPA-no./total no. (%)	18/62 (29.0%)	14/26 (53.8%)	4/36 (11.1%)	<0.001
ASPECTS (-DWI)-med.	7	7	6	NS
Site of occlusion: no./total no. (%)				
ICA*	27/62 (43.5%)	10/26 (38.5%)	17/36 (47.2%)	NS
M1	27/62 (43.5%)	13/26 (50%)	14/36 (38.9%)	NS
M2	8/62 (12.9%)	3/26 (11.5%)	5/36 (13.9%)	NS
Time interval-min.-med.				
O2D	106.5	72.5	146	NS
D2P	–	95	–	–
P2R	–	80	–	–
Successful recanalization: no./total no. (%)	–	23/26 (88.5%)	–	–
Favorable outcome at 3 months: no./total no. (%)	17/62 (27.4%)	13/26 (50%)	4/36 (11.1%)	0.0012
Death at 3 months: no./total no. (%)	9/62 (14.5%)	1/26 (3.8%)	8/36 (22.2%)	NS

Af: atrial fibrillation; ASPECTS: Alberta Stroke Program Early Computed Tomography Score; DM: diabetes mellitus; EVT: endovascular treatment; HL: hyperlipidemia; HT: hyper tension; ICA: internal carotid artery; IV tPA: intravenous tissue plasminogen activator; mRS: modified Rankin Scale score; NIHSS: National Institutes of Health Stroke Scale Score
*Including tandem occlusion, D2P: door to puncture time; M1: M1 portion of middle cerebral artery; M2: M2 portion of middle cerebral artery; NS: not significant; O2D: onset to door time; P2R: puncture to recanalization time

Category variables were compared using Fisher's exact test. A P value of 0.05 was considered significant (R3.0, R Foundation for Statistical Computing, http://www.r-project.org).

Results

The median age of the subjects was 79 years. Of the 62 patients, EVT was performed in 26 (41.9%). In 47 (75.8%) of the 62 patients, cardiogenic cerebral embolism was etiologically involved in occlusion. Eleven patients (17.8%) developed ischemic stroke during hospitalization. Of the 51 patients with out-of-hospital onset, 49 (96.1%) were transported to our hospital by ambulance. Our hospital has a heliport for patient transportation, but no patient was transported by helicopter. One patient in the non-EVT group was referred/transported from another hospital. There were no "Drip, Ship and Retrieve" patients. As shown in **Table 1**, background factors were compared between the EVT and non-EVT groups. There were significant differences in the age (median, 75.5 years vs. 81 years, respectively, P = 0.0411), rate of patients who underwent intravenous thrombolysis with alteplase (tissue plasminogen activator [tPA]) (53.5 vs. 11.1%, respectively, P <0.001), and rate of patients with a favorable outcome 3 months after onset (50 vs. 11.1%, respectively, P = 0.0012) between the two groups. The interval from onset until consultation at the outpatient clinic (onset to door time [O2D]) was slightly longer in the non-EVT group than the EVT group, although there was no significant difference between the two groups. The mortality rate 3 months after onset was slightly higher in the non-EVT group than in the EVT group, although there was no significant difference between the two groups. Regarding the cause of death, one patient in the EVT group died of a factor other than ischemic stroke, whereas eight patients in the non-EVT group died of ischemic stroke. In the EVT group, the interval from consultation until puncture (door to puncture time [D2P]) was 95 minutes and that from puncture until recanalization (puncture to recanalization time [P2R]) was 80 minutes. Of the 26 patients, recanalization after EVT was achieved in 23 (88.5%), and the outcome 3 months after onset was favorable in 13 patients (50%). Symptomatic intracranial hemorrhage after EVT was observed in 2 (7.7%) of the 26 patients, one of whom required surgical hematoma removal.

The results were compared among the four groups divided based on the area of onset: three cities comprising

Table 2 Comparison of clinical outcomes by region

	Sumoto (N = 18)	Minami-Awaji (N = 19)	Awaji (N = 14)	Hospital (N = 11)	P value
Age: yr.-med.	76	81	81.5	80	NS
IV-tPA: no./total no.(%)	6/18 (33.3%)	7/19 (36.9%)	3/14 (21.4%)	2/11 (18.1%)	NS
EVT: no./total no.(%)	10/18 (55.6%)	7/19 (36.9%)	5/14 (35.7%)	4/11 (36.3%)	NS
NIHSS score-med.	14.5	16	18	20	NS
ASPECTS(-DWI)-med.	7	7	8	6	NS
Site of occlusion: no./total no.(%)					
ICA*	9/18 (50%)	10/19 (52.6%)	3/14 (21.4%)	5/11 (45.5%)	NS
M1	8/18 (44.4%)	8/19 (42.1%)	7/14 (50%)	4/11 (36.4%)	NS
M2	1/18 (5.6%)	1/19 (5.3%)	4/14 (28.6%)	2/11 (18.1%)	NS
Time interval: min.-med.					
O2D	190.5	111	175.0	–	NS
Favorable outcome at 3 months: no./total no.(%)	7/18 (38.9%)	4/19 (21.1%)	6/14 (42.9%)	0/11 (0%)	0.048
Death at 3 months: no./total no.(%)	1/18 (5.6%)	5/19 (26.3%)	0/14 (0%)	3/11 (27.2%)	NS

ASPECTS: Alberta Stroke Program Early Computed Tomography Score; EVT: endovascular treatment; ICA: internal cerebral artery; IV tPA: intravenous tissue plasminogen activator; NIHSS: National Institutes of Health Stroke Scale Score
*Including tandem occlusion, M1: M1 portion of middle cerebral artery; M2: M2 portion of middle cerebral artery; mRS: modified Rankin Scale score; NS: not significant; O2D: onset to door time

the Awaji Island and an in-hospital onset group. There were no significant differences in the examined items, including the number of patients and rate of patients who underwent EVT. However, there was a significant difference in the rate of patients with a favorable outcome 3 months after onset. The value in the in-hospital onset group was lowest (Sumoto City, 38.9%; Minami Awaji City, 21.1%; Awaji City, 42.9%; and in-hospital onset group, 0%; P = 0.048) (**Table 2**). In patients who were transported to our hospital by ambulance, the median transfer time was 8 minutes in the Sumoto City onset group, 27 minutes in the Minami Awaji City onset group, and 32 minutes in the Awaji City onset group, with no significant difference between these groups.

We compared the results between 13 patients with a favorable outcome and 13 with an unfavorable outcome in the EVT group. There was a significant difference in the pre-treatment NIHSS score between the two groups (median, 15 vs. 19, respectively, P = 0.0237). Regarding the time frame, there were no significant differences in the O2D, D2P, or P2R, but the total time comprising these intervals, that is, the interval from onset until recanalization (onset to recanalization time [O2R]), was significantly shorter in the favorable outcome group than in the unfavorable outcome group (median, 240 vs. 323 minutes, respectively, P = 0.0128) (**Table 3**).

Discussion

One important risk factor for cardiogenic cerebral embolism is atrial fibrillation. Its morbidity rate is higher at a more advanced age.[11] Therefore, acute-phase recanalization therapy, including acute-phase revascularization for LVO, is important in the Awaji medical area, which has a high percentage of elderly persons. In this study, the median age of the subjects was 79 years, being markedly higher than that reported in a meta-analysis of five studies by the Highly Effective Reperfusion evaluated in Multiple Endovascular Stroke (HERMES) Trials collaboration (68 years).[6]

EVT vs. non-EVT

The non-EVT group had a significantly higher median age than the EVT group. However, the rate of patients who underwent intravenous thrombolysis with tPA was significantly lower in the non-EVT group than in the EVT group probably because the 36 patients in the non-EVT group included 7 (19.4%) mild-status patients with a pre-treatment NIHSS score of ≤4, 13 (36.1%) patients with an interval of ≥4.5 hours from onset, and 13 (36.1%) patients who had infarction involving ≥one-third of the middle cerebral artery perfusion area. EVT was not indicated for patients with a pre-treatment NIHSS score of ≤4 or those with infarction involving ≥one-third of the middle cerebral artery perfusion area. The O2D was slightly longer in the non-EVT group than in the EVT group, although there was no significant difference between the two groups. The mortality rate was slightly lower in the EVT group than in the non-EVT group, although there was no significant difference between the two groups.

Comparison among the areas of onset

The Awaji Island comprises Sumoto City, where our hospital is located, Awaji City (north of Sumoto City), and Minami Awaji City (south of Sumoto City). The population is similar among the three cities. When comparing the results

Table 3 Comparison of EVT groups

	Favorable outcome (N = 13)	Unfavorable outcome (N = 13)	P value
Age: yr.-med.	71	78	NS
NIHSS: med.	15	19	0.0237
ASPECTS: med.	8	6	NS
IV-tPA: no./total no. (%)	10/13 (76.9%)	4/13 (30.8%)	NS
Time interval: min.-med.			
O2D	70	80	NS
D2P	90	100	NS
P2R	56	91	NS
O2R	240	323	0.0128
Site of occlusion: no./total no. (%)			
Intracranial ICA	3/13 (23.1%)	2/13 (15.4%)	NS
Extracranial ICA	0	2/13 (15.4%)	NS
Tandem (extracranial ICA and M1 or M2)	2/13 (15.4%)	1/13 (7.7%)	NS
M1	6/13 (46.2%)	7/13 (53.8%)	NS
M2	2/13 (15.4%)	1/13 (7.7%)	NS
Etiology of occlusion: no./total no. (%)			
Cardioembolic	10/13 (76.9%)	9/13 (69.2%)	NS
Large-artery Atherosclerosis	3/13 (23.1%)	4/13 (30.8%)	NS
Complication			
Symptomatic ICH: no./total no. (%)	0	2/13 (15.4%)	NS
Unrecovered ENT: no./total no. (%)	0	2/13 (15.4%)	NS
Successful recanalization: no./total no.(%)	12/13 (92.3%)	11/13 (84.6%)	NS
Procedures: no./total no. (%)			
Stent retriever only	1/13 (7.7%)	1/13 (7.7%)	NS
Combination*	9/13 (69.2%)	9/13 (69.2%)	NS
IC PTA/S	1/13 (7.7%)	0	NS
EC PTA/S	0	2/13 (15.4%)	NS
EC PTA/S and combination	2/13 (15.4%)	1/13 (7.7%)	NS
Number of passes to recanalization for intracranial occlusion: no./total no. (%)			
1	8/13 (61.5%)	3/11 (27.3%)	NS
2	4/13 (30.8%)	4/11 (36.4%)	NS
3≥	1/13 (7.7%)	4/11 (36.4%)	NS

ASPECTS: Alberta Stroke Program Early Computed Tomography Score; ENT: embolization to new territories; EVT: endovascular treatment; ICA: internal carotid artery; ICH: intracracial hemorrhage; IV tPA: intravenous tissue plasminogen activator; M1: M1 portion of middle cerebral artery; M2: M2 portion of middle cerebral artery; NIHSS: National Institutes of Health Stroke Scale Score; NS: not significant; PTA/S: percutaneous transluminal angioplasty or stenting

*Combined using of stent retriever and Penumbra system, D2P: door to puncture time; EC: extracranial; IC: intracranial; NS: not significant; O2D: onset to door time; O2R: onset to recanalization; PTA/S: percutaneous transluminal angioplasty or stenting; P2R: puncture to recanalization time

among the three cities, there were differences in the interval required for emergency transport and O2D, but they were insignificant. The O2D was longest in Sumoto City. We compared the results among the four groups involving the three cities and in-hospital onset. There were no significant differences in the age, rate of patients who underwent intravenous thrombolysis with tPA, rate of patients who underwent EVT, pre-treatment NIHSS score, or ASPECTS (-DWI); there were no area-related differences in the conditions before therapeutic intervention. Therefore, statistically, the distance between the area of onset was not associated with the medical institution where treatment is possible in the Awaji medical area. Regarding the reasons, the outcome of in-hospital onset patients was unfavorable; a poor general condition related to the primary disease for which the patients were admitted may have influenced the outcome. Furthermore, the following factors may have influenced the overall outcome of patients who underwent EVT: the pre-stroke mRS score was ≥3 in 2 (50%) of the four patients who underwent EVT, and EVT did not lead to recanalization in one patient with a pre-stroke mRS score of 0. Additionally, the median interval from detection until diagnostic imaging was 90 minutes in the in-hospital onset group. These patients were managed in departments other than the Department of Neurosurgery, which is responsible for the treatment of this disease in our hospital. In 7 of the 11 patients, ischemic stroke developed during non-working hours. Regarding management during non-working hours,

both internists and surgeons allocated for overtime work on that day stay at our hospital, and one or two neurosurgeons watch and wait on the island; therefore, prompt management for the onset of stroke in inpatients may be provided. However, the in-hospital onset patients with LVO investigated in this study were initially managed in the departments to which they had been admitted at the time of onset, and several patients were referred to our department after CT. This may have prolonged the interval until diagnostic imaging that facilitates a definitive diagnosis (by MRI or CT angiography). This delay may have resulted from insufficient cooperation with physicians/nurses in other departments and radiological technologists. The number of patients who undergo EVT at our hospital is approximately 15 per year. It was similar to that (approximately 13 per year) converted from the national mean in 2018 in the RESCUE Japan Project[9] as a value per 130,000 persons on Awaji Island. However, the number of such patients may increase because the rate of elderly persons is high in the region.

The EVT group

The Japanese guidelines for the appropriate use of mechanical thrombectomy devices for acute stroke contributed by the Japan Stroke Society, Japan Neurosurgical Society, and Japanese Society for Neuroendovascular Therapy[10] state that acute-phase revascularization can be started within 6 hours after onset on the basis of the results of five randomized controlled trials.[1–5] This procedure is strongly recommended for the following patients: (1) those with a pre-stroke mRS score of 0 or 1, (2) those with ICA or M1 occlusion, (3) those with an ASPECTS of ≥6, and (4) those with a NIHSS score of ≥6. At our hospital, the pre-stroke mRS score was not restricted because the rate of elderly persons in this area is high. Regarding the site of occlusion, this procedure was indicated for patients with M2 occlusion.[12] Regarding the extent of infarction, this procedure was indicated for patients with an ASPECTS (-DWI) of ≥5.[13] As a result, the pre-stroke mRS scores ranged from 2 to 5 in 5 (19.2%) of the 26 patients, leading to an unfavorable outcome. M2 occlusion was observed in 3 (11.5%) of the 26 patients, 2 of whom had a favorable outcome. Regarding the enlargement of the extent of infarction for which this procedure is indicated, the number of patients with infarction involving ≤one-third of the middle cerebral artery perfusion area and an ASPECTS (-DWI) of 5 was small (2 [7.7%] of the 26 patients in the EVT group). In one of these two patients, the outcome was favorable. After March 2018, this procedure was also indicated for patients with an interval of >6 hours from onset on the basis of the results of the Clinical Mismatch in the Triage of Wake Up and Late Presenting Strokes Undergoing Neurointervention With Trevo (DAWN)[7] and the Endovascular Therapy Following Imaging Evaluation for Ischemic Stroke[8] trials. In 8 (30.8%) of the 26 patients, the interval from onset exceeded 6 hours, and the median O2D was 527.5 minutes. Additionally, the median pre-treatment NIHSS score was 15, and the median ASPECTS (-DWI) was 7. The rate of patients with a favorable outcome was 37.5% (3/8). In the DAWN trial[7] involving patients with an interval of 6–24 hours from onset, the median O2D in the EVT group was 732 minutes, and the median pre-treatment NIHSS score was 17; the O2D was shorter and the pre-treatment NIHSS score was lower in our study. Although the number of subjects was small, the number of patients with a favorable outcome may not be small in real-world clinical practice. Therefore, data on such patients should be accumulated under the current treatment indications. When comparing the results between patients with a favorable outcome and those with an unfavorable outcome in the EVT group, there were significant differences in the pre-treatment NIHSS score and O2R between the two groups. This finding suggests that the pre-treatment NIHSS score and O2R influence the outcome under the conditions that EVT is indicated only for patients with an ASPECTS (-DWI) of ≥5 and that there is no significant difference in the recanalization rate. However, the ASPECTS (-DWI) was higher in the favorable outcome group than in the unfavorable outcome group, although there was no significant difference between the two groups. Therefore, we cannot rule out the possibility that it influenced the outcome. There were no significant differences in any time frame comprising the O2R (O2D, D2P, and P2R) between the two groups. However, there was a significant difference in the total time frame (O2R) between the two groups, and the importance of shortening each time frame was demonstrated again. Furthermore, in the EVT group, the D2P, as an in-hospital factor for shortening the time, was 95 minutes, and the P2R was 80 minutes. Regarding the D2P, a meta-analysis of five trials by the HERMES collaboration[6] proposed that a D2P of ≤75 minutes should be targeted. The P2R was approximately ≤60 minutes in the five trials.[1–5] The D2P suggested the importance of arranging an in-hospital system, and the P2R suggested the importance of improving procedures. Regarding procedures, the rate of combined procedure using a stent retriever with aspiration catheter was approximately 70% in

the favorable and unfavorable outcome groups. Several studies have reported the advantages of combined procedures,[14–16] but we have performed the procedure, emphasizing that a higher recanalization rate was achieved on the first pass than the procedures with a stent retriever or aspiration catheter alone.[17] In this study, combined procedures comprised the greater portion. However, it is important to standardize a simple technique with a stent retriever to equalize skills; accordingly, the burden for neuroendovascular specialist can be reduced in medical institutions with a small number of physicians. This aspect should be addressed in future studies. Furthermore, procedure-related complications were observed in the unfavorable outcome group, and the recanalization rate of the first pass was low, although there were no significant differences between the favorable and unfavorable outcome groups. These factors may have influenced the results.

Conclusion

We reported the current treatment of anterior circulation LVO at our hospital as a core hospital in the Awaji medical area after the neuroendovascular specialist was employed full time. In this area with a high rate of elderly persons, the number of patients may increase in the future. Therefore, it is necessary to potentiate a cooperative relationship among medical institutions, arrange an in-hospital system, educate the regional residents, and accumulate procedural experience as a medical institution. Even in an island area, it is possible to complete the treatment within the regional medical area. This may increase the number of patients undergoing EVT, improving their outcome.

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Disclosure Statement

We declare no conflicts of interest.

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