Rescue Stenting for Failed Mechanical Thrombectomy in Acute Ischemic Stroke

A Multicenter Experience

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Background and Purpose—Effective rescue treatment has not yet been suggested in patients with mechanical thrombectomy (MT) failure. This study aimed to test whether rescue stenting (RS) improved clinical outcomes in MT-failed patients.

Methods—This is a retrospective analysis of the cohorts of the 16 comprehensive stroke centers between September 2010 and December 2015. We identified the patients who underwent MT but failed to recanalize intracranial internal carotid artery or middle cerebral artery M1 occlusion. Patients were dichotomized into 2 groups: patients with RS and without RS after MT failure. Clinical and laboratory findings and outcomes were compared between the 2 groups. It was tested whether RS is associated with functional outcome.

Results—MT failed in 148 (25.0%) of the 591 patients with internal carotid artery or middle cerebral artery M1 occlusion. Of these 148 patients, 48 received RS (RS group) and 100 were left without further treatment (no stenting group). Recanalization was successful in 64.6% (31 of 48 patients) of RS group. Compared with no stenting group, RS group showed a significantly higher rate of good outcome (modified Rankin Scale score, 0–2; 39.6% versus 22.0%; P=0.031) without increasing symptomatic intracranial hemorrhage (16.7% versus 20.0%; P=0.823) or mortality (12.5% versus 19.0%; P=0.360). Of the RS group, patients who had recanalization success had 54.8% of good outcome, which is comparable to that (55.4%) of recanalization success group with MT. RS remained independently associated with good outcome after adjustment of other factors (odds ratio, 3.393; 95% confidence interval, 1.192–9.655; P=0.022). Follow-up vascular imaging was available in the 23 (74.2%) of 31 patients with recanalization success with RS. The stent was patent in 20 (87.0%) of the 23 patients. Glycoprotein IIb/IIIa inhibitor was significantly associated with stent patency but not with symptomatic intracranial hemorrhage.

Conclusions—RS was independently associated with good outcomes without increasing symptomatic intracranial hemorrhage or mortality. RS seemed considered in MT-failed internal carotid artery or middle cerebral artery M1 occlusion. **(*Stroke*. 2018;49:958-964. DOI: 10.1161/STROKEAHA.117.020072.)**

Key Words: middle cerebral artery ■ stents ■ stroke ■ thrombectomy

Received November 9, 2017; final revision received January 24, 2018; accepted February 15, 2018.

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After the success of 5 randomized clinical trials, most guidelines recommend mechanical thrombectomy (MT) for acute stroke because of anterior circulation large vessel occlusion (LVO).[1–7] Nevertheless, in a meta-analysis of the 5 pivotal randomized controlled trials of MT, the rate of recanalization failure was up to 29%.[8] Because recanalization success is one of the most powerful factors for good outcome after acute stroke,[1–9] many studies have been focused on improving MT efficacy.[10,11] Yet, few studies have addressed on the rescue treatment strategies for recanalization failure with the currently available MT tools. Permanent placement of a self-expanding stent has been suggested as a primary or rescue modality for intracranial LVO.[12–17] After MT failed in patients with acute stroke because of anterior circulation LVO, however, there has only been one small single-center case series comparing rescue permanent stenting (RS) and nonstenting groups without further treatment.[18]

We hypothesized that patients with RS (RS group [RSG]) would have better outcomes than those without RS who were left nonrecanalized (no stenting group [NSG]) after MT failed. To test the hypothesis, we compared functional outcome at 3 months, symptomatic intracranial hemorrhage (sICH), and mortality between RSG and NSG in a cohort of patients in whom MT had failed to recanalize intracranial internal carotid artery (ICA) or middle cerebral artery (MCA) M1 occlusion.

Materials and Methods

The data that support the findings of this study are available from the corresponding author on reasonable request.

Patient Enrollment

We identified all patients who underwent MT using a stent retriever (Solitaire AB/FR, Covidien/ev3, Irvine, CA; Trevo Proview, Stryker, CA), Penumbra system (Penumbra, Alameda, CA), or both for acute ischemic stroke because of LVO between September 2010 and December 2015 and had the 3-month modified Rankin Scale score (mRS) available. This study was initiated by the Korea Health Technology R&D Project, and the study population was recruited from the cohorts prospectively registered in 16 participating comprehensive stroke centers. Tandem cervical ICA and intracranial large artery occlusions were included. Cervical ICA dissection was included, but intracranial artery dissection was excluded. Bilateral large artery occlusions was also excluded. Enrollment criteria were as follows: (1) age ≥18 years old, (2) initial National Institutes of Health Stroke Scale score (NIHSS) ≥4, (3) onset-to-puncture time ≤600 minutes, (4) mRS of 0 or 1 before qualifying stroke, (5) collateral grading on computed tomographic angiogram (CTA) assessable, (6) recanalization success or failure assessable, and (7) intracranial ICA or MCA-M1 occlusion documented during the endovascular therapy. The institutional review boards of all participating hospitals approved this study and waived the requirement for informed consent for study inclusion based on the retrospective study design.

Data Collection and Assessment

All data including clinical and laboratory findings were obtained from the each participating hospital and then filled-up in the predefined case report form. The procedural details, including complications during endovascular therapy, were obtained from the neurointerventional database of each participating center and were also added to the case report form. The case report forms were anonymized and then sent to the central core laboratory. All imaging data, including pretreatment nonenhanced computed tomography (CT) and CTA, catheter angiograms during the endovascular therapy, and follow-up CT or magnetic resonance (MR) imaging, were anonymized and sent to the central core laboratory as digital imaging and communication in medicine files. Two neuroradiologists independently assessed the images to determine Alberta Stroke Program Early CT Score and collateral status on CTA using a commercialized digital imaging and communication in medicine viewer (OsiriX, Pixmeo, Geneva, Switzerland). The Alberta Stroke Program Early CT Score was evaluated on 5-mm thickness nonenhanced CT images, and the CTA collateral grade was assessed on 20-mm thickness maximum intensity projection images of single-phase CTA. The CTA collateral grade was dichotomized into either good or poor collateral. Poor collateral was defined when there were few or no vessel markings in more than one half of the MCA territory of the affected side. Recanalization success was defined as a modified Tissue Thrombolysis in Cerebral Ischemia grade of 2b or 3 on the final control angiogram. Modified Tissue Thrombolysis in Cerebral Ischemia grades were assessed independently by 2 interventional neurointerventionalists in the core laboratory using the same software. Those reviewers were blind to Alberta Stroke Program Early CT Score, collateral status, and clinical outcome. The κ value of the dichotomized modified Tissue Thrombolysis in Cerebral Ischemia grades (0–2a and 2b–3) was 0.813. Discrepant cases were resolved by consensus between raters who were still blind to both the patient's clinical outcome and the findings on follow-up CT or MR.

Endovascular Treatment

MT was performed under local anesthesia or conscious sedation in all participating centers. Because this study was a retrospective analysis of the data collected from the each participating stroke center, use of a balloon guide catheter and choosing the type of MT device as the first tool were at the operator's discretion in each center. After MT failed, RS was performed at the discretion of the operator. The indications for RS were retrospectively surveyed among the centers where RS was done. In addition, it was surveyed among the 16 participating centers how many LVO might be attributable to intracranial atherosclerotic stenosis (ICAS). It depended on the each participating hospital's protocol whether glycoprotein IIb/IIIa inhibitor was administered, whether balloon angioplasty was performed, and which type of stent was used for RS.

Clinical and Imaging Follow-Up

All patients were examined via MR imaging or CT within 3 days after endovascular treatment depending on each participating center's follow-up protocol. Although the MR imaging sequences were different depending on each center's protocol, T2*, Flair, and diffusion-weighted imaging were included in common. When the patient's neurological status abruptly deteriorated, a CT scan was immediately obtained. Intracranial hemorrhage was evaluated on CT or T2* MR images. Intracranial hemorrhage was regarded as symptomatic (sICH) if the patient's NIHSS score increased to ≥4 and there were no other evident causes for the increased NIHSS score. The clinical follow-up schedule followed each center's protocol.

Outcome Measurement

The rate of recanalization success was evaluated in the RSG. Then, we compared RSG with NSG patients in clinical and laboratory findings, the use of an intravenous tissue-type plasminogen activator, MT method, the rate of good outcome, and incidence of sICH and mortality. Good outcome was defined as a mRS of 0 to 2 at 3 months. Finally, we evaluated whether RS remained independently associated with good outcome after adjustment of other factors potentially associated with functional outcome.

Statistical Analysis

All statistical analyses were performed with IBM SPSS Statistics version 23 (IBM Corp, Armonk, NY). All categorical variables are presented as number and frequency (%), and continuous variables

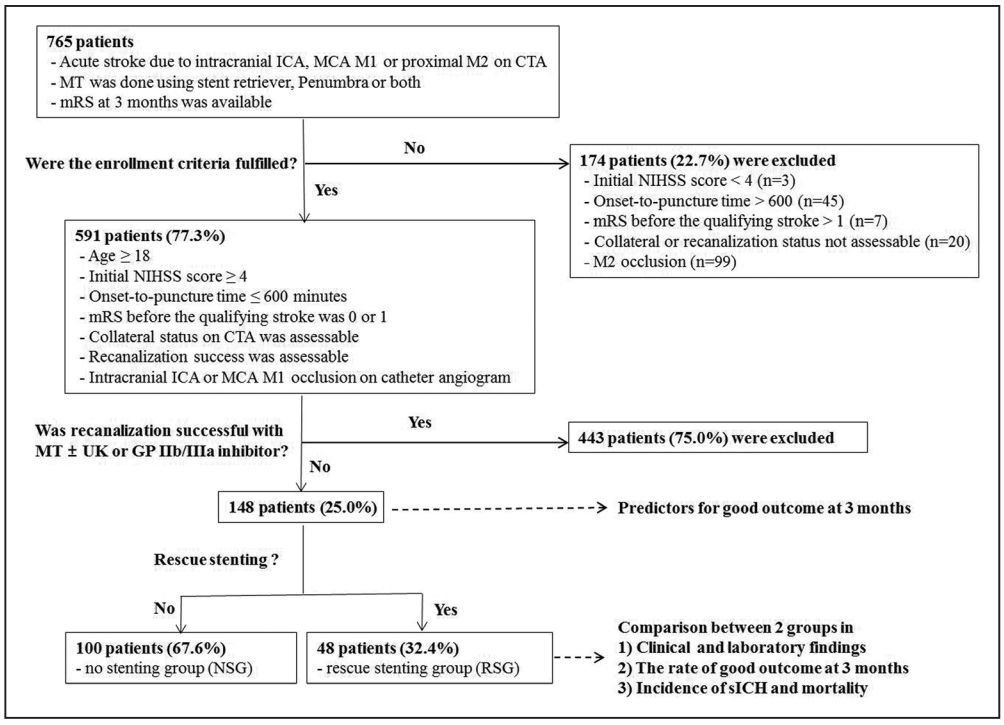

Figure 1. Flow chart of patient inclusion steps and findings analyzed at each step. CTA indicates computed tomographic angiogram; EVT, endovascular therapy; GP, glycoprotein; IA, intra-arterial; ICA, internal carotid artery; ICH, intracranial hemorrhage; MCA, middle cerebral artery; mRS, modified Rankin Scale; MT, mechanical thrombectomy; NIHSS, National Institutes of Health Stroke Scale; NSG, no stenting group; RSG, rescue stenting group; sICH, symptomatic intracranial hemorrhage; and UK, urokinase.

are presented as the mean±SD or the median±interquartile range. In the univariate analysis to find the factors associated with good outcome in the patients with MT failure, and to compare RSG with NSG patients, clinical and laboratory findings, the use of intravenous tissue-type plasminogen activator, MT tool, incidence of sICH, and functional outcome (mRS) were evaluated using the χ^2 test, Fisher exact test, student t test, and Mann–Whitney U test as appropriate. Finally, to find independent factors associated with good outcome in

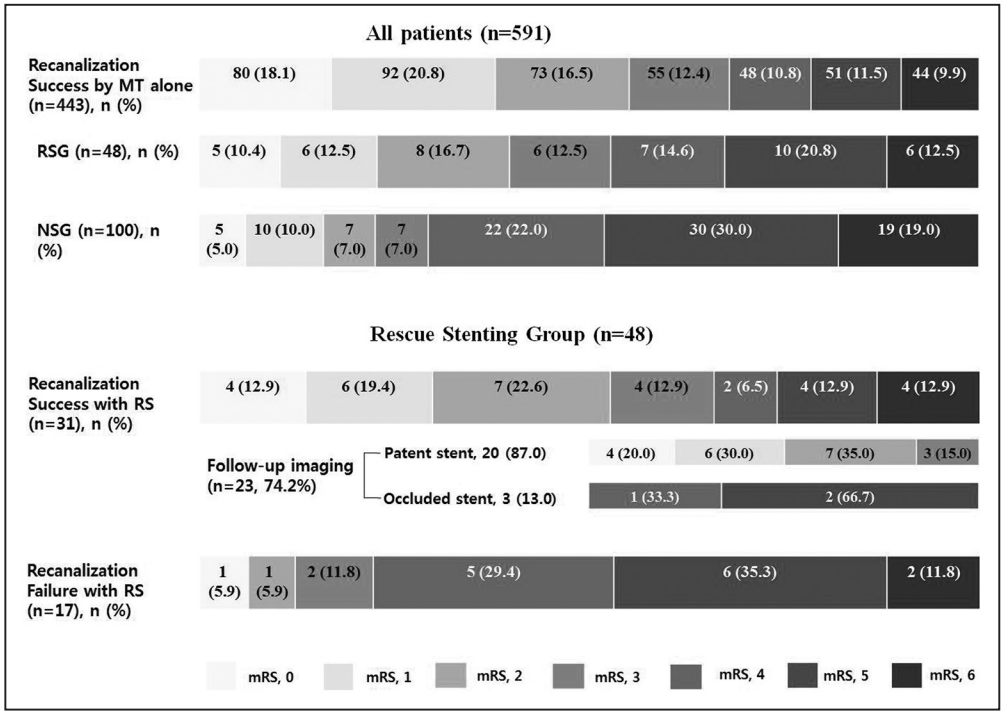

Figure 2. Distributions of the 3-month modified Rankin Scale score (mRS) of patients with recanalization success by mechanical thrombectomy alone and patients with rescue stenting and without rescue stenting after mechanical. MT indicates mechanical thrombectomy; NSG, no stenting group; recanalization success, modified Tissue Thrombolysis in Cerebral Ischemia, 2b–3; RS, rescue stenting; and RSG, rescue stenting group.

the patients with MT failure, multivariate binary logistic regression analysis was performed. We included variables with a potential association in the univariate analysis ($P<0.20$) in the multivariate binary logistic regression analysis. We assessed the model's goodness of fit with the Hosmer and Lemeshow test.

A $P<0.05$ is considered significant with a 95% confidence interval.

Results

Five hundred ninety-one patients fulfilled enrollment criteria (Figure 1). Recanalization was successful in 443 patients (75.0%). Good outcome rate of recanalization success with MT was 55.4% (Figure 2). Of the 443 patients with recanalization success, the final method for achieving recanalization was stent retriever in 74.5% (n=330), Penumbra system in 19.4% (n=86), stent retriever plus Penumbra system in 3.4% (n=15), glycoprotein IIb/IIIa inhibitor in 1.9% (n=8), balloon angioplasty in 0.5% (n=2), and urokinase in 0.5% (n=2). Finally, MT failed in 148 patients (25.0%; mean age, 66.6±13.7 years; male:female=73:75). The mean number of MT attempt was significantly smaller in recanalization success (n=443; 2.4±1.7) than in recanalization failure (n=148; 3.6±2.1; $P<0.01$). Of the patients with recanalization failure with MT, 48 received RS while 100 were left without RS (Figure 1). In the survey of the 9 centers where RS was done, the indications for RS were (1) ICAS was highly suspected as a cause of LVO;

Table 1. Comparisons of the Clinical, Laboratory, and Procedural Factors and Outcomes Between the Rescue Stenting and Nonstenting Groups

	Total (n=148)	Nonstenting (n=100)	Rescue Stent (n=48)	*P* Value
Age, y	66.6±13.7	68.0±12.1	63.7±16.8	0.110
Male sex	73 (49.8%)	51 (51.0%)	22 (45.8%)	0.601
Hypertension	93 (62.8%)	67 (67.0%)	26 (54.2%)	0.148
Diabetes mellitus	44 (29.7%)	27 (27.0%)	17 (35.4%)	0.339
Dyslipidemia	13 (8.8%)	11 (11.0%)	2 (4.2%)	0.224
Smoker	49 (33.1%)	30 (30.0%)	16 (33.3%)	0.707
CAD	24 (16.2%)	16 (16.0%)	8 (16.7%)	0.999
Atrial fibrillation	70 (47.3%)	53 (53.0%)	17 (35.4%)	0.054
Previous ischemic stroke	23 (15.5%)	17 (17.0%)	6 (12.5%)	0.629
Good collateral	114 (77%)	75 (75.0%)	39 (81.3%)	0.532
Initial NIHSS, median±IQR		15±6	14±8	0.819
ASPECTS, median±IQR	8±2.0	8±2	8±1.75	0.337
Distal ICA occlusion	54 (36.5%)	35 (35.0%)	19 (39.6%)	0.590
Reocclusion	56 (37.8%)	28 (28.0%)	28 (58.3%)*	0.001
Use of IV tPA	68 (49.5%)	46 (46.0%)	22 (45.8%)	0.999
Onset-to-puncture time		250.5±110.8	232.7±118.6	0.414
BGC	60 (40.5%)	60 (60.0%)	22 (45.8%)	0.377
MT tool used				0.01
Stentriever		62 (62.0%)	36 (75.0%)	
Penumbra		26 (26.0%)	3 (6.3%)	
Both		12 (12.0%)	9 (18.8%)	
No. of MT attempt, mean±SD	3.6±2.1	3.7±2.1	3.4±1.6	0.182
IA GP	48 (32.4%)	14 (14.0%)	34 (70.8%)	<0.001
IA UK	23 (15.5%)	16 (16.0%)	7 (14.6%)	0.999
mTICI 2b–3		0	31 (64.6%)	<0.001
Balloon angioplasty	19 (12.8%)	4 (4.0%)	15 (31.3%)	<0.001
Symptomatic ICH	28 (18.9%)	20 (20.0%)	8 (16.7%)	0.823
mRS 0–2	41 (27.7%)	22 (22.0%)	19 (39.6%)	0.031
Mortality	25 (16.9%)	19 (19.0%)	6 (12.5%)	0.36

ASPECTS indicates Alberta Stroke Program Early CT Score; BGC, balloon guide catheter; CAD, coronary artery disease; GPI, glycoprotein IIb/IIIa inhibitor; IA, intra-arterial; ICA, internal carotid artery; ICH, intracranial hemorrhage; IQR, interquartile range; IV, intravenous; mRS, modified Rankin Scale score; MT, mechanical thrombectomy; mTICI, modified Tissue Thrombolysis in Cerebral Ischemia; NIHSS, National Institutes of Health Stroke Scale; RS, rescue stenting; tPA, tissue-type plasminogen activator; and UK, urokinase.

*Reocclusion rate before RS.

(2) repeat reocclusion shortly after recanalization with MT; (3) clinical-infarct core mismatch (NIHSS ≧8 and Alberta Stroke Program Early CT Score 9 or 10); (4) good antegrade flow (modified Tissue Thrombolysis in Cerebral Ischemia 2b or 3) with stent retriever placement was persistent at least 10 minutes, but instant occlusion occurred after retrieval of stent; or (5) aggravating flow compromise because of residual stenosis after MT. In the survey among the all 16 participating centers, ICAS was suspected as a cause of large artery occlusions in 110 (18.7%) of the study population.

There were no differences in clinical and laboratory findings except for reocclusion rate (58.3% before RS in RSG versus 28% in NSG), the use of a glycoprotein IIb/IIIa inhibitor (70.8% in RSG versus 14.0% in NSG), and balloon angioplasty (31.3% in RSG versus 4.0% in NSG). The types of stents for RS were Solitaire AB/FR in 37 (77.1%), Wingspan in 8 (16.7%), Enterprise in 2 (4.2%), and a balloon-expandable stent in 1 (2.1%). Recanalization was successful in 31 patients (64.5%) of the RSG group. There was no RS procedure-related complication during the procedure. There was no difference in recanalization rate among stent type: 67.6% (25 of 37) with Solitaire AB/FR, 50% (4 of 8) with Wingspan, 50% with Enterprise (1 of 2), and 100% (1 of 1) with coronary stent (P=0.654). There were no differences between RS with and without balloon angioplasty in recanalization rate (81.3% versus 53.1%; P=0.068) and 3-month good outcome rate (40.0% versus 39.4%; P=0.99). The mean of puncture-to-recanalization time was significantly longer in patients with recanalization success with RS (n=31; 113±53 minutes) than in those with recanalization success with MT (n=443; 62±39 minutes; P<0.001). The RSG had a significantly higher rate of good outcome (mRS, 0–2 at 3 months; 39.6% in RSG versus 22.0% in NSG; P=0.031) with no difference in sICH (16.7% in RSG versus 20.0% in NSG; P=0.823) or mortality (12.5% in SG versus 19.0% in NSG; P=0.36; Table 1) Of the patients who had recanalization success with RS, 54.8% (17 of 31) had

Table 2. Clinical, Laboratory, and Procedural Factors for Good Outcome (Modified Rankin Scale, 0–2) in Univariate and Multivariate Analyses

	Poor	Good	*P* Value, Univariate	*P* Value, Multivariate	OR (95% CI)
Age, y	69.4±11.7	59.3±15.9	0.001	0.377	
Male sex	48 (44.9%)	25 (61.0%)	0.099	0.221	
Hypertension	77 (72.0%)	16 (39.0%)	<0.001	0.172	
DM	38 (35.5%)	6 (14.6%)	0.097	0.981	
Dyslipidemia	12 (11.2%)	1 (2.4%)	0.113	0.364	
Smoker	31 (29%)	15 (36.6%)	0.429		
CAD	15 (14%)	9 (22.0%)	0.318		
Atrial fibrillation	56 (52.3%)	14 (34.1%)	0.065	0.805	
Previous stroke	21 (19.6%)	2 (4.9%)	0.04	0.324	
Good collateral	74 (69.2%)	40 (97.6%)	<0.001	0.020	13.893 (1.515–127.391)
Initial NIHSS, median±IQR	15±7.0	12±6.5	<0.001	0.008	0.864 (0.775–0.963)
ASPECTS, median±IQR	8±2.0	8±1.25	0.616		
Distal ICA occlusion	45 (42.1%)	9 (22.0%)	0.024	0.349	
Reocclusion	41 (38.3%)	15 (36.6%)	0.999		
IV tPA	52 (48.6%)	16 (39.0%)	0.358		
OPT, mean±SD, min	240.8	254.1	0.565		
BGC	42 (39.3%)	18 (43.9%)	0.709		
MT tool			0.199		
Stentriever	71 (66.4%)	27 (65.9%)		Reference	
Penumbra	18 (16.8%)	11 (26.8%)		0.785	
Both	18 (16.8%)	3 (7.3%)		0.845	
Balloon angioplasty	12 (11.2%)	7 (17.1%)	0.411		
Rescue stenting	29 (27.1%)	19 (46.3%)	0.031	0.022	3.393 (1.192–9.655)
IA GPI	28 (26.2%)	13 (31.7%)	0.541		
IA UK	17 (15.9%)	6 (14.6%)	0.999		

ASPECTS indicates Alberta Stroke Program Early CT Score; BGC, balloon guiding catheter; CAD, coronary artery disease; CI, confidence interval; DM, diabetes mellitus; GPI, glycoprotein IIb/IIIa inhibitor; IA, intra-arterial; ICA, internal carotid artery; IQR, interquartile range; IV, intravenous; MT, mechanical thrombectomy; NIHSS, National Institutes of Health Stroke Scale; OPT, onset-to-puncture time; OR, odds ratio; sICH, symptomatic intracranial hemorrhage; tPA, tissue-type plasminogen activator; and UK, urokinase.

good outcome, which is comparable to that (55.4%) of recanalization success group with MT. Furthermore, of the patients who had recanalization success with RS, the distribution of mRS at 3 months was similar to that of patients with recanalization success with MT. In contrast, of the patients who had recanalization failure even if RS was done, only 11.8% (2 of 17) had good outcome (Figure 2). In multivariate binary logistic regression analysis, RS (odds ratio, 3.393; 95% confidence interval, 1.192–9.655; *P*=0.022) remained independently associated with good outcome, along with the initial National Institutes of Health Stroke Scale (odds ratio, 0.864; 95% confidence interval, 0.775–0.963; *P*=0.008) and good collateral on CTA (odds ratio, 13.893; 95% confidence interval, 1.515–127.393; *P*=0.02; Table 2). Follow-up vascular imaging was available in the 23 (74.2%) of 31 patients with recanalization success with RS. The stent was patent in 20 (87.0%) of the 23 patients. The patients with patent stent had 87% of good outcome, whereas none of the 3 patients with stent occlusion had good outcome (*P*=0.011; Figure 2).

The antiplatelet strategy were determined by consensus between the operator and the responsible stroke neurologist based on the patients' clinical status and each center's protocol. Those were classified as follows: (1) glycoprotein IIb/IIIa inhibitor just before or after RS (loading of Tirofiban, 0.3–1.0 mg or Reopro 5–10 mg, followed by intravenous maintenance dose of the same drug for a 6–12 hours and then changed to dual antiplatelet medication), (2) oral dual antiplatelet medication just before or after RS (aspirin, 100–500 mg and plavix, 300 mg), (3) oral antiplatelet monotherapy just after RS (Plavix, 75–300 mg), and (4) no antiaggregation therapy was done until follow-up nonenhanced CT or MR was obtained next day.

Stent patency was associated with the use of glycoprotein IIb/IIIa inhibitor during or after the procedure but not with antiplatelet medication (aspirin, clopidogrel, or both) during the periprocedural period. Neither glycoprotein IIb/IIIa inhibitor nor antiplatelet medication increased the rate of sICH (Table 3).

Discussion

The major findings of this study are as follows: (1) RS resulted in successful recanalization in 64.6% of patients with recanalization failure with MT, and RSG had a significantly higher rate of good outcome without increasing sICH and mortality compared with NSG, (2) RS remained independently associated with good outcome after adjustment, and (3) the patients who had recanalization success with RS showed good outcome rate comparable to that of successful MT group. In contrast, of the patients who had recanalization failure even if RS was done, only 11.8% (2/17) had good outcome (Figure 2). Those findings highlight once again that recanalization success is one of the most important factors regardless of recanalization tools.

In the meta-analysis of 5 randomized trials (the HERMES investigation), recanalization failed in ≈29% of the patients who underwent MT.[8] There are several causes that underlies MT failure. One of the major causes is ICAS in situ thromboocclusion especially in Asian populations.[16,17] In ICAS LVO, even after successful recanalization was achieved with MT, repeat reocclusion occurred up to 77%, resulting in MT failure.[16] In this study, repeat reocclusion was significantly higher in the RSG than in the NSG. For MT-failed LVO especially because of repeat reocclusions, glycoprotein IIb/IIIa antagonist, balloon angioplasty, RS, or any combination of those have been suggested.[11] Placement of a self-expanding stent has been suggested as one of the effective endovascular tools before the MT era.[12–15] The results of this study suggest that RS can be revisited as a rescue option in cases with MT failure because of ICAS LVO.[11,16,18] Taking it into consideration that ≈1 of 5 LVO might be attributable to ICAS in the survey among all participating centers, the results are of important clinical implications.

RS may require glycoprotein IIb/IIIa antagonist or oral antiplatelet medication to prevent in-stent thrombosis. There has been a major concern that glycoprotein IIb/IIIa antagonist administration or oral antiplatelet medication in acute stroke setting may potentially increase sICH. However, the use of a glycoprotein IIb/IIIa inhibitor did not increase sICH rate but did the likelihood of stent patency significantly. Although not significant, in fact, the rate of sICH was lower in patients with glycoprotein IIb/IIIa inhibitor than those without. In addition, post-RS oral antiplatelet medication was also not associated with increasing sICH rate. Those results corresponded with the previous studies, indicating that glycoprotein IIb/IIIa

Table 3. Relationships of Glycoprotein IIb/IIIa Inhibitor or Antiplatelet Medication Use to Stent Patency and Symptomatic Intracranial Hemorrhage in Rescue Stenting Group

	Stent Patency at Follow-Up (n=23)				Symptomatic ICH in RSG (n=48)		
	Patent (n=20)	Occlusion (n=3)	*P* Value		Yes (n=8)	No (n=40)	*P* Value
GPI, n (%)			0.03	GPI, n (%)			0.18
Yes (n=20)	19 (95.0)	1 (5.0)		Yes (n=34)	3 (16.7)	31 (83.3)	
No (n=3)	1 (33.3)	2 (66.7)		No (n=14)	5 (35.7)	9 (64.3)	
Anti-plt, n (%)			0.99	Anti-plt, n (%)			0.99
Yes (n=22)	19 (86.4)	3 (13.6)		Yes (n=40)	7 (17.5)	33 (82.5)	
No (n=1)	1 (100)	0		No (n=8)	1 (12.5)	7 (87.5)	

Anti-plt indicates oral antiplatelet drug medication after the procedure, administration of aspirin, clopidogrel, or both; GPI, glycoprotein IIb/IIIa inhibitor administration during or after the procedure; ICH, intracranial hemorrhage; and RSG, rescue stenting group.

inhibitor use with or without stenting in an acute stage may be safe.[18–21]

This study has several limitations inherent to its retrospective nature. The results of this study should be interpreted with caution because selection bias might have an influence on the results. However, the study population was recruited from the prospectively maintained registries of participating centers and showed balanced distribution of clinical variables, including stroke risk factors between the 2 groups. Therefore, selection bias less likely affected the major findings of the analysis. A prospective clinical trial is essential for confirming the results of this analysis. Nevertheless, the results of this study are important for contributing to baseline data for designing prospective studies and may be helpful in solving intracranial ICA or MCA-M1 occlusion refractory to MT.

In conclusion, RS was independently associated with good outcomes without increasing sICH or mortality in the study population. RS can be considered in MT-failed ICA or MCA-M1 occlusion despite of repetitive MT. Further studies are needed to define the optimal time of RS and the use of adjuvant antithrombotics in patients with failed MT.

Sources of Funding

This research was investigator initiated and supported by a grant of the Korea Health Technology R&D Project through the Korea Health Industry Development Institute, funded by the Ministry of Health & Welfare, Republic of Korea (HC15C1056).

Disclosures

None.

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