Merci mechanical thrombectomy retriever for acute ischemic stroke therapy

Literature review

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ABSTRACT

Background: Mechanical thrombectomy is a promising adjuvant or stand-alone therapy for acute ischemic stroke (AIS) caused by occlusion of a large vessel in patients beyond the systemic thrombolysis therapeutic window. This review focuses on the clinical and angiographic outcomes of mechanical thrombectomy with use of the Merci retriever device.

Methods: Available literature published to date on the major trials and observational studies involving the Merci retriever was reviewed. In addition to the review, results from studies involving the Merci retriever were compared to results from Prolyse in Acute Cerebral Thromboembolism II (PROACT II) and the Penumbra device studies. The predictors for favorable outcome following revascularization with the Merci device were reviewed on the basis of published stratified analyses. Favorable clinical outcome was defined in the Merci experience by a modified Rankin Scale (mRS) score of ≤2 at 90 days following AIS.

Results: Presented in this review are a total of 1,226 patients treated with the Merci device; 305 patients are from 2 pivotal trials involving the device, and the remaining 921 patients are from observational studies in the Merci registry. The 90-day mRS of ≤2 was achieved in 32% of the patient group, with an overall mortality rate of 35.2%. Symptomatic intracerebral hemorrhage was identified in 7.3% of patients treated with Merci retriever, a result comparable to that in the PROACT II and Penumbra thrombectomy trials. Successful recanalization, lower NIH Stroke Scale score, and younger age were identified as the strongest predictors of favorable outcomes.

Conclusion: Mechanical thrombectomy with the Merci retriever device is a safe treatment modality for AIS patients presenting with a large-vessel occlusion within 8 hours of symptom onset. Although the Merci retriever showed a good recanalization rate, there are currently no randomized clinical trials to assess its clinical efficacy in comparison with systemic thrombolysis within a window of 3 to 4.5 hours or with standard of care beyond a 4.5-hour window. ***Neurology*® 2012;79 (Suppl 1):S126–S134**

GLOSSARY

AIS = acute ischemic stroke; **CI** = confidence interval; **IA-tPA** = intra-arterial tissue plasminogen activator; **ICH** = intracerebral hemorrhage; **IV-tPA** = IV tissue plasminogen activator; **MERCI** = Mechanical Embolus Removal in Cerebral Ischemia; **mRS** = modified Rankin Scale; **NIHSS** = NIH Stroke Scale; **OR** = odds ratio; **PROACT** = Prolyse in Acute Cerebral Thromboembolism; **TICI** = thrombolysis in cerebral infarction; **TIMI** = thrombolysis in myocardial infarction.

IV tissue plasminogen activator (IV-tPA), despite its use since 1996 and being the only therapy approved by the US Food and Drug Administration for acute ischemic stroke (AIS), is used to treat less than 3% of patients with AIS in the United States.[1,2] The narrow therapeutic window for systemic thrombolysis is the leading cause for treatment exclusion.[2,3] Mechanical thrombectomy emerged as an adjuvant or stand-alone modality for AIS, and it offers some advantages over systemic thrombolysis. First, it is possible to expand the treatment window beyond the 4.5 hours given for systemic thrombolysis. Indeed, mechanical therapies were safely administered to patients within an 8-hour window in the clinical trials.[4–6] Second, clot retrieval may provide rapid revascularization and may be more efficient with materials resistant to enzymatic degra-

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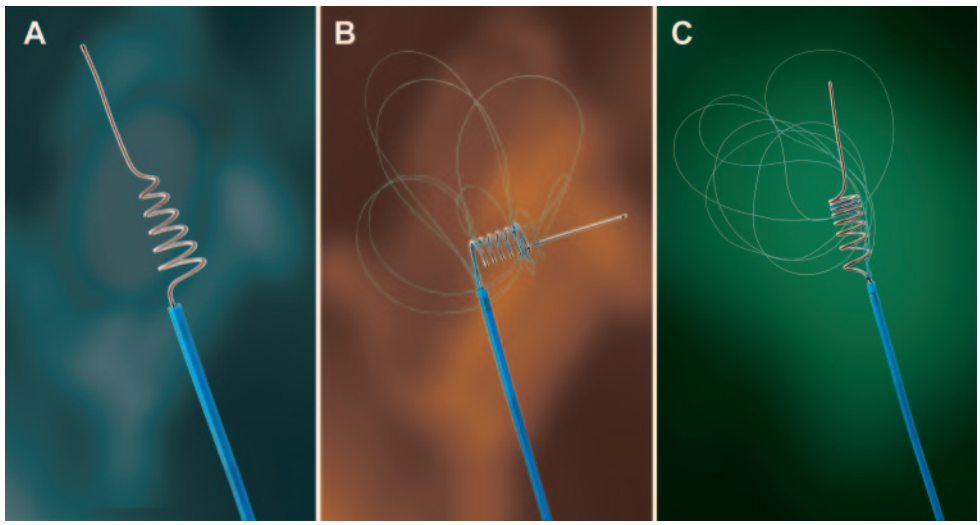
dation such as mature fibrin cross-linked thrombi and thrombi containing other debris such as calcium or cholesterol crystals.[7]

However, the mechanical approach suffers from many technical issues, including the difficulty navigating devices into the cranial circulation and the excessive trauma to the vessels that can lead to dissection, vasospasm, or intracerebral and subarachnoid hemorrhages. Additionally, thrombus fragmentation may lead to distal embolization and subsequent ischemia in smaller and initially spared cerebral vessels. Nonetheless, mechanical approaches with little or no thrombolytic agent have emerged as a viable option for patients who have a contraindication to systemic thrombolysis, are resistant to it, or are outside the treatment time window.[8,9]

There are several options for endovascular mechanical thrombectomy; however, at the time of this review only the Merci retriever system (Concentric Medical, Mountain View, CA) and the Penumbra system (Penumbra Inc., Alameda, CA) have been approved for use in the United States. These devices have yet to be experimentally and directly compared. However, they are both used clinically and seem similarly safe and effective. In this review, we briefly describe the technical and design aspects of the Merci retriever system as well as selected outcome clinical studies using this system.

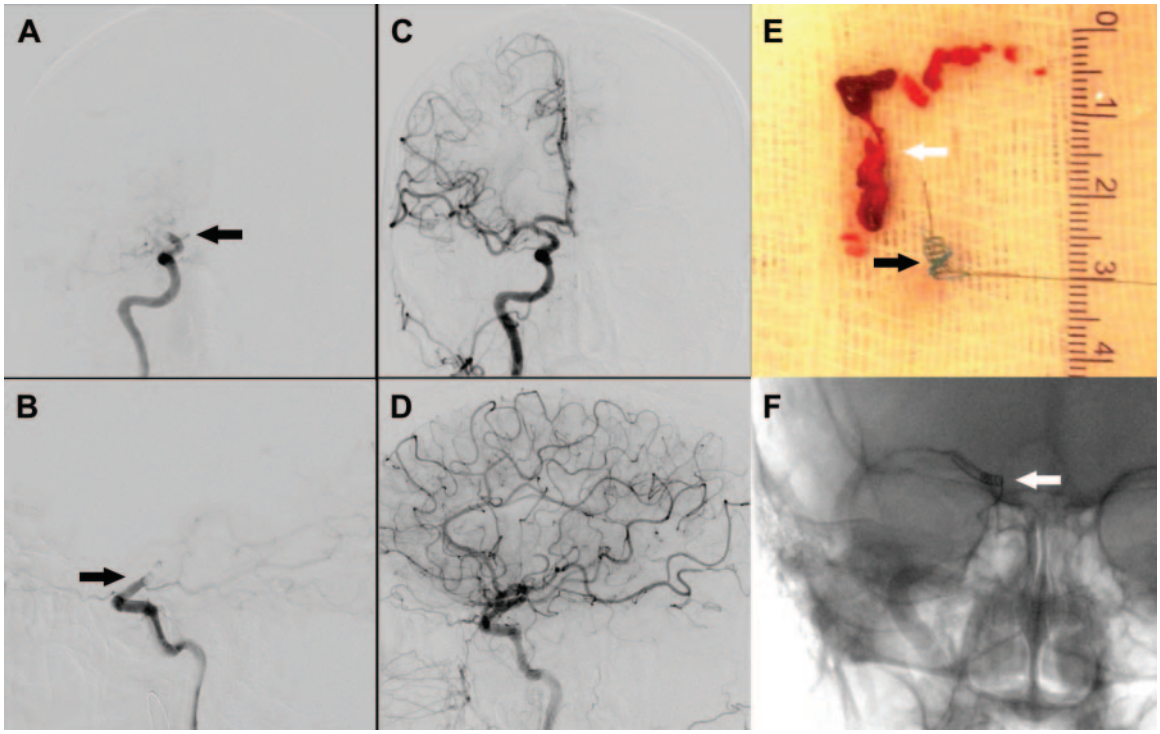
THE MERCI RETRIEVER SYSTEM In 2004, the Merci retriever system was approved by the US Food and Drug Administration as the first mechanical thrombectomy device for removing clot in AIS patients. The Merci retriever has undergone considerable redesigns throughout its existence. The first generation of the retriever device (X5 and X6) boasted a corkscrew appearance due to the helical tapered fashion in which the nitinol was coiled. It was further revised and reiterated for the second generation (L4, L5, and L6) to include arcading filaments that were attached to a nontapering helical nitinol coil. The L-generation helical coil was designed in a 90-degree angle with respect to the proximal catheter. The third generation (V 2.0, V 2.5, and V 3.0) is a hybrid design of a nontapered, nonangulated filamented helical coil that was provided in soft and firm versions. The current generation is based on flexible nitinol wire that assumes a helical shape once it emerges from the tip of a microcatheter (figure 1). The helical coil loops are attached to a wire pusher and delivered through a microcatheter (18L). The system is usually used in conjunction with an 8- or 9-French balloon guide catheter. Inflating the silicone balloon at the distal end of the guide catheter temporarily arrests the antegrade flow in the carotid or the vertebral arteries and also allows for aspiration during the clot retrieval process.[10] Figure 2 demonstrates an occluded right carotid terminus

Figure 1 **Merci retriever devices**



The first-generation X series (A) had a tapered design without filaments. The Merci second-generation L-series (B) incorporated a "side-winder" 90-degree angle with added filaments. The Merci third-generation V series (C) is available in soft and firm configurations and incorporates a variable spring rate design along the coil for optimal clot retention. Permission to use photographs was granted by Stryker.

Figure 2 Demonstration of a case treated with L6 Merci retriever



Pretreatment anterior and lateral angiograms (A and B) show an occluded right carotid terminus (black arrows). Following the Merci thrombectomy, anterior and lateral angiograms (C and D) show complete recanalization. The retrieved thrombus (E, white arrow) and the L6 Merci device (black arrow) are shown. F is a native image of the Merci device (white arrow) in the middle cerebral artery during the retrieval process.

treated successfully with the Merci clot retrieval device.

Outcomes with the Merci retrieval system. Nearly 75% of patients with a severe stroke, exceeding 10 on the NIH Stroke Scale (NIHSS), treated with IV-tPA continue to have persisting vascular occlusions, with only 8% likelihood of significant clinical improvement.[11–13] In contrast, treatment mechanical thrombectomy devices lead to higher rates of revascularization.[8,14,15] It is important to note that the correlation between revascularization and good clinical outcomes has been repeatedly demonstrated.[16,17] Given the lack of randomized control clinical efficacy trials comparing the Merci retriever to standard of care, the limited data on single-arm prospective trials, and the American Stroke Association guidelines, the level of evidence is considered less well established (Class II, level of evidence B).[18] Here we summarize the more significant studies involving the Merci retriever.

MERCI pivotal trials. Successful revascularization, measured by thrombolysis in myocardial infarction (TIMI) score of 2–3, was observed in a pilot study of 30 patients with major cerebral arterial occlusion (exceeding 10 on the NIHSS).[5] When the Merci system was used alone, 12 patients (43%) demonstrated revascularization. This proportion increased to 18 (64%) when intra-arterial tissue plasminogen activator (IA-tPA) was combined with the Merci device. Furthermore, 12 (43%) of the patients had asymptomatic intracerebral hemorrhage (ICH), but none were symptomatic. Significant recovery, assessed with the modified Rankin Scale (mRS score of $\leq$3), was demonstrated in 50% (9 of 18) and 0% (0 of 10) of revascularized and nonvascularized patients, respectively, after 1 month. A total of 10 patients (36%) died during the 30-day follow-up period; none of the deaths were related to the study device.

The Mechanical Embolus Removal in Cerebral Ischemia (MERCI) and multi-MERCI trials, designed to test the safety and efficacy of the first and second generations of the retriever devices, showed similar results.[9,15] Both trials were prospective, multicenter single-arm studies of patient populations, up to 8 hours after symptom onset, with occlusion of major cerebral blood vessel and moderate to severe stroke (NIHSS score $\geq$8). Patients treated with IV-tPA were included in the multi-MERCI trial. Treatable vessels included the intracranial vertebral artery, basilar artery, intracranial carotid artery, and M1 and M2 segments of the middle cerebral artery. Patients were excluded if the angiogram revealed severe arte-

Table 1 Demographics, efficacy, and safety outcome associated with the use of Merci retrieval system

Variable	MERCI[15] (n = 141)	Multi-MERCI[9] (n = 164)	Devlin et al.[20] (n = 25)	Kim et al.[21] (n = 24)	MERCI registry[22] (n = 872)	Total (n = 1,226)
Basic demographics						
Age, y	67.0	68.1	63.0	64.0	NA	65.5
Female, %	46	57	36	42	NA	45.2
Onset to Merci, h	4.3	4.3	4.3	3.23	6.33	4.49
Baseline NIHSS	20.1	19	18	21	NA	19.52
Site of arterial occlusion, %						
Distal carotid artery	33	32	36	38	NA	34.7
Middle cerebral artery	57	60	48	58	NA	55.7
Vertebrobasilar	10	8	4	4	NA	6.5
Efficacy, %						
Revascularization	60	68	56	54	80.1	63.6
mRS ≤2 at 90 d	27.7	36	24	25	31.6	32.0
Safety, %						
Mortality at 90 d	43.5	34	36	29	33.4	35.2
Procedural complications	7.1	5.5	0	0	NA	6.3
Symptomatic ICH	7.8[a]	9.8[a]	4	8	7	7.3

Abbreviations: ICH = intracerebral hemorrhage; mRS = modified Rankin Scale score; NA = not available; NIHSS = NIH Stroke Scale score.

[a] Decline of 4 points or greater in NIHSS score within 24 hours with any blood products (petechial bleeding, hematoma, or subarachnoid hemorrhage) evident on head CT at 24 hours or any intracranial hemorrhage case in which no further NIHSS scores were available beyond baseline and the patient died.

rial stenosis proximal to the thrombus. The rate of successful recanalization (defined as achieving TIMI 2 or 3 in all treatable vessels) and procedural safety served as the primary outcomes. Specific safety outcomes included symptomatic ICH, defined as any associated hemorrhage with clinical deterioration ≥4 points on the NIHSS,[18] mortality rate, and procedural complications. In addition, secondary outcome assessed functional recovery between the revascularized and nonrevascularized patients at day 90.

A total of 141 patients were treated in the MERCI trial and 164 patients in the multi-MERCI trial. The baseline demographics, vessels treated, and safety and efficacy rates are summarized in table 1. Overall, 65% (197/305) of the patients demonstrated successful revascularization. The overall rate of favorable functional outcome (mRS ≤2) at 3 months was 32%, with a slight improvement from 28% in the MERCI trial to 36% in the multi-MERCI trial. A significantly larger proportion of revascularized than nonrevascularized patients displayed good functional outcome (48% vs 10%; relative risk, 4.98; 95% confidence interval [CI], 2.9–8.7). Symptomatic ICH was observed in 7.8% and 9.8% of the patients enrolled in the MERCI and multi-MERCI trials, respectively. The mortality rates of the MERCI (43.5%) and multi-MERCI (34%) trials differed. It is important to note that only 28% of patients who demonstrated revascularization, compared with 53% of those who did not, died. Furthermore, logistic regression analysis of the 2 pivotal trials revealed that successful recanalization after Merci embolectomy is highly associated with favorable clinical outcome and lower mortality rate (odds ratio [OR] of 20.4 for 90-day favorable mRS; OR of 0.28 for 90-day mortality).[16]

Subcohorts treated with IV- and IA-tPA. It should be noted that 29.3% of patients in the multi-MERCI trial were treated with IV-tPA. Revascularization was demonstrated in 73% of this patient population. Meanwhile, 58% of patients receiving stand-alone treatment with Merci retrievers displayed revascularization. The rate of favorable clinical outcome was 38% and the mortality rate was 29% among those treated with IV-tPA in the multi-MERCI trial. In a pooled analysis of the MERCI and multi-MERCI trials, the rate of revascularization was 73% in the IV-tPA group vs 63% in the remaining sample, with a mortality rate of 27.7% and 40.1%, respectively. However, favorable outcome was not significantly different (38% vs 31%).[19] A total of 64 patients (20.9%) had received adjuvant IA-tPA following unsuccessful recanalization with Merci embolectomy in the multi-MERCI trial.[15] Of those receiving IA-tPA, 37.5% achieved revascularization, 27.8% had a favorable functional outcome at 90 days, 10.9% had symptomatic ICH, and 46.8% died.

Few conclusions can be drawn from the IV-tPA-treated cohort within the multi-MERCI trial. First, it remains unclear whether IV-tPA in combination with mechanical thrombectomy influences revascularization and clinical outcomes. Second, pretreatment with IV-tPA is relatively safe, as there were no significant differences in the rates of symptomatic ICH or clinically significant procedural complications between patients who were treated or not treated with IV-tPA.

Observational experience with the Merci retrieval system. Twenty-five consecutive patients were treated prospectively with mechanical thrombectomy for AIS by means of the Merci retrieval system in a single-center study at the Erlanger Southeast Regional Stroke Center.[20] Inclusion and exclusion criteria for patients included in the study were similar to the criteria used in the MERCI trials. Out of the total cohort, 15 patients received adjuvant IA-TPA, 9 patients were treated within 3 hours of onset, and 8 patients had stenosis of the proximal carotid artery in excess of 50%. Fourteen patients were successfully revascularized, and only 1 patient had symptomatic ICH. The overall mortality rate was 36%, and all were nonvascularized patients. After 90 days, nearly a quarter of the patients included in the study achieved a favorable outcome. Successful revascularization occurred in half of patients with tandem lesions in the carotid and middle cerebral arteries.

Besides treating patients with tandem lesions, some institutions have used multimodal neuroimaging (CT or MRI) technology to design protocols to treat patients beyond the 8-hour symptom onset window. In a study of endovascular mechanical clot retrieval, 24 patients with relatively small established core infarcts (less than one-third of the middle cerebral artery) and relatively large persisting salvageable ischemic penumbra (exceeding 20% of tissue) experienced cerebral blood flow of sufficient amplitude to threaten tissue integrity.[21] This study included 5 patients treated with IV-tPA and 4 patients treated outside the 8-hour window. In addition, IA-tPA was used along with platelet-disaggregating agents in revascularization failure. Within the study cohort, 54% achieved revascularization (29% partial and 25% complete revascularization) of the occluded vessel, as defined by the MERCI pivotal trials. Additionally, patients treated with only the Merci system had a revascularization rate of 63%, and 75% of patients (3/4) treated outside the 8-hour window from symptom onset achieved revascularization. Symptomatic ICH occurred in 2 patients (8.3%), both of whom underwent mechanical embolectomy with the Merci device as rescue treatment after recanalization failure with IV-tPA. Furthermore, asymptomatic ICH was reported in 38% of patients, as well as subarachnoid hemorrhage in 2 patients. Some complications were reported in the study procedure. Fracture of the coil device and detachment of the Merci retriever tip were noted in 3 patients. In 2 of those patients, the detached tips were successfully retrieved. Investigators attributed this fracture to overtorquing of the Merci device. The 90-day overall mortality rate was 29% and did not differ according to revascularization status. However, favorable clinical outcome at 90 days was clearly higher in the revascularized group (21% vs 4%). The overall favorable outcome rate was 25%.[21]

The multicenter Merci registry. At the 2011 International Stroke Conference in Los Angeles, results from 872 patients treated with the Merci system in a prospective multicenter open-label registry were re-

Table 2 Comparison of outcomes of the MERCI, Multi-MERCI, PROACT II, and Penumbra trials

Variable	MERCI[15]	Multi-MERCI[9]	PROACT II[23]	Penumbra[4]
No.	141	164	121	125
Age, y	67	68	64	64
Baseline NIHSS	20	19	17	18
Revascularization, % (95% CI)	48 (39.7–56.8)	68 (61.0–75.0)	66 (57.0–74.5)	82 (73.7–88.0)
Symptomatic ICH, % (95% CI)	7.8[a] (3.5–12.7)	9.8[a] (5.2–14.3)	10.9[b] (5.9–17.7)	11.2[a] (6.3–18.1)
Asymptomatic ICH, % (95% CI)	27.7 (20.5–35.8)	30.5 (24.0–38.0)	25 (17.4–33.5)	16.8 (10.7–24.5)
Mortality rate, % (95% CI)	43.5 (35.0–51.9)	34 (26.0–41.0)	25 (17.4–33.5)	32.8 (24.7–41.8)
90-day mRS ≤2, % (95% CI)	27.7 (21.1–36.6)	36 (29.0–44.0)	40 (31.7–44.0)	25 (17.6–33.7)

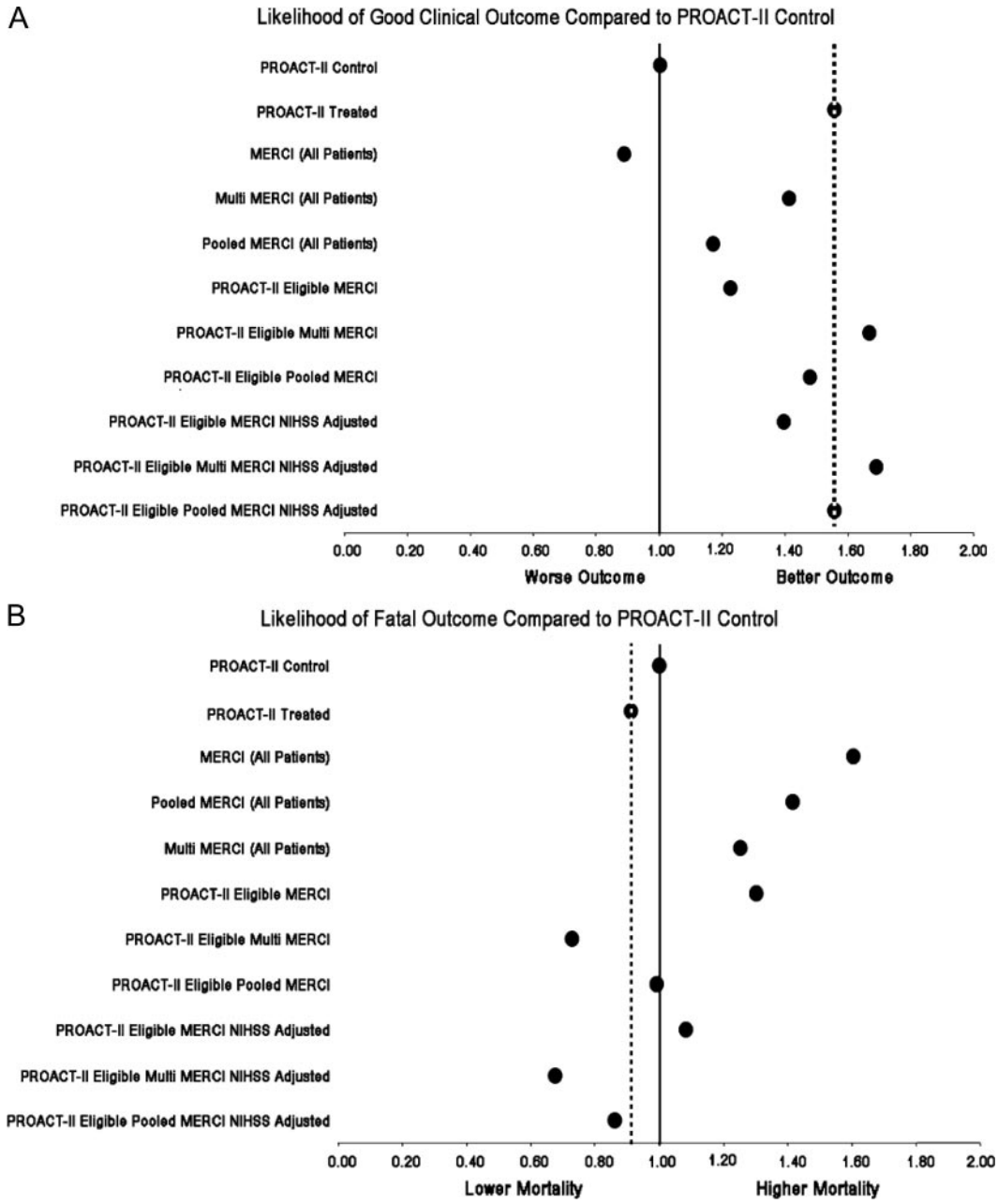
Abbreviations: CI = confidence interval; ICH = intracerebral hemorrhage; mRS = modified Rankin Scale score; NIHSS = NIH Stroke Scale score.

[a] Decline of 4 points or greater in NIHSS score within 24 hours with any blood products (petechial bleeding, hematoma, or subarachnoid hemorrhage) evident on head CT at 24 hours or any intracranial hemorrhage case in which no further NIHSS scores were available beyond baseline and the patient died.

[b] If it was associated with a clinical deterioration of >4 points on the NIHSS or a 1-point deterioration in the level of consciousness.

ported.[22] The study has broad inclusion criteria. Essentially, any AIS patient with a large-vessel occlusion who was treated with at least 1 pass of the Merci retriever could be included in the study, reflecting a "real world experience." The overall rate of partial or complete revascularization (thrombolysis in cerebral infarction [TICI]-2A or higher) was 80.1%. At the 90-day study outcome, close to one-third (31.6%) of patients enrolled achieved favorable clinical outcomes, and 33.4% of patients died. The overall rate of symptomatic ICH in the registry was 7%. Age and recanalization were strong predictors of clinical outcome, particularly TICI-2B and TICI-3 across all ages. Predictors of favorable outcome on multivariate analysis were younger age, lower baseline NIHSS score, successful recanalization, and lack of intubation/general anesthesia during procedure. Results from this large observational cohort on the use of the

Figure 3 Outcome comparison of MERCI and PROACT II



The likelihood of good clinical outcome (A) and mortality (B) in PROACT-eligible MERCI, in comparison with the PROACT II control and treated arms. The solid and dashed lines represent the outcome in the control and treatment arms, respectively. In (A), better rates of good outcome (90-day modified Rankin Scale score of ≤2) are indicated by data points farther to the right on the x-axis, whereas the converse is true for the mortality data in (B). Figure modified and reprinted[24] with permission from Springer Science+Business Media.

Merci retrieval system are comparable to those published in pivotal MERCI trials.

COMPARING OUTCOMES WITH MERCI VS PROACT II AND PENUMBRA Both MERCI and Penumbra pivotal trials were single-arm studies that compared outcomes with historical controls. In contrast, Prolyse in Acute Cerebral Thromboembolism (PROACT II) was a randomized clinical trial.[23] Reported rates of successful revascularization and symptomatic ICH were highest in the Penumbra trial (82% and 11.2%, respectively) and lowest in the MERCI trial (48% and 7.8%). These results are summarized in table 2. PROACT II and the multi-MERCI trial had similar rates of revascularization and symptomatic ICH: 67% and 10%, respectively. The mortality rate was higher in the MERCI (43.5%) and multi-MERCI (34%) trials and similar in the Penumbra (25%) and PROACT II (25%) trials.

Patients from the MERCI pivotal trials and PROACT II trial were carefully analyzed in a recent study (figure 3).[24] The study population was matched on age, baseline NIHSS score, and site of the arterial occlusion. The authors identified patients with AIS due to occlusion of the middle cerebral artery who were potentially eligible for inclusion in the PROACT II trial.[23,24] A total of 141 eligible patients pooled from the MERCI pivotal trials (61 from MERCI and 80 from multi-MERCI trials) were compared with 180 patients from the PROACT II trial (59 controls and 121 prourokinase-treated patients). Notable differences in baseline characteristics of the groups were noted, such as the MERCI cohort being older and having more severe strokes, even after careful matching. As demonstrated in figure 2A, there was a trend toward better clinical outcome in the MERCI cohort vs the PROACT II control arm at 90 days (adjusted analysis: MERCI, 35.4%, p = nonsignificant; multi-MERCI, 42.8%, $p = 0.048$; PROACT II control, 25.4%). In both adjusted and unadjusted analyses, however, the mortality did not significantly differ between the MERCI and PROACT II cohorts (adjusted analysis:

Table 3 Relationship of outcomes and baseline characteristics in MERCI and Multi-MERCI trials[a]

		Successful revascularization		90-day mRS ≤2		90-day mortality	
Variable	Overall	Yes	No	Yes	No	Yes	No
No., %	305	64.6	35.4	32.4	67.6	38.1	61.9
Demographics							
Age, y	72	71	72	67.5	73	76	67
Baseline median NIHSS	19	18	20	16	20	21	17
Stroke onset to treatment, h	4.3	4.2	4.4	4.1	4.4	4.4	4.2
Median systolic blood pressure, mm Hg	147	141	152	136	151	153	140
Gender, %							
Male	47.9	69.9	30.1	33.3	66.7	38.6	61.4
Female	52.1	59.7	40.3	31.5	68.5	37.7	62.3
Revascularization, %							
Successful	64	100	0	47	53	27	73
Failed	36	0	100	9	92	55	45
Site of arterial occlusion, %							
Internal carotid artery	32.5	62.6	37.4	28.9	71.1	48	52
M1 branch of MCA	49.2	60	40	33.3	66.7	32.9	67.1
M2 branch of MCA	9.2	82.1	17.9	40.7	59.3	25.9	74.1
Vertebrobasilar system	9.2	78.6	21.4	32.1	67.9	42.9	57.1
Right side occlusion	43.7	62	38	33.6	66.4	33.6	66.4
Left side occlusion	56.3	64.1	35.9	31.5	68.5	40.8	59.2
Thrombolysis, %							
IV	28.2	72	28	36	64	27.7	72.3
IA	29	63	37	37	63	42.1	57.9

Abbreviations: IA = intra-arterial; MCA = middle cerebral artery; mRS = modified Rankin Scale score; NIHSS = NIH Stroke Scale score.
[a] Abstracted from Nogueira et al.,[16] with permission.

MERCI, 29.1%; multi-MERCI, 18.0%; PROACT II control, 27.1%) (figure 3).

DISCUSSION Several conclusions can be drawn from this review. First, the Merci system appears to be effective in retracting clots lodged in large vessels, causing devastating ischemic strokes. The relative efficacy and safety of the device have been demonstrated both in the initial MERCI trials and in subsequent observational evidence. The Merci retrieval system, according to a pooled analysis and when compared with the natural history, appears to be a safe option that may lead to better outcomes.[16] Though the revascularization rate was different in patients treated with the Merci system vs other systems, the clinical and safety outcomes were comparable.[4] It should be noted that different angiographic outcomes were used in these different trials, so comparisons about revascularization rates are unreliable at best. Second, outcomes of the MERCI trials have been reproduced by real-world evaluation of the Merci system. Third, whether or not Merci system therapy is plausible after 8 hours from symptom onset remains unclear. In fact, viable brain tissue, assessed via imaging, has been found in a recent retrospective multicenter analysis of patients who had symptoms outside the 8-hour window.[25] Merci embolectomy was performed on 62% of the patient population and elicited revascularization in 73.8%, accompanied by a symptomatic ICH rate of 8.8%. A favorable clinical outcome and mortality rate of 45% and 21.5%, respectively, was seen at day 90. Fourth, outcomes from the MERCI trials are similar to those from the PROACT II and Penumbra trials. These converging results suggest that there may be multiple viable options for the treatment of large-vessel occlusions. However, the lack of direct comparison has left practitioners in a predicament in terms of choosing the best treatment modality for revascularization.

Pooling the MERCI trials made it possible to predict favorable clinical outcomes and mortality rates at day 90 after Merci treatment. Using the demographics and the site of vessel occlusion, as indicated in table 3, allowed Nogueira and colleagues[16] to suggest that revascularization was the strongest predictor of favorable functional outcome (OR 20.4; 95% CI 7.74–53.92) and lower mortality (OR 0.28; 95% CI 0.16–0.51).[16] In addition, favorable outcomes were more likely given a lower initial NIHSS score (OR 0.86; 95% CI 0.81–0.92) and associated with younger age (OR 0.96; 95% CI 0.95–0.98). In contrast, poor revascularization, higher NIHSS on initial presentation, older age, and occlusion at the internal carotid artery terminus were associated with higher mortality rates.

The Merci retriever system was the first device approved for clot removal in AIS patients presenting with a large-vessel occlusion. Adding further credence to its efficacy are outcomes of the Merci retriever trials, comparable to those of the PROACT II and Penumbra trials. The Merci retriever is safe for treating patients presenting with moderate to large ischemic syndromes (NIHSS score ≥8) within 8 hours from symptom onset. Additional studies are necessary to investigate its use beyond the traditional time window and to fully validate its clinical efficacy against best medical treatment alone.

AUTHOR CONTRIBUTIONS

Dr. Alshekhlee: drafting/revising the manuscript, study concept or design, analysis or interpretation of data. Dr. Pandya: drafting/revising the manuscript, study concept or design, analysis or interpretation of data. Dr. English: drafting/revising the manuscript, analysis or interpretation of data. Dr. Zaidat: drafting/revising the manuscript, study concept or design, acquisition of data, study supervision. Dr. Gupta: drafting/revising the manuscript, study supervision. Dr. Mueller: drafting/revising the manuscript. Dr. Nogueira: drafting/revising the manuscript, study concept or design, analysis or interpretation of data, study supervision.

DISCLOSURE

Dr. Alshekhlee and Dr. Pandya report no disclosures. Dr. English has served on the advisory boards of CoAxia Inc. and eV3 Inc.; served as Associate Editor of *Journal of Neuroimaging*; was an employee of Concentric Medical Inc., CoAxia Inc., and eV3 Inc.; and has served as an expert witness. Dr. Zaidat serves on the scientific advisory board for Talecris; served on the adjudication committee for Stryker; received speaker honoraria from Stryker; served on the editorial board of *Frontiers in Neurology* (Endovascular & Interventional Neurology Section); serves as Editor of *The Journal of Neurointerventional Surgery*, and serves as Associate Editor and is a member of the Editorial Board of *Journal of Stroke & Cerebrovascular Diseases*; served as a consultant for Stryker Neurovascular–Commercial, Codman Neurovascular–Commercial, and Microvention Inc.–Commercial; and has received research support from a Society of Vascular & Interventional Neurology (SVIN) grant for this educational activity. Dr. Gupta has served as Chair of DSMB for Reverse Medical and Rapid Medical; has served on the scientific advisory boards for Concentric Medical and CoAxia; and has served as Associate Editor for *Journal of Neuroimaging*. Dr. Mueller performs mechanical embolectomy (10%). Dr. Nogueira has served on the scientific advisory boards for Concentric Medical, eV3 Neurovascular Inc, CoAxia, and Rapid Reverse Medical and performs thrombectomy for acute ischemic stroke. **Go to Neurology.org for full disclosures.**

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