The MERCI Trial

An overview of the device design and clinical results for the Merci stroke treatment system.

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The MERCI (Mechanical Embolus Removal in Cerebral Ischemia) Trial was a prospective, nonrandomized, multicenter trial designed to evaluate the Merci Retrieval System (Concentric Medical, Inc., Mountain View, CA) in the treatment of neurovascular thrombotic occlusions. The vessels treated in the study included the internal carotid artery (ICA), the M1 and M2 segments of the middle cerebral artery (MCA), and the basilar and vertebral arteries. The primary endpoint was based on treatment success, defined as the ability to achieve arterial revascularization (TIMI [thrombolysis in myocardial infarction] flow grade II or III) while minimizing the occurrence of serious device-related adverse events.

Serious device-related adverse events were defined as vessel perforation, intramural arterial dissection, or significant embolization in a previously uninvolved territory. The secondary endpoints examined were patient neurological condition (National Institute of Health Stroke Scale [NIHSS] and Modified Rankin Score [mRS]) at 24 hours, 5 days or day of discharge, 30 days, and 90 days after treatment. Other secondary endpoints were major adverse events defined as death, new stroke, and myocardial infarction.

PATIENTS

This article presents an interim analysis of the MERCI Trial patient cohort. One hundred fourteen patients are discussed in this article. An additional seven patients were enrolled in the trial but were not treated. The trial was conducted during the period from May 2001 to December 2003 at the 25 US centers (Table 1). Patients who met all clinical and CT scan criteria and from whom a signed informed consent was obtained underwent diagnostic cerebral angiography of the symptomatic territory to determine angiographic inclusion and exclusion criteria.

Two populations were included in this study. Population 1 included patients who presented within 3 hours of stroke onset but in whom intravenous (IV) thrombolysis was contraindicated due to increased risk of hemorrhage. Population 2 included patients who presented after the 3-hour time frame for IV thrombolysis in whom the embolectomy procedure could be completed within 8 hours of symptom onset. Patients who had previously received IV thrombolysis for the current stroke were not included in the study.

The MERCI Trial inclusion criteria were (1) diagnosis of acute ischemic stroke, (2) patients presenting within population 1 or 2, (3) patient age >18 years, (4) NIHSS ≥8, and (5) angiography showing an occlusion of the ICA, M1/M2 segment of the MCA, basilar artery, or vertebral artery. Exclusion criteria included (1) glucose <50 mg/dL, (2) exces-

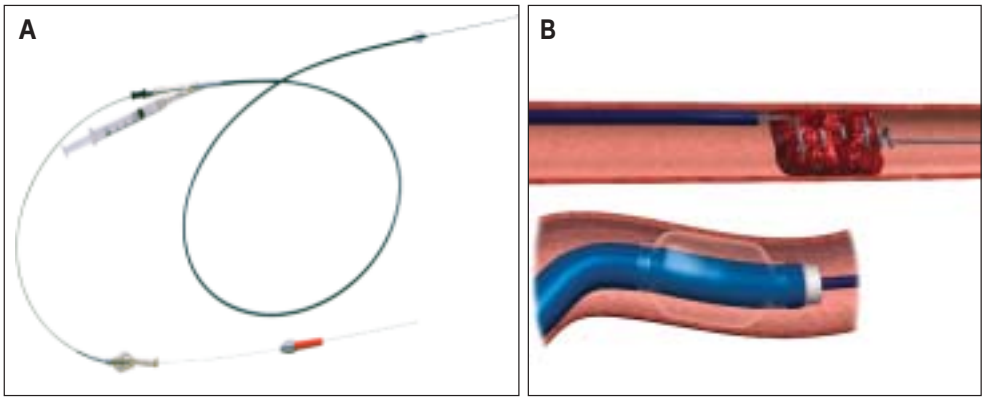

Figure 1. The Merci Retrieval System consists of the Merci Retriever, the Merci Microcatheter, and the Merci Balloon Guide Catheter (A). The Retriever engages and ensnares the thrombus while the balloon guide catheter is inflated to control flow (B).

sive vessel tortuosity, (3) known hemorrhagic diathesis, coagulation factor deficiency, or oral anticoagulation therapy with international normalized ratio >3.0, (4) receipt of heparin within 48 hours with a partial thromboplastin time greater than two times the lab normal, (5) platelets <30,000, (6) sustained severe hypertension, (7) CT scan revealed significant mass effect with midline shift, (8) CT scan revealed large (more than one-third of the MCA) regions of hypodensity, (9) angiography showing a severe arterial stenosis (>50%) proximal to the embolus, and (10) informed consent could not be obtained.

DEVICE AND STUDY PROCEDURE

The Device

The Merci Retrieval System (Figure 1) consists of a retriever, a microcatheter, and a balloon guide catheter. The retriever is a flexible, tapered nitinol core wire with helical loops at the distal end. A platinum coil is attached over the distal end to facilitate fluoroscopic visualization. The microcatheter is a flexible single-lumen catheter with a radiopaque tip. The balloon guide catheter is a 9-F, coaxial, lumen-braided shaft, variable-stiffness catheter with a radiopaque marker on the distal end. The balloon is flush mounted on the distal end of the catheter.

TABLE 1. US CENTERS PARTICIPATING IN THE MERCI TRIAL

UCLA Medical Center—Los Angeles, CA
Oregon Health Sciences University—Portland, OR
Mid American Brain & Stroke Institute—Kansas City, MO
Massachusetts General/Brigham & Women's—Boston, MA
Hartford Hospital—Hartford, CT
NY Presbyterian/Columbia—New York, NY
NY Presbyterian/Cornell—New York, NY
UCSF Medical Center—San Francisco, CA
Florida Hospital—Orlando, FL
Stanford University—Palo Alto, CA
Carolina's Medical Center—Charlotte, NC
Riverside Methodist—Columbus, OH
Georgetown University—Washington, DC
University of Maryland—Baltimore, MD
University of Pennsylvania—Philadelphia, PA
LDS Hospital—Salt Lake City, UT
Louisiana State University—Shreveport, LA
State University of NY—Buffalo, NY
University of North Carolina—Chapel Hill, NC
Baptist Memorial—Memphis, TN
Barrows Neurological Institute—Phoenix, AZ
Baton Rouge General—Baton Rouge, LA
University of Texas—Houston, TX
Emory University—Atlanta, GA
Washoe Medical Center—Reno, NV

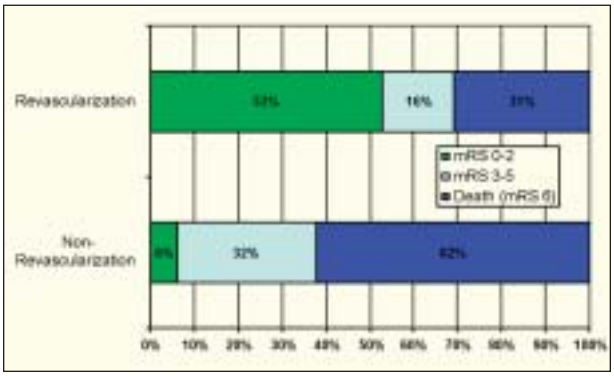

Figure 2. Modified Rankin score at 90 days (revascularized patients compared to nonrevascularized patients).

The Procedure

All patients included in the study received a standard IV bolus and/or an infusion of heparin before the procedure. The balloon guide catheter was placed into the common carotid artery, internal carotid artery, or the subclavian artery. Using standard cerebral catheterization techniques, the microcatheter was passed through the balloon guide catheter into the target vessel beyond the thrombus and the guidewire was removed from the microcatheter. After contrast injection to determine correct placement, the retriever was then deployed from the microcatheter and retracted into the occlusion, allowing the loops to ensnare the thrombus. The balloon guide catheter was then inflated to control blood flow. The retriever with the ensnared clot and the microcatheter were then withdrawn together into the balloon guide catheter. Continuous aspiration was applied to the balloon guide catheter to ensure complete thrombus removal. Upon confirmation of complete evacuation of thrombus from the balloon guide catheter, the balloon was deflated to re-establish flow, and a final angiogram was obtained to assess vessel patency.

RESULTS

A total of 121 patients were enrolled in the MERCI Trial for this cohort of patients. Of those 121 patients, 114 were treated with the Merci Retrieval System. A patient was considered treated in the trial when the retriever was deployed in the patient. The seven patients enrolled in the trial but not treated were excluded because (1) the investigator was unable to access the occlusion with the guidewire/microcatheter in two patients, (2) the investigator was unable to place the balloon guide catheter in one patient, (3) the investigator was unable to advance the retriever through the microcatheter in two patients, (4) the vessel sponta-

neously recanalized in one patient, and (5) the occlusion was located in a nontreatable vessel in one patient.

The median age of the patients in this data set was 71 years (range, 28-93 years), with a median baseline NIHSS score of 19 (range, 9-40). Forty-six percent of the patients were female. The median time from symptom onset to the final angiogram was 6.1 hours (range, 2-14 hours) and the median procedure time was 1.8 hours (range, 0.3-5.9 hours). In this cohort, thrombus occurred in the following target areas allowed by the protocol: 21 (18%) occlusions occurred in the ICA, 65 (57%) occurred in the MCA, 16 (14%) were ICA T-occlusions (ICA and MCA), and 12 (11%) were in the posterior circulation.

Procedure-related adverse events were seen in eight cases (7%). Three cases involved dissection. In two cases, this complication was thought to be due to the placement of the balloon guide catheter, and the third case was thought to be related to guidewire manipulation. Of these three cases, one of the patients died from complications associated with the treatment of the dissection. The other patients had no sequelae. Three arterial perforations were also recorded, two related to the use of the retriever and one to the microcatheter used in the procedure. One of the patients experiencing perforations had an intracranial hemorrhage and died, the other two experienced no sequelae. The other two procedure-related adverse events occurred due to embolization of the thrombus into an uninvolved territory.

The combined symptomatic (n=8) and/or device-related (n=1) hemorrhage rate reviewed by the Data Safety Monitoring Board was 7.9% (9 of 114). The asymptomatic intracranial hemorrhage rate was 28.9% (33 of 114).

Revascularization was achieved in 61 (53.5%) of the patients treated in this cohort of 114 patients. By target vessel, revascularization was achieved in 21 (57%) in the ICA/ICA-T, 33 (51%) in the MCA, and 7 (58%) in the posterior circulation. The two retriever perforations and the two embolizations into previously uninvolved territory are serious device-related adverse events, leading to a 3.5% serious device-related adverse event rate.

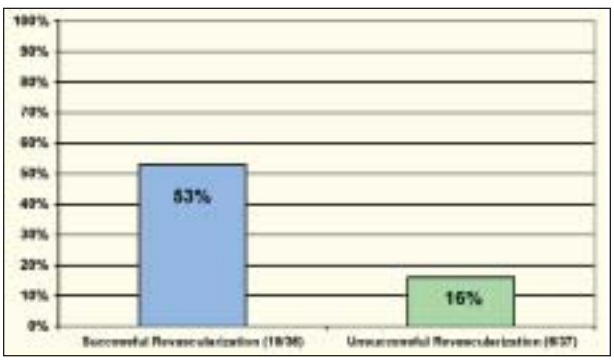

Figure 3. NIHSS ≥10-point improvement at 90 days (revascularized patients compared to nonrevascularized patients).

The secondary endpoints were patient outcomes, specifically major adverse events and neurologic status at 30 days and 90 days. Thirty- and 90-day follow-up was not available for all patients at the time of this publication. All deaths through 90 days were recorded, and the mortality rate through 90 days was 39% (45 of 114) for all treated patients. For those patients successfully revascularized, the mortality rate was 25% (15 of 61) versus 53% (28 of 53) in those who were not revascularized. Two patients experienced embolization of a previously uninvolved territory resulting in each patient having a new stroke. Two patients experienced acute myocardial infarction after treatment.

Thirty-day patient outcomes were similar to the 90-day, therefore only the 90-day follow-up results were included in this report. For those patients available for 90-day follow-up, 34% of patients (25 of 73) achieved a ≥10-point improvement in NIHSS. Of those patients successfully revascularized, 53% (19 of 36) had a ≥10-point improvement in NIHSS compared to 16% (6 of 37) of those unsuccessfully revascularized. Thirty-one percent of patients (30 of 98) had an mRS ≤2 at 90 days. Of those patients successfully revascularized, 53% (27 of 51) had an mRs ≤2 compared to 6% (3 of 47) of those unsuccessfully revascularized. Figure 2 compares the Modified Rankin data of successfully revascularized patients to unsuccessfully revascularized patients. Figure 3 compares the NIHSS Score of successfully revascularized patients to unsuccessfully revascularized patients.

These data were presented to the FDA on February 23, 2004. The FDA is now reviewing the application, and a final decision is pending.

CONCLUSION

The MERCI Trial has shown that the Concentric Merci Retriever is safe for use in removing thrombus in patients experiencing ischemic stroke. The Concentric Retriever was able to restore TIMI flow grade II or III in 53.5% of patients with a device-related adverse event rate of 3.5%. The use of this device potentially increases the time window of treatment for ischemic stroke patients, opening the narrow window of 3 hours to 8 hours. Patients revascularized with the Merci Retrieval System demonstrated better outcomes with improved NIHSS Score and Modified Rankin Score at 90 days compared to those who were not revascularized. ■

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