Stroke on the MEND
University of Miami pioneers an innovative stroke curriculum

DOROTHY POTTER BEGINS TO MAKE BREAKFAST FOR HER family. As her husband and two teenage daughters join her, she drops a fork, which she insists is a foot. Her family becomes alarmed about her sudden confusion and also notices that she has slurred speech and weakness on her right side. Dorothy's husband calls 9-1-1 while her daughters comfort her.

The dispatcher enters the information into her terminal, sending the closest ALS unit while Dorothy's husband receives pre-arrival instructions, such as the need to monitor her breathing and refrain from giving her anything to eat or drink.

Rescue 34 arrives within four minutes of the initial call to find Dorothy, a 47-year-old female, slumped sideways in a chair. The lead paramedic begins by asking the family questions to determine what happened. Other rescuers perform the primary survey, including vital signs. Dorothy has no airway or breathing compromise, but the crew quickly determines that the patient uses inappropriate words when answering questions.

The patient's vital signs are BP 204/116, pulse 82 and regular, and respirations 22. Pulse oximetry is 98%. The EMS crew suspects Dorothy is experiencing an acute stroke and decide to continue the remainder of the assessment in the ambulance to expedite transport to the community stroke center. As they package the patient for transport, paramedics administer oxygen and perform the three-step Cincinnati Prehospital Stroke Scale.

Dorothy's husband accompanies her to the hospital in the ambulance to provide additional witness information for the stroke team. During the short emergency transport, the paramedics apply an ECG monitor and insert an IV of normal saline. Her blood glucose remains normal. The lead paramedic obtains further medical history from the patient's husband while another rescuer performs an expanded neurological examination.

The rescuers contact the hospital to alert the stroke team of the
In the incoming patient:

"Rescue 34 to General Hospital, we are en route with an acute stroke alert. Our patient is a 47-year-old female who was last without symptoms approximately 40 minutes ago. Family members report that she had an acute onset of confusion and motor weakness. She is now conscious and alert. We note an expressive aphasia with a left gaze preference and right motor and sensory loss. She has no thrombolytic exclusion criteria, and her husband is accompanying us. Our ETA is approximately 10 minutes."

The emergency department (ED) initiates its Code Gray Stroke Alert protocol by paging the stroke physician, computerized tomography (CT) technician, radiologist, laboratory supervisor and pharmacist. Team members then report to their respective areas to prepare for the patient.

Moments later, the ambulance transporting Dorothy arrives at the ED. The paramedics report that her condition has not changed. Stroke team members re-evaluate her vital signs and confirm the diagnosis of stroke with onset one hour earlier. They draw blood and send it stat to the laboratory. The patient is transported to the CT lab so a scan can rule out intracranial hemorrhage. The radiologist reads the CT scan of Dorothy's head as normal, without evidence of bleeding. Laboratory results come back normal just as the patient returns to the ED. The negative CT scan and normal lab results mean that Dorothy does not have a intracranial bleed and her clotting time is acceptable, making her a good candidate for t-PA.

The ED nurses initiate IV tissue-plasminogen activator (t-PA, a thrombolytic agent used extensively for acute myocardial infarction patients) and perform neuro checks every 15 minutes during the one-hour infusion.

Ninety minutes after her arrival at the hospital, Dorothy is transported to the Acute Stroke Unit. She regains some language ability, and the strength on her right side improves. Over the next two days, she receives rehabilitation and a diagnostic evaluation to determine what caused her stroke. The neurologist credits the positive outcome to her family's swift recognition of the problem and the excellent care rendered by the EMS providers and the hospital stroke team.

**Stroke is an emergency**

A national emergency, stroke warrants the full attention of health-care providers at every level. Stroke remains the third leading cause of death and the leading cause of long-term disability in the United States. More than 700,000 Americans suffer stroke annually: approximately one-third die, one-third become disabled and one-third recover. Stroke devastates the lives of individuals and families and costs this country more than $40 billion annually.

In the past few years, research has revealed information regarding the need for emergent restoration of blood flow to ischemic brain tissue. Until recently, physicians could only diagnose the stroke, prevent additional events and provide rehabilitative and supportive care. However, in 1996, the Food and Drug Administration approved the use of t-PA for acute ischemic stroke, giving the medical profession an effective therapy to restore blood flow in some stroke patients.

The caveat: A patient must receive t-PA within the first three hours of ischemic stroke onset or suffer from increased risk of bleeding within the brain.

**Time factor**

Time remains the critical factor that prevents the majority of stroke patients from receiving thrombolytic therapy. Recent studies have shown that less than 24% of stroke patients arrive at a hospital within three hours of symptom onset.

EMS organizations can, in part, reduce these delays by adopting principles learned from caring for acute myocardial infarction patients. They can:

1. Participate in community-awareness programs;
2. Educate personnel to recognize stroke;
3. Minimize scene and transport delays; and
4. Alert the hospital stroke team of the inbound stroke patient.

However, at this time little standardization exists in instructing EMS providers in how to recognize and treat stroke. Further, few current EMS texts contain information on stroke and most do not explain the use of newly developed examinations specifically developed to assess patients with local (localized) neurological deficit.

New time-sensitive stroke treatments have defined a critical role for EMS providers. The prehospital provider can reduce the time from stroke onset to t-PA administration if they can recognize, stabilize, transport and notify the ED of the impending arrival of an acute stroke patient.
Innovative new curriculum

EMS providers have traditionally evaluated acute stroke patients using the Glasgow Coma Scale. This scale, originally designed to quantify the level of consciousness of patients with head trauma, remains a useful tool for evaluating patients with diffuse brain injury. However, patients with stroke more commonly have localized neurological deficits, not global brain dysfunction. Thus the Glasgow Coma Scale provides little valuable information in the assessment of these patients. Consequently, the overall recognition of stroke by prehospital providers has been only fair.7,8

Recently, EMS providers have begun using the Cincinnati Prehospital Stroke Scale (CPSS), endorsed by the American Heart Association. In an effort to further improve EMS recognition of stroke, the Center for Research in Medical Education (CRME) at the University of Miami School of Medicine has developed an innovative, standardized stroke curriculum. EMS providers learn the intricacies of stroke assessment, including the performance of more appropriate neurological examinations.

The curriculum emphasizes performing the basic CPSS and, if time allows, utilizing the expanded Miami Emergency Neurologic Deficit (MEND) exam. The CPSS allows for rapid identification of stroke, and the MEND exam permits rapid assessment of stroke severity.

A group of national experts in stroke, EMS and medical education developed and refined this course. The standardized eight-hour curriculum includes several brief lectures and highly interactive simulations using paramedic instructors as mock stroke patients. This article discusses the importance of stroke education and the innovative approach CRME employs to educate EMS providers.

Learning through simulation

Since January 1998, more than 1,000 participants have attended the course, primarily certified paramedics from the south Florida area. At the beginning and end of each course, participants take a 20-question, multiple-choice examination containing items that

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**Table 1: Miami Emergency Neurologic Deficit (MEND) Exam**

- Perform the Cincinnati Prehospital Stroke Scale (in shaded areas) on scene to determine stroke presence.
- Perform the expanded MEND exam en route (if time permits) to assess stroke severity.
- Check the box to the left if the response is abnormal.

**MENTAL STATUS**

- Level of Consciousness. Determine if patient is awake and alert, lethargic, but responsive to verbal stimuli, responsive only to painful stimuli or unresponsive to all stimuli.
- Speech. Ask patient to repeat: “You can’t teach an old dog new tricks.”
- Questions. Ask patient: “How old are you?” and “What month is this?”
- Commands. Ask patient to close and open eyes.

**CRANIAL NERVES**

- Facial Droop. Ask patient to show their teeth or smile. Determine if both sides of face move equally well.
- Visual Fields. Ask patient to look at your nose. Place your hands just above your nose level, wiggle fingers on one hand at a time to deter-

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**LIMBS**

- Motor—Arm Drift. Ask patient to hold out both arms with palms down and eyes closed for five seconds. Observe for drift.
- Motor—Leg Drift. Ask patient to lift one leg and hold for five seconds. Observe for drift. Repeat with other leg.
- Sensory—Arms and Legs. Ask patient to close eyes and uncross arms and legs. Gently touch or pinch each limb and determine if patient can feel stimuli equally on both sides.
- Coordination—Arms. Ask patient to touch their finger with one finger, then touch their own nose, then touch your finger again. Observe for limb ataxia (clumsiness or dyscoordination). Repeat with other arm.
- Coordination—Legs. Ask patient to touch knee of one leg with heel of opposite leg and slide heel down the shin. Observe for limb ataxia. Repeat with other leg.
Table 2a: Five Major Stroke Syndromes—Typical Stroke Signs

<table>
<thead>
<tr>
<th>Left (Dominant) Hemisphere</th>
<th>Right (Nondominant) Hemisphere</th>
<th>Brainstem</th>
<th>Cerebellum</th>
<th>Hemorrhage*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aphasia</td>
<td>Neglect/</td>
<td>Hemiparesis or</td>
<td>Truncal/gait ataxia</td>
<td>Headache</td>
</tr>
<tr>
<td>L gaze preference</td>
<td>L hemi-inattention</td>
<td>quadriaparesis</td>
<td></td>
<td>Neck stiffness</td>
</tr>
<tr>
<td>R visual field deficit</td>
<td>R gaze</td>
<td>Hemisensory loss</td>
<td></td>
<td>Neck pain</td>
</tr>
<tr>
<td>R hemiparesis</td>
<td>preference</td>
<td>or sensory loss</td>
<td></td>
<td>Light intolerance</td>
</tr>
<tr>
<td>R hemiparesis loss</td>
<td>L visual field</td>
<td>in all four limbs</td>
<td></td>
<td>Nausea, vomiting</td>
</tr>
<tr>
<td></td>
<td>L hemiparesis</td>
<td>CROSSED SIGNS</td>
<td></td>
<td>Decreased consciousness</td>
</tr>
<tr>
<td></td>
<td>loss</td>
<td>DIPLOPIA,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>DISCOCONJUGATE GAZE,</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>GAZE PALSY</td>
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Key: L = Left and R = Right

* These symptoms are only suggestive of hemorrhagic stroke. Their presence without focal (localized) deficit is particularly worrisome for subarachnoid hemorrhage. CT scan is far more reliable than clinical features in determining presence of intracranial hemorrhage.

reflect the learning objectives of the course. The pretest measures the baseline knowledge of the paramedics and focuses their minds on the learning objectives. The post-test assesses the progress of the individual participants and serves as a measure of how effectively the CRMCE course communicated the learning objectives. In a previously published abstract, CRMCE reported a mean pretest score of 53% with a range of 30-80% and a mean post-test score of 87% with a range of 60-100%.

Following the pretest, instructors present two brief lectures. One covers stroke epidemiology, risk factors and prevention, and the other discusses the performance of prehospital neurological exams, including the basic CPSS and the expanded MEND exam (see Table 1).

The MEND exam is based on the National Institutes of Health Stroke Scale (NIHSS), an examination developed for use by hospital-based health-care professionals to measure the neurological deficits of acute ischemic stroke patients.

Although the MEND and NIHSS examinations closely resemble each other, the MEND exam takes less time to perform and does not require scoring. The similarity of the two examinations enhances communication between paramedics and physicians and enables a comparison of the patient’s neurological status in out-of-hospital and in-hospital settings.

To reinforce the lecture material, participants practice performing the MEND exam on paramedic instructors who portray standardized patients with normal neurological exams. In these small-group sessions of six or fewer learners, the instructor actors emphasize examination technique, history-taking skills and organization of the ED report.

Following the practice session, participants reconvene for a presentation on the major stroke syndromes and conditions that mimic a stroke, such as hypoglycemia, drug overdose or brain tumor. In this session, paramedics learn the major divisions of the brain and their functions to help improve their rapid recognition of the five major stroke syndromes: 1) left hemisphere, 2) right hemisphere, 3) brainstem, 4) cerebellum and 5) hemorrhage (see Table 2). In addition, the paramedics learn to use clinical clues to differentiate a stroke from conditions with similar symptoms.

The next lecture covers the prehospital management of patients with suspected stroke (see Table 3) followed by the course highlight—a second small-group session in which the participants once again practice the MEND exam on paramedic instructors. This time, however, the instructors simulate stroke patients. Each instructor actor portrays a different stroke syndrome and participants rotate through four stations, perfecting their examination technique, diagnosing the stroke syndrome (based on examination and history) and concluding with a fictitious radio report to the ED to discuss the key aspects of the case.

Table 2b: Glossary

- **Crossed signs**: Weakness or numbness on one side of the face and the other side of the body.
- **Diplopia**: Vertical–double vision in which one image is seen at a higher level than the other.
- **Dysarthria**: Slurred, slurred or distorted speech caused by weakening of the tongue or other muscles essential to speech.
- **Discoconjugate gaze**: Failure of both eyes to move together.
- **Dysphagia**: Swallowing difficulty.
- **Gaze palsy**: Weakness of the eye muscles in which both eyes are fixed to the side or midline.
- **Hemiparesis**: Partial weakness on one side of the body.
- **Hemisensory loss**: Weakness or absence of sensation on one side of the body.
- **Light intolerance**: Also known as photophobia; abnormal reaction to light by the eyes.
- **Neglect**: Also called left hemi–inattention; a condition in which the patient does not acknowledge left-sided body parts; may include denial of visual or tactile stimulation on the left.
- **Quadriaparesis**: Partial weakness of all four limbs.
- **Tinnitus**: Ringing in the ears.
- **Truncal/gait ataxia**: Imbalance while walking; manifested by walking with a wide base.
- **Vertigo**: A sensation of movement that is not actually present; often described as a spinning sensation.
Extensive pre-course training enables the accurate portrayal of stroke patients by the instructor actors. Do they portray stroke patients realistically? When shown videotape of one paramedic instructor portraying a patient with a left hemispheric stroke, two world-renowned neurologists could not determine whether the patient was real or simulated. The course concludes with a presentation on field management issues, followed by a comprehensive review and the course post-test.

Participant satisfaction with the course remains high, and CRME currently works to disseminate this curriculum to all Florida community colleges with paramedic programs.

Conclusion
The goal of EMS training is to ensure the clinical competency of field providers. As a result of new stroke therapy, the role of the EMS provider in the care of acute stroke patients has expanded. EMS providers must have the ability to recognize, stabilize and rapidly transport acute stroke patients to appropriate medical facilities.

The University of Miami's interactive, hands-on course has proven an educational and enjoyable way for prehospital providers to prepare for their increased role. During the course, paramedic instructor actors realistically simulate stroke patients in order to teach paramedics a neurological examination more appropriate and informative than the traditional Glasgow Coma Scale when evaluating patients with focal neurological deficits. Paramedics learning with simulated patients have reacted positively.

For more information, contact the Center for Research in Medical Education, University of Miami School of Medicine, P.O. Box 016960 (D-41), Miami, Florida 33101, 305/243-6491 or e-mail dlacombe@umiami.edu.

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Table 3: Sample EMS Stroke Protocol

<table>
<thead>
<tr>
<th>HISTORY</th>
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<tbody>
<tr>
<td>• When was patient last known to be without symptoms?</td>
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<tr>
<td>• Did patient have a seizure or head injury at onset of symptoms?</td>
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<tr>
<td>• Is patient taking Coumadin?</td>
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<tr>
<td>• Obtain witness contact information</td>
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<table>
<thead>
<tr>
<th>EXAMINATION</th>
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<tbody>
<tr>
<td>• Perform three-step Cincinnati Prehospital Stroke Scale</td>
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<tr>
<td>• If time allows, perform Miami Emergency Neurological Deficit (MEND) exam (do not delay transport for the sake of performing exam.)</td>
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<tr>
<th>MANAGEMENT</th>
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<tbody>
<tr>
<td>Assess ABCs</td>
</tr>
<tr>
<td>• Maintain airway, straighten head</td>
</tr>
<tr>
<td>• Place 2–4L of O₂ via nasal cannula (only give higher flow if hypoxemia suspected)</td>
</tr>
<tr>
<td>Prevent Aspiration</td>
</tr>
<tr>
<td>• Keep patient NPO (i.e., give nothing by mouth)</td>
</tr>
<tr>
<td>• Elevate head of stretcher ≥ 30° at all times</td>
</tr>
<tr>
<td>• If emesis occurs, turn patient to lateral recovery position</td>
</tr>
<tr>
<td>Prevent Low Blood Pressure</td>
</tr>
<tr>
<td>• Do not treat high blood pressure</td>
</tr>
<tr>
<td>Prevent High Glucose</td>
</tr>
<tr>
<td>• Initiate IV NS 50–75 cc/hour (no dextrose solutions)</td>
</tr>
<tr>
<td>• Check blood glucose; administer thiamine and glucose only if glucose low (&lt; 50 mg/dL)</td>
</tr>
<tr>
<td>Transport &amp; Communicate</td>
</tr>
<tr>
<td>• Transport patient to appropriate destination without delay</td>
</tr>
<tr>
<td>• Advise medical control of stroke—patient status as soon as possible</td>
</tr>
</tbody>
</table>

Motor-leg drift: Ask the patient to lift one leg and hold for five seconds. Observe for drift. Repeat with other leg.

Sensory—Arms: Ask the patient to close his eyes and uncross his arms and legs. Gently touch or pinch each limb and determine if he can feel stimuli equally on both sides.

Coordination—Arms: Ask the patient to touch your finger with one finger; then touch his nose; then touch your finger again. Observe for limb ataxia (clumsiness or uncoordination). Repeat with other arm.

Coordination—Legs: Ask the patient to touch his knee with the heel of his opposite leg and slide the heel down the shin. Observe for limb ataxia. Repeat with other leg.
References

MEND Exam Facts
Valuable—Performing the MEND exam in the field establishes a baseline neurological status. Paramedics record the MEND exam results on their patient care report. Subsequent examinations, performed in the hospital, are compared with the MEND exam to determine improvement or deterioration in the patient's status. This is an important consideration when evaluating ischemic stroke patients for thrombolytic therapy.

Rapid—Providers can perform the exam in less than two minutes.

Reproducible—The exam's highly objective structure ensures consistency when performed by multiple examiners.

 Pertinent—The MEND exam is based on the same exam that hospital-based providers use (the NIH Stroke Scale) and incorporates the AHA-endorsed Cincinnati Prehospital Stroke Scale.

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