Prehospital Management of Stroke

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After returning home from the supermarket, a woman finds her 67-year-old husband in the kitchen with slurred speech and left-sided weakness. He was acting normally when she left the house earlier that evening. She immediately calls her friend across the street to ask for help. The friend arrives a few minutes later only to find that the patient’s symptoms are getting worse. They decide to call 911. EMS personnel arrive within 5 minutes of the call. Paramedics evaluate the patient and are concerned that the patient may be having a stroke. What are the important elements of the prehospital management of potential stroke patients?
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Introduction

Many healthcare professionals have been investigating strategies to improve the incidence and outcome from stroke, the third leading cause of death and a leading cause of adult disability in the United States. These initiatives have been met with some successes such as the FDA approval of tissue plasminogen activator (t-PA) for acute ischemic stroke victims. The philosophy that ‘time is brain’ is now considered as important as the ‘golden hour’ for trauma or early defibrillation for cardiac arrest victims. Due to its time dependency and the need for early intervention, prehospital care providers are considered an integral part in the Chain of Survival and Recovery.

At a minimum, the first four steps in the Chain of Survival and Recovery (detection, dispatch, delivery, door, data, decision, and drug) involve the participation and cooperation of EMS providers. These important roles of EMS are described below.2

- **Detection**: EMS personnel as well as laypersons should understand the symptoms of stroke and be able to recognize it early. Just as EMS personnel have been instrumental in educating their communities about the symptoms of a heart attack, so too should they play an important role in educating the public about stroke.

- **Dispatch**: As part of the educational campaign for stroke, laypersons should understand the important role of 911 in caring for stroke patients. Similarly, EMS dispatch protocols should reflect the emergent nature that stroke presents.

- **Delivery**: EMS personnel should be competent in the prehospital assessment and management of potential stroke victims. Initial patient stabilization and exclusion of other alternative etiologies should be performed in a timely fashion.

- **Door**: Patients should be triaged to appropriate hospitals capable of timely stroke care and intervention. Additionally, EMS personnel should assure a smooth transition of patient care from the prehospital setting. This includes direct contact with the healthcare providers of the receiving institution.

Regrettably, there is strong evidence that these principles of optimal prehospital stroke care have not been adequately taught to EMS personnel. ‘A Nationwide Prehospital Stroke Survey’ was published in Prehospital Emergency Care in 1999. Three hundred fifty-five EMS personnel participated in this survey (256 paramedics and 99 advanced EMTs). The authors found: (1) A lack of awareness/understanding of TIA; (2) A common sentiment that strokes could be managed non-emergently; and (3) Less than half of survey participants were aware of the 3-hour time window for IV tPA.3 A separate study by Kothari et al. found that paramedic diagnosis of stroke/TIA was correct in 72% of cases, yet EMS dispatchers correctly identified stroke/TIA in only 52% of cases. Interestingly, this same study found that the time to emergency department evaluation and computed tomography (CT) imaging was shorter when patients were transported by advanced life support (ALS) personnel compared to basic life support (BLS).4 The reasons for this difference require further investigation so that ALS and BLS responses can provide stroke patients with equal opportunities for early evaluation and intervention.
The most important piece of historical information that an EMS provider can obtain is the time of symptom onset, and prehospital care providers are often in a unique position to do so. Friends, family, or bystanders are often immediately available to prehospital personnel for questioning regarding historical details. EMS providers must remember that there is a difference between the actual time of symptom onset and the time that the patient’s symptoms were noticed. To identify the true time of symptom onset, EMS personnel should follow some simple guidelines.

First, EMS personnel should question multiple sources for historical information. By doing so, they will be able to determine if there is agreement among these sources of information. If the historical information is not consistent among friends, family, or other witnesses, then an attempt should be made to determine which source is most reliable.

Second, prehospital providers should employ ‘reference times’ when searching for the time of symptom onset. It is rare that people will be able to provide an exact time of symptom onset without relating it to a recent event. Subsequently, EMS personnel must be resourceful and try to establish a reliable time of onset based upon any surrounding events. For example, a family member may be able to remember that their father was acting normally when a basketball game started or the nightly news broadcast ended. By knowing when these events actually occurred in time, the time of onset can subsequently be determined. Therefore, the true time of symptom onset may be more easily established when related to a surrounding daily event. Determining the time of symptom onset can be greatly assisted when EMS personnel refer to ‘reference times’.

Finally, EMS personnel should determine the answers to two very important questions, ‘how normal was the patient prior to this event and how rapidly did the symptoms evolve?’ It is useful to know the patient’s baseline level of neurologic function prior to the current event. Some patients may have had prior strokes, for instance, and their usual level of neurologic function includes hemiparesis or slurred speech. Additionally, EMS personnel should try to determine if the patient’s symptoms had a stuttering pattern of progression or an abrupt onset. The time course of symptom onset can have important implications for the patient’s therapy in the hospital setting.

A frequent concern among prehospital care providers is the optimal method of stroke detection. After suspecting the presence of a stroke on a historical basis, EMS personnel are commonly unfamiliar with the physical examination techniques to evaluate for neurologic deficits. To accomplish this task, there are several validated prehospital stroke scales that EMS personnel can choose from. The first is the Cincinnati Prehospital Stroke Scale (CPSS). This involves an assessment for facial droop, arm drift, and slurred speech. Facial droop can be recognized after asking a patient to smile or show their teeth. Arm drift is assessed while a patient is asked to hold their arms fully extended 90° from the body for 10 seconds. Any downward drift or rotation of an arm or hand is considered to be abnormal. Finally, slurred speech can be tested by asking the patient to repeat a simple sentence. Any abnormalities in this three-item test should increase suspicion that a stroke has occurred.\(^5,6\) Other prehospital stroke scales include the Los Angeles Prehospital Stroke Scale\(^8\) or MEND.
When a patient or loved-one is concerned about a stroke, their first contact may be a critical decision. It is clear that ‘time is brain’, and maximal neuronal salvage can only be achieved with early care. EMS can offer this early care to stroke victims in two ways. First, when considering the time from symptom onset to emergency department arrival, the use of 911 results in a shorter time interval when compared to patients who contacted their private physicians first or went directly to the hospital. Second, EMS personnel can initiate appropriate stroke care well ahead of direct physician contact. While CT scanning and tPA administration must occur in the hospital setting, there are several components to stroke care that can be initiated in the prehospital setting by EMS personnel.

Airway, breathing, and circulation assessments are the foundation of emergency care and should be the first priority in stroke care just as it is in trauma management and cardiac arrest care. After the ABCs have been addressed, prehospital care providers should assess the patient’s vital signs including blood pressure, heart rate, and respiratory rate. A patient’s vital signs may suggest the reason for their symptoms and can often direct EMS personnel toward their next appropriate action. If the vital signs do not require any immediate actions on the part of the EMS personnel, then a concise history and physical should be obtained if it was not already sought during concurrent vital sign assessment. A very important component of the historical information is the time of symptom onset. Even if outside of the therapeutic window for intravenous or intra-arterial thrombolysis, knowing the time of symptom onset can be beneficial to the care of the patient. This may help in the interpretation of brain imaging and determining optimal patient management. Methods of determining the actual time of onset have been previously discussed. As part of the physical examination, EMS should determine the patient’s Glasgow Coma Score and perform a prehospital stroke scale assessment. Any patient with an altered mental status should have a serum blood sugar measured by EMS personnel trained and authorized to perform this procedure. It is important to understand that hypoglycemia can mimic the symptoms of a stroke and can be excluded only after objective blood sugar measurement. Adhering to the principle that ‘time is brain’, EMS personnel must arrange for rapid transport of any potential stroke victims to the nearest appropriate hospital. The destination emergency department should be notified as soon as possible so that qualified personnel and appropriate resources can be mobilized in anticipation of the patient’s arrival. For those EMS agencies capable of doing so while en route, intravenous access should be established as well as administration of oxygen and cardiac monitoring. The insertion of an IV and cardiac monitoring can be helpful for the recognition and management of arrhythmias. Oxygen has not demonstrated any definitive benefit but should certainly be provided to any patient with hypoxemia.

While it is important for EMS personnel to know what to do in the prehospital care of stroke patients, it is equally as important to understand what not to do. If some basics tenets of prehospital stroke care are not followed, EMS providers may fail to provide their patients with an optimal chance at full recovery. First, it is important to not delay transport. Time is brain, and with every minute that passes, the chances of full neurologic recovery are diminished. Second, EMS providers should not administer large volumes of fluid unless the patient is in shock. Large boluses of crystalloid may result in worsening brain edema and subsequent herniation. Third, dextrose should only be
administered in the setting of hypoglycemia. It is uncertain whether hyperglycemia worsens outcomes from stroke, but until further data is available, dextrose should only be utilized in the setting of hypoglycemia. Fourth, the prehospital reduction of elevated blood pressure should be avoided. Precipitous drops in blood pressure may worsen or precipitate an ischemic insult.

While the fight against stroke has achieved some successes, there is still a great deal of work to be done and many questions to be answered. The vision of stroke care in the new millennium is bold and bright. It is important for EMS providers to understand the long-term goals of stroke experts and to include themselves as part of this ongoing process of improved stroke care. During the next ten years, we plan to: (1) Increase public education relating to stroke; (2) Continue the development of stroke protocols and teams in order to deliver a unified approach; and (3) Continue to develop the pivotal and expanding role of prehospital care.

In summary, EMS personnel must receive more stroke education so that they are capable of providing rapid recognition and optimal management of stroke patients. They must also recognize the importance of determining the time of symptom onset and make every effort to investigate this. Calling destination hospitals early and transferring patients immediately underscores the time advantage that EMS can offer. And above all else, EMS personnel must remember that stroke is an EMERGENCY!
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Case Outcome

When the paramedics arrived, their first action was to evaluate the patient’s airway, breathing, and circulation status. Since these were found to be adequate, the patient’s vital signs were then assessed. The results were as follows: blood pressure = 180/96, heart rate = 106, and respiratory rate = 22. While one paramedic then acquired some history from the patient’s wife, the other paramedic performed a concise physical examination that included a Glasgow Coma Score (GCS) and a prehospital stroke scale assessment.

Based upon the wife’s account, her husband was acting normally 45 minutes earlier when she went grocery shopping. He has never had symptoms like this before and is otherwise a very healthy person. She did not know what to do, so she called her friend across the street. By the time she arrived, he was getting worse, so she called 911. By this time, the second paramedic has determined that the patient has a GCS of 13 (E4 V3 M6). The prehospital stroke scale reveals the presence of left-sided facial droop, left-sided arm drift, and slurred speech.

The paramedics then measure the patient’s blood sugar and oxygen saturation. Both are found to be normal. They explain to the patient’s wife that her husband appears to be having a stroke. Time is critical, and they encourage her to come with them since her assistance may be needed. The patient is promptly transferred to the ambulance. While en route to the hospital, an IV is established, and the patient is placed on a cardiac monitor and low flow oxygen. The receiving hospital is contacted during the patient’s transport. Upon their arrival at the Emergency Department, the staff have already vacated a room and the physician begins evaluating the patient immediately.
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Annotated Bibliography


This study evaluated the proportion of EMS responses that involve stroke patients as well as the accuracy of paramedics and medical dispatchers to correctly identify these patients. Approximately 2% of all EMS responses in this study involved patients with stroke or TIA. Paramedics were found to have 72% accuracy in identifying these patients while dispatchers were only 52% accurate. Many of the patients that were incorrectly thought to have stroke-related symptoms still required advanced life support intervention.


This article addresses the educational issues relating to the prehospital care of stroke patients. It describes the current knowledge-base, physical examination skills, and management strategies of EMT-Basics and paramedics for stroke patients. It then outlines future goals for the prehospital management of stroke patients by EMS personnel. Sample protocols for EMT-Basics and paramedics are provided.


This article provides a concise overview of the current recommendations for the prehospital management of stroke patients. The recommendations address dispatch issues, prehospital medical care issues, and access to care. It also provides research recommendations for the future.
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Questions

1. **What is the most important piece of historical information that should be acquired relating to a stroke patient?**
   
a. History of stroke previously  
b. History of diabetes  
c. Time of symptom onset  
d. Recent use of drugs or alcohol

2. **At what level should attempts be made to reduce blood pressure in the prehospital setting?**
   
a. 140/90  
b. 180/105  
c. 220/120  
d. Never reduce BP in the prehospital setting unless instructed to do so by a medical command physician.

3. **Which of the following is NOT an important component in the prehospital care of stroke patients?**
   
a. Determine the time of symptom onset  
b. Call the destination hospital early  
c. Acquire a 12-lead EKG  
d. Transfer the patient as soon as possible

4. **Which of the following should be performed on any patient with an altered mental status or neurologic deficits?**
   
a. Measure the serum blood sugar  
b. Administer large volumes of intravenous crystalloid solution  
c. Keep the systolic blood pressure below 100 mmHg

5. **When obtaining historical information on a potential stroke victim, which of the following is routinely recommended?**
   
a. Question multiple sources  
b. Determine the patient’s previous baseline neurologic function level  
c. Establish the time of symptom onset using ‘reference times’  
d. All of the above
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Answers

1. **Answer c.** The most important piece of historical information that can be acquired is the time of symptom onset. A history of stroke, diabetes, or recent drug/alcohol use can help healthcare professionals to provide appropriate patient care, but the time of symptom onset frequently dictates the methods of stroke intervention and care.

2. **Answer d.** The prehospital reduction of elevated blood pressure should be avoided. Precipitous drops in blood pressure may worsen or precipitate an ischemic insult.

3. **Answer c.** Acquiring a 12-lead EKG is not an important component in the prehospital care of stroke patients. Determining the time of symptom onset is important for purposes of selecting optimal treatment and intervention modalities. Transporting the patient rapidly and notifying the destination hospital early are important steps in the efficient management of potential stroke victims. Remember, time is brain!

4. **Answer a.** Any patient with an altered mental status or neurologic deficits should have a serum blood sugar measured by a trained individual. Large volumes of intravenous crystalloid solution can worsen cerebral edema. Additionally, blood pressure should not be reduced in the prehospital setting as noted in question #2.

5. **Answer d.** EMS personnel should question multiple sources for historical information. By doing so, they will be able to determine if there is agreement among these sources of information. Prehospital providers must also be resourceful and try to establish a reliable time of onset based upon any surrounding events. Lastly, it is useful to know the patient’s baseline level of neurologic function prior to the current event. Some patients may have had prior strokes, for instance, and their usual level of neurologic function includes hemiparesis or slurred speech.