Lack of Impact of Paramedic Training and Use of the Cincinnati Prehospital Stroke Scale on Stroke Patient Identification and On-Scene Time

Daniel M. Frendl, BA, EMT-B; David G. Strauss, BA, EMT-I; B. Kevin Underhill, EMT-P; Larry B. Goldstein, MD, FAAN, FAHA

Background and Purpose—The Cincinnati Prehospital Stroke Scale (CPSS) is recommended for emergency medical services use in identifying patients with stroke. Data evaluating its performance in the field are limited. We assessed the impact of training and use of the CPSS on the accuracy of paramedics’ stroke patient identification and on-scene time.

Methods—A 1-hour interactive educational presentation on the use of the CPSS was conducted for paramedics transporting patients to an academic medical center. Patients with stroke/transient ischemic attack (TIA) were identified retrospectively from paramedic records and were compared with the hospital’s prospective stroke registry for the year before and after the training.

Results—There were 154 patients with suspected stroke/transient ischemic attack identified (56% women, 53% white, 44% black, mean age 67±16 years). There was no difference in paramedics’ use of the CPSS (37.5% versus 23.8%, P=0.123) or accuracy of stroke/TIA patient identification (40.5% versus 38.9%, P=0.859) before and after training. Of responsive patients identified by paramedics as having a stroke/TIA, 57% had an abnormality in at least one CPSS item with no effect on on-scene time (17±6 minutes with a normal versus 18±6 minutes with an abnormal CPSS, P=0.492). Those with a final diagnosis of stroke/TIA (n=61, 40%) more frequently had at least one abnormal CPSS item (70% versus 30%, P=0.008, sensitivity 0.71, specificity 0.52) with 49% of patients with an abnormality having a discharge diagnosis of stroke/TIA.

Conclusions—Paramedic training in the CPSS, or its use, had no impact on the accuracy of their identification of patients with stroke/TIA or on-scene time.

Keywords: diagnosis ■ emergency services ■ stroke

The benefit of thrombolytic therapy in patients with acute ischemic stroke increases as the time between symptom onset and treatment decreases.1 Patients with stroke who use 911 to contact emergency medical services (EMS) for transport to the hospital have shorter times to both hospital arrival2–6 and physician evaluation.5,7–9 To minimize delays and increase the numbers of potentially treatable patients, the American Stroke Association recommends rapid access to EMS that use diagnostic algorithms to efficiently identify, triage, and transport patients with acute stroke to an appropriate center.10

A variety of systems have been developed to aid emergency medical technicians and paramedics in successfully identifying patients with stroke. The American Stroke Association recommends EMS use algorithms such as the Los Angeles Prehospital Stroke Scale or the Cincinnati Prehospital Stroke Scale (CPSS) for this purpose.10 The CPSS evaluates facial droop, arm drift, and speech clarity. Previous work has found good agreement between physicians and paramedics using the CPSS in an emergency department setting.11 There are, however, only limited data assessing its performance when used by EMS personnel in the field. Our primary aim was to assess the impact of routine training and use of the CPSS on the accuracy of EMS personnel’s identification of patients with stroke and on-scene time.

Subjects and Methods

Emergency Medical Services System and Training Module

Durham County Emergency Medical Services (DC-EMS) provides Advanced Life Support level, paramedic, emergency ambulance service in Durham County, North Carolina (catchment population approximately 275,000). Ambulance crews may be comprised of 2 paramedics or a paramedic and an emergency medical technician–intermediate. DC-EMS operates 11 ambulances that transport patients with stroke to either Duke University Medical Center or a community hospital also located in the county. DC-EMS patient care protocols include the use of the CPSS in screening all patients with suspected stroke.
A 1-hour long interactive educational presentation for DC-EMS personnel was conducted in November 2004 focusing on stroke recognition and the use of the CPSS. The session was a component of standard monthly continuing education required for all EMS personnel. Written materials describing the use of the CPSS were provided and the session videotaped for later review by DC-EMS personnel.

**Subjects**

Durham County EMS uses standard codes to indicate the reason for transport for all patients. All patients transported by DC-EMS to Duke University Medical Center and coded by EMS as having a possible stroke or transient ischemic attack (TIA) were identified retrospectively by review of computerized and paper-based paramedic records for the year before and after training regardless of whether or not an abnormality was noted for a CPSS item. These records were then compared with the hospital’s prospective stroke registry for the same period. The stroke registry includes all patients admitted to the study hospital with a discharge diagnosis of stroke or TIA. Those not in the registry had other conditions. The hospital-based stroke diagnosis is based on standard clinical criteria including the results of neuroimaging studies. Patients identified by EMS as being “unresponsive” were excluded.

**Data Analysis**

EMS report forms and paramedic narratives were evaluated for documentation of the CPSS. Documentation of the presence or absence of facial droop, speech deficit, and arm drift were considered as evidence of having completed the CPSS if the use of the scale was not explicitly noted. Additionally, other means of stroke screening, including documentation of grip strength, visual abnormalities, and numbness or tingling, were recorded to explore their impact on the accuracy of the assessment. If no paramedic narrative was available, documentation of the CPSS was used to determine whether or not an abnormality was noted for a CPSS item. Those with a final diagnosis of stroke or TIA (n = 191) more frequently had at least one abnormal CPSS item (70% versus 30% with no CPSS abnormality, P < 0.001; sensitivity 0.71, 95% CI 0.58 to 0.80; specificity 0.52, 95% CI 0.42 to 0.62). In cases in which paramedics documented assessment of all elements of the CPSS, the positive predictive value of having at least one abnormality was 0.52, negative predictive value 0.64, sensitivity 0.74, and specificity 0.41 (Table).

Alternative methods of stroke screening using elements not included in the CPSS were often documented (51% [n = 79]) with 32% of patients presenting with a non-CPSS abnormality. These included reduced grip strength (12% abnormal [n = 19]), visual deficits (14% abnormal [n = 22]), or numbness or tingling (13% abnormal [n = 20]). No patient with a negative CPSS had documented abnormalities in grip strength. Patients with a negative CPSS were equally likely to have documented normal vision or a visual abnormality (5% abnormal, 5% normal). Patients with a negative CPSS more frequently had documented numbness or tingling (8% abnormal, 3% normal). Of the total patient population, 68% had an abnormality in at least one component of the CPSS, grip strength, vision, numbness, or tingling. Of patients with a final diagnosis of stroke or TIA, 94% had an abnormality in at least one of these elements (sensitivity 0.94, specificity 0.20, positive predictive value 0.47, negative predictive value 0.83). For patients with a final diagnosis of stroke or TIA for whom the data were recorded, 11.5% had an abnormality of grip strength, vision, or numbness/tingling but a normal CPSS (16% of those with a noncerebrovascular final diagnosis and a normal CPSS had one of these abnormalities).

On-scene time for patients with stroke/TIA did not vary significantly before as compared with after the training in the use of the CPSS (19 ± 6 minutes versus 17 ± 6 minutes, mean ± SD; P = 0.08). In addition, the presence of a documented CPSS item abnormality had no significant effect on paramedic’s on-scene time (17 ± 6 minutes with a normal CPSS versus 18 ± 6 minutes with an abnormal CPSS, P = 0.492). There was no significant reduction in the accuracy of the paramedics’ use of the CPSS (37.5% versus 23.3%, P = 0.123) or in the accuracy of the paramedic’s stroke/TIA identification (40.5% versus 38.9%, P = 0.859) before as compared with after training were not significant.

Of responsive patients with a paramedic-identified stroke or TIA, 57% had an abnormality in at least one CPSS item. Those with a final diagnosis of stroke or TIA (n = 61 [40%]) more frequently had at least one abnormal CPSS item (70% versus 30% with no CPSS abnormality, P < 0.001; sensitivity 0.71, 95% CI 0.58 to 0.80; specificity 0.52, 95% CI 0.42 to 0.62). In cases in which paramedics documented assessment of all elements of the CPSS, the positive predictive value of having at least one abnormality was 0.52, negative predictive value 0.64, sensitivity 0.74, and specificity 0.41 (Table).

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**Table. Test Characteristics of the CPSS as Used in the Field as Compared With Final Diagnosis After Hospital Evaluation**

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Positive Predictive Value</th>
<th>Negative Predictive Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any CPSS item abnormal and/or deficit in grip, vision, numbness/tingling</td>
<td>0.94 (0.84–0.98)</td>
<td>0.20 (0.13–0.31)</td>
<td>0.47 (0.38–0.57)</td>
<td>0.83 (0.59–0.94)</td>
</tr>
<tr>
<td>Any CPSS items documented abnormal</td>
<td>0.71 (0.58–0.80)</td>
<td>0.52 (0.42–0.62)</td>
<td>0.49 (0.39–0.59)</td>
<td>0.73 (0.61–0.82)</td>
</tr>
<tr>
<td>Complete CPSS and ≥1 item abnormal</td>
<td>0.74 (0.51–0.88)</td>
<td>0.41 (0.23–0.61)</td>
<td>0.52 (0.34–0.69)</td>
<td>0.64 (0.39–0.84)</td>
</tr>
<tr>
<td>Complete CPSS and ≥2 items abnormal</td>
<td>0.37 (0.19–0.59)</td>
<td>0.64 (0.43–0.80)</td>
<td>0.47 (0.25–0.70)</td>
<td>0.54 (0.36–0.71)</td>
</tr>
<tr>
<td>Complete CPSS and 3 items abnormal</td>
<td>0.21 (0.09–0.43)</td>
<td>0.73 (0.52–0.87)</td>
<td>0.40 (0.17–0.87)</td>
<td>0.52 (0.35–0.68)</td>
</tr>
</tbody>
</table>

Those considered to have a complete CPSS had documentation of the presence or absence of facial droop, speech deficit, and arm drift if the use of the scale was not explicitly noted. Calculations include those with no abnormalities for any of the items. Numbers in parentheses reflect 95% CIs.
Discussion

The primary finding of this study is that simple EMS training in the CPSS, or its use, had no impact on paramedic’s stroke/TIA identification accuracy or on-scene time. Routine training in the use of the scale did not influence how often it was actually used. We found 70% of patients with a final diagnosis of stroke had at least one documented CPSS abnormality. Of patients presenting with a CPSS abnormality, however, less than half had a final diagnosis of stroke or TIA, reflecting the low specificity of the scale as used in the field. This raises important questions regarding the scale’s usefulness for prehospital patient identification and triage.

Prior work found that the CPSS is reliable and reproducible in an emergency department setting with a coefficient of correlation of 0.89 (95% CI, 0.87 to 0.92) between physicians and EMS personnel.11 In the emergency department, the CPSS had a 0.66 sensitivity (95% CI, 0.49 to 0.80) and 0.87 specificity (95% CI, 0.80 to 0.92). Our study found similar sensitivity (0.71; 95% CI, 0.58 to 0.80) but somewhat poorer specificity (0.52; 95% CI, 0.42 to 0.62) when used in the field. Given the diversity of their call volume, this may be due to the reduced frequency with which EMS personnel practice stroke screening in the field or may be due to other factors, including differences in patient populations between the 2 studies. Whether improvements can be achieved with more extensive training or through ongoing performance improvement programs requires further study.

Although based on an exploratory analysis, our data suggest that the sensitivity of EMS stroke/TIA screening increases greatly when assessments of grip strength, visual deficits, and numbness and tingling are added to the CPSS (11.5% of patients with a final diagnosis of stroke or TIA had a normal CPSS but one of these other abnormalities). This increased sensitivity, however, comes at the cost of a great decrease in specificity. If the goal of EMS stroke screening is to identify the greatest number of patients with potential stroke/TIA, increasing screening elements is of benefit. Such a screening measure be used for activating in-hospital stroke teams, the number of false-positive cases may, however, be unsustainably high. If prehospital screening is to be used for costly transport diversion, specificity must improve beyond the 52% found in our study. The CPSS may need to be re-evaluated as a key prehospital stroke screening tool, especially because EMS systems are increasingly relied on to triage patients with suspected stroke/TIA.

Given that this retrospective study relied on EMS documentation as an indication of performance of stroke screening measures, our results may be biased if documentation was incomplete or inadequate. This may be particularly true for the non-CRSS measures. As a system, however, DC-EMS encourages clear documentation of key screening steps, and there was high consistency between paramedic narrative reporting styles.

Further study of the CPSS and similar stroke scales in the field will be necessary to optimize their use in helping to identify and triage patients with suspected stroke or TIA. Of note, the EMS system studied in this report recently implemented a program in which paramedics directly contact cardiac catheterization laboratory personnel for patients with symptoms suggestive of an acute coronary syndrome and having ST elevation on 12-lead electrocardiogram. This was successful in reducing the time to reperfusion treatment.12 A similar system may be possible for patients with acute stroke. Prospective studies carried out in the prehospital setting should further evaluate the CPSS and additional stroke screening tools, specifically including the elements associated with increased sensitivity that were identified in our exploratory analysis.

Source of Funding

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Disclosures

None.

References

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