Agreement Between Ambulance Paramedic- and Physician-Recorded Neurological Signs With Face Arm Speech Test (FAST) in Acute Stroke Patients

A. Mohd Nor, MRCP; C. McAllister; S.J. Louw, FRCP; A.G. Dyker, MD; M. Davis, MD; D. Jenkinson, PhD; G.A. Ford, FRCP

Background and Purpose—Patients with suspected stroke first assessed by ambulance paramedics require early recognition to facilitate appropriate triage and early treatment. We determined paramedic’s accuracy in detecting acute stroke signs by comparing agreement between neurological signs recorded in the Face Arm Speech Test (FAST), a stroke recognition instrument, by paramedics on the scene and by stroke physicians after admission.

Methods—Suspected stroke patients admitted by ambulance paramedics directly to an acute stroke unit through a rapid ambulance protocol were examined by a trainee stroke neurologist or admitting stroke physician over a 1-year period. Recorded neurological signs (facial weakness, arm weakness, speech disturbance) in confirmed acute stroke/transient ischemic attack (TIA) cases were compared between paramedics and the stroke neurologist/physician.

Results—Ambulance crews referred 278 suspected stroke patients of whom 217 (78%) had confirmed stroke (n=189) or TIA (n=28); 95% were examined by the stroke neurologist (median 18 hours after paramedic assessment). Recorded signs and agreement between paramedics and stroke physicians in confirmed stroke group were: facial weakness, 68% versus 70% (κ=0.49; 95% CI: 0.36 to 0.62); arm weakness, 96% versus 95% (κ=0.77; 95% CI: 0.55 to 0.99); and speech disturbance, 79% versus 77% (κ=0.69; 95% CI: 0.56 to 0.82). Interrater agreement was complete for arm weakness in 98% cases.

Conclusions—Recognition of neurological deficits by ambulance paramedics using FAST shows good agreement with physician assessment, even allowing for temporal evolution of deficits. The high prevalence and good agreement for arm weakness suggest that this sign may have the greatest usefulness for prehospital ambulance triage and paramedic-based neuroprotective trials. (Stroke. 2004;35:1355-1359.)

Key Words: stroke ■ emergency medical services

Accurate identification of stroke by prehospital personnel could expedite triage of patients to acute stroke units and facilitate delivery of acute stroke therapies either in hospital or in the community. Prehospital stroke recognition instruments were introduced in the mid 1990s in the USA (Los Angeles Paramedic Stroke Scale [LAPSS] and Cincinnati Prehospital Stroke Scale [CPSS]) and in the late 1990s in the UK (Face Arm Speech Test [FAST], a modification of the Cincinnati scale).1–4 We incorporated the FAST in 1998 into a rapid ambulance protocol to improve the rapid triage of patients with suspected acute stroke to our acute stroke unit (ASU).5

Considerable data exist for interobserver reliability in the identification of neurological signs in acute stroke and in the classification of stroke subtype comparing neurologists, other physicians, and specialist nurses.6,7 However, data are sparse comparing paramedics with physicians and, to our knowledge, there have been no studies published to date that have assessed the agreement for neurological signs that are recorded in routine practice. Moderate to excellent agreement has been reported between stroke neurologists/physicians, although this varies depending on the signs examined. Agreement for hemiparesis is better than for hemianopia or limb ataxia.8 Moderate to excellent agreement has been confirmed between neurologists and trained research nurses using the National Institute of Health Stroke Scale (NIHSS).9

We determined the interobserver agreement between ambulance paramedics and stroke physicians in acute stroke patients triaged by a rapid ambulance protocol for the component neurological signs of the FAST stroke diagnosis instrument.

Subjects and Methods

Ambulance Service and Training Package
The North East Ambulance Service (NEAS) provides the emergency ambulance service to our study population in Newcastle-on-Tyne

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and neighboring areas (catchment population ~300,000) in addition to the surrounding North East region (total catchment population of ~2 million, covering an area of 3000 square miles) of the UK. Each ambulance crew usually comprises an ambulance technician and a paramedic. Eighty-seven crew members assess and transport suspected stroke patients to our service. Ambulance technicians undergo an 8-week Institute of Health Care Development Ambulance Aid program with a probation period of at least 12 months before they are deemed competent. Paramedics are selected from technicians who have completed 18 months of qualified practice and receive 6 weeks classroom-based training, followed by a 4-week hospital placement. Training in the use of the FAST is an integral component of the paramedic training module and is incorporated in the paramedic’s patient report form (PRF) used in the field.

FAST Prehospital Stroke Recognition Instrument

FAST was developed in 1998 as a stroke identification instrument by a group of stroke physicians, ambulance personnel, and an emergency room physician. It was designed to be an integral part of a training package for UK ambulance personnel and has been described in detail elsewhere. As with the CPSS, the FAST consists of 3 items (facial weakness, arm weakness, and speech disturbance) but avoids the need for the patient to repeat a sentence as a measure of speech. Instead, language fluency and clarity are assessed by the paramedic during conversation with the patient.

Subjects

All suspected stroke/transient ischemic attack (TIA) patients referred to our ASU by paramedics through the Rapid Ambulance Protocol were prospectively studied over a 1-year period (August 2001 to July 2002). Stroke was defined according to the World Health Organization criteria of a focal or global neurological deficit with symptoms lasting for 24 hours or more, or resulting in death before 24 hours, which was considered to be caused by a vascular cause after investigations. TIA was defined as a sudden loss of neurological function, lasting <24 hours, caused by oclusive thromboembolic cerebrovascular disease. No patients with amaurosis fugax were admitted via the protocol. All patients with confirmed acute stroke/TIA were examined by the trainee stroke neurologist (A.M.N.; 3 years of neurology training and certified in the use of NIH Stroke Scale) or senior admitting stroke physicians (specialist registrar or consultant). The majority (95%) of suspected stroke patients in this study had their history reviewed and full neurological examination performed by the trainee stroke neurologist. In the remainder (5%), the history and examination findings recorded by the senior stroke physician who had seen the patient were taken retrospectively from patients’ clinical notes. Patients with confirmed stroke or TIA who were initially seen by paramedics and taken to the emergency room at another hospital and then transferred to the stroke unit were not included in the analysis because of greater delays between paramedic and admitting stroke physician assessments.

Analysis was confined to confirmed acute stroke cases in which neurological findings were compared between paramedics (recorded FAST findings on the patient’s ambulance patient report form) and the research neurologist or stroke physicians. The three signs compared were facial weakness, arm weakness, and speech disturbance (dysphasia or dysarthria). When comparing the assessments of ambulance paramedics with those of stroke physicians, TIA patients were excluded to reduce the influence of resolution of signs between paramedic and physician assessment. Nonstroke patients were also excluded but analyzed separately.

The time delay between the assessments performed by the paramedics and the research neurologist/admitting stroke physician was recorded. The final discharge diagnosis of stroke/TIA or other diagnosis was confirmed by the clinical stroke team, based on a combination of clinical features and findings on brain imaging (computed tomography or magnetic resonance imaging), which was performed in all stroke patients. Strokes were classified according to the Oxford Community Stroke Project (OCSP) categories. The study was discussed with the local research ethics committee members who approved the study as a patient audit. Verbal consent was obtained from patients to be examined by the trainee stroke neurologist and for the collection and analysis of data.

Data Analysis

Data were recorded in a secure computerized database program (Access 2000, Microsoft) compliant with UK Data Protection legislation. The observed agreement for each component of FAST sign in confirmed stroke cases was recorded. In cases in which the paramedic had checked the “uncertain” box, this was taken as indicating “yes,” because in all confirmed stroke cases, the sign was observed to be present by the assessing physician. Contingency tables were generated and interobserver agreement was assessed using Cohen kappa statistics (κ). The strength of agreement for κ values are: poor, 0 to 0.2; fair, 0.21 to 0.40; moderate, 0.41 to 0.60; good, 0.61 to 0.80; and excellent, 0.81 to 1.0. Statistical analyses were performed using SPSS version 10 (SPSS UK Ltd).

Results

Two hundred seventy-eight suspected stroke patients were referred via the rapid ambulance protocol, of which 217 (78%) were confirmed to have had a stroke (n=189) or TIA (n=28). Ninety-five percent of total referrals and 98% of stroke cases (185/189) were examined by the trainee stroke neurologist. The median time delay from assessment by the paramedics to examination by the trainee stroke neurologist or admitting stroke physician for cases with confirmed stroke was 18 hours (interquartile range, 8 to 24 hours). Patients’ demographic data and OCSP stroke subtype classification are shown in Table 1. Anterior circulation infarction constituted almost half of the referrals with few posterior circulation strokes. Diagnoses in nonstroke cases were: seizure (17), sepsis (9), syncope (7), metabolic (7; 6 hypoglycemia, 1 hyponatremia), brain tumor (4), functional/psychological (3), migraine (2), deteriorating dementia (2), subarachnoid hemorrhage (2), labyrinthitis (1), subdural hematoma (1), parkinsonism (1), neuropathy/radiculopathy (1), medication-related (1), alcohol-related (1), paraneoplastic syndrome (1), and extradural hematoma (1).

Paramedics performed and recorded FAST findings on the PRF in all 278 referrals. Prevalence of each finding for stroke, TIA, and nonstroke groups is shown in Table 2. The most prevalent sign in confirmed acute stroke patients was arm weakness, which was present in 96% of patients. FAST signs were present in 79% (22/28) of the patients who were admitted with TIA. During the same period, 38% (116) of patients with confirmed stroke and 67% (37) of patients with

### Table 1. Patient Demographic and Clinical Stroke Types by OCSP Classification

<table>
<thead>
<tr>
<th>Total Referrals for Stroke/TIA</th>
<th>217</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men, N (%)</td>
<td>114 (53)</td>
</tr>
<tr>
<td>Age, y (median [IQR])</td>
<td>76 (66-82)</td>
</tr>
<tr>
<td>Stroke Subtypes N (%)</td>
<td>58 (27)</td>
</tr>
<tr>
<td>Total anterior circulation infarction</td>
<td>42 (19)</td>
</tr>
<tr>
<td>Partial anterior circulation infarction</td>
<td>51 (23)</td>
</tr>
<tr>
<td>Lacunar circulation infarction</td>
<td>51 (23)</td>
</tr>
<tr>
<td>Posterior circulation infarction</td>
<td>10 (5)</td>
</tr>
<tr>
<td>Primary intracerebral hemorrhage</td>
<td>28 (13)</td>
</tr>
<tr>
<td>TIA</td>
<td>28 (13)</td>
</tr>
</tbody>
</table>
confirmed TIA were initially taken to the emergency room. Analysis of admitting physician findings in all patients with confirmed stroke indicated that 87% (266/305) had arm weakness, 62% (189) had facial weakness, and 72% (220) had speech disturbance. FAST signs were absent on stroke physician assessment in 3.6% (11/305) of all patients admitted with confirmed stroke (2/189). Twenty-five patients with posterior circulation infarcts initially presented to paramedics, of which 21 had completed FAST forms (10/10 admitted via the rapid ambulance protocol; 11/15 taken to the emergency room). Of these, 62% (13/21) were FAST-positive: facial weakness in 3 patients, arm weakness in 5, and speech disturbance in 12.

The respective prevalence rates of FAST signs recorded by paramedics and physicians in confirmed stroke patients is shown in Figure. Agreement between paramedics and physicians for each FAST neurological sign is shown in Table 3. In all cases of confirmed stroke in which the paramedic was uncertain about the presence of a sign, it was assessed as present by the assessing physician. The uncertain category was therefore included as indicating presence of the sign when calculating kappa values. Good agreement (κ: 0.61 to 0.80) was seen for arm weakness (κ=0.77; 95% CI: 0.55 to 0.99) and speech disturbance (κ=0.69; 95% CI: 0.56 to 0.82), and moderate agreement was seen for facial weakness (κ=0.49; 95% CI: 0.36 to 0.62). Results were not significantly different when the paramedic-uncertain categories were excluded from the analysis (data not shown). Complete agreement for each neurological sign was: facial weakness, 78%; arm weakness, 98%; and speech disturbance, 89%. Analysis of agreement of neurological signs in nonstroke/TIA patients is shown in Table 4. Disagreement for nonstroke cases was mainly because of paramedics but not the assessing physicians recording a sign as present. In the 15 nonstroke cases in which disagreement for the presence of arm weakness was seen, the diagnoses were as follows: hypoglycemia (4), sepsis (3), seizures (2), psychological (2), Parkinsonism (1), radiculopathy (1), migraine (1), and subdural hematoma (1).

Discussion

This study is the largest and the first clinical practice (nonexperimental) study in which the ability of ambulance paramedics to detect specific neurological signs in acute stroke patients has been compared with that of stroke physicians or neurologists. Recognition of neurological deficits by ambulance paramedics using the FAST shows moderate to excellent agreement with stroke physicians despite significant time delays between the 2 sets of observations, during which evolution of deficits might have occurred. Arm weakness was present in 95% of patients and showed near-excellent agreement, suggesting that this may be the most appropriate clinical finding to use in triage and paramedic intervention studies.

Acute stroke is a dynamic process and fluctuation in clinical signs is a well-recognized entity, particularly within...
the first 24 to 48 hours of stroke onset. Previous studies in which the interrater agreement in acute stroke diagnosis has been assessed have focused principally on neurologists/physicians and to a smaller extent on stroke research nurses. Lindley et al.\(^4\) have shown good interobserver agreement between physicians for neurological signs, such as hemiparesis and dysphasia, but poor agreement for sensory signs in 85 stroke patients assessed by 2 physicians, with an average time between assessments of 1.5 days. Despite temporal differences in assessment time, the reproducibility of motor and speech signs was considered to be reasonable. These findings were fairly comparable to other groups.\(^14\) Other studies have also shown good interobserver agreement between physicians, especially for signs relating to motor weakness and speech impairment (Table 5). In a community study by Dewey et al.\(^9\) of 31 stroke patients who were predominantly assessed in a nonacute setting by a group of trained stroke nurses and by 2 neurologists, good agreement was reported between doctors and nurses for assessment of motor and speech signs. We found less good agreement between paramedics and physicians for nonstroke cases. This is likely to be caused by resolution of signs between assessments. In the 15 cases in which disagreement for arm weakness was present, 8 had a diagnosis (hypoglycemia, seizure, migraine, and subdural hematoma) for which an early resolution of motor weakness might be expected. Our observations emphasize the importance of paramedics considering and excluding hypoglycemia as a stroke mimic, because this accounted for 2% (6/278) of suspected stroke cases presenting directly to paramedics. The FAST currently includes a “?” box for paramedics to use if they are uncertain about the presence of a sign. In most cases, we found a sign recorded as suspected or uncertain to be present on physician assessment. These observations support removing the uncertain “?” box from FAST.

The only published study that specifically evaluates interrater agreement between paramedics and neurologists/stroke physicians is from the Cincinnati group.\(^1\) It involved a small group of paramedics in a predominantly nonacute study setting who simultaneously scored their findings based on assessment of stroke patients by a physician. They showed impressive overall intraclass correlation coefficients, with the best agreement on arm weakness. This study is limited by its design (as acknowledged by the authors) being unrepresentative of routine clinical practice. Additionally, prehospital personnel were instructed to score the findings on examinations undertaken by a neurologist without having to elicit the signs themselves, which, again, is not reflective of their clinical abilities or representative of the routine practice of prehospital personnel. These differences in study design might be expected to lead to greater agreement between paramedics and physicians than in a clinical practice comparison study such as ours. It is difficult to compare the results of this study directly with our results because of differences in the methodology and in the statistical analysis for interrater reliability. Despite the use of a different scale to measure agreement (ICC and Kappa), it is of note that both studies demonstrate that arm weakness is the most reliable sign, followed by speech impairment and facial weakness.

The findings of our study are similar to other studies, although only 1 of these involves paramedics comparing interobserver agreement for neurological signs after acute stroke.\(^1,7,8\) It confirms previous observations of physicians and trained nurses that arm weakness is the sign with the best interobserver agreement.\(^9\) Facial weakness is a less reliable sign compared with motor weakness or speech impairment. In contrast to other clinical stroke diagnostic instrument studies, our study was performed to look specifically at the usefulness of FAST in the setting of daily clinical practice, and the results are likely to be generalizable to routine clinical practice. Additionally, our study has also involved the largest number of stroke patients and paramedic teams to date.

Fewer posterior circulation strokes were represented in this study compared with the typical prevalence in community studies.\(^14\) A number of reasons may account for this discrepancy. Like other prehospital stroke instruments, the FAST is less sensitive in detecting posterior circulation syndrome strokes unless they are accompanied by face/arm weakness or speech disturbance.\(^1,3\) In the small number of patients with posterior circulation events presenting directly to paramedics, FAST was positive in approximately two thirds. In fact, many other studies have consistently shown the poor reproducibility of posterior circulatory signs, such as limb ataxia.\(^7,9,15\) Furthermore, it has been shown that posterior circulation stroke is difficult to diagnose, even by physicians.\(^16\) It is noteworthy, however, that a relatively small proportion of posterior circulation strokes present directly to paramedicprehospital services; during the present study period, posterior circulation stroke comprised only 5% of total stroke/TIA referrals.

We suggest that the FAST assessment may be sufficiently reliable to use as a stroke diagnostic instrument for prehospital diagnosis, including the potential involvement of ambulance paramedics in drug administration in neuroprotective trials. Recently, the LAPSS has been used in a research setting involving the prehospital administration by paramedics of intravenous magnesium as a neuroprotective agent, and the early data are promising.\(^17\) LAPSS has been shown to be a highly accurate instrument, but the published series have only included a small number of stroke patients and paramedics compared with our study.\(^3\) Furthermore, it excluded

<table>
<thead>
<tr>
<th>Item</th>
<th>Present Study (n=189)</th>
<th>Brott (n=24)</th>
<th>Lindley (n=85)</th>
<th>Dewey* (n=31)</th>
<th>Kothari† (n=38)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facial palsy</td>
<td>0.49</td>
<td>0.46</td>
<td>0.63</td>
<td>0.53/0.70</td>
<td>0.78</td>
</tr>
<tr>
<td>Arm paresis</td>
<td>0.77</td>
<td>0.79</td>
<td>0.77</td>
<td>0.71/0.76(R)</td>
<td>0.91</td>
</tr>
<tr>
<td>Dysphasia</td>
<td>0.68</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dysarthria</td>
<td>0.61</td>
<td>0.70</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

*Two values are given for comparison between 2 different neurologists. †Values shown in bold are intraclass correlation coefficients (ICC). ‡Inclusive of dysarthria and/or dysphasia.
those stroke patients with onset of $\geq 24$ hours (11% [24/217] in our study).

The FAST is a brief, reliable tool that is simple to administer, and it is therefore a potential instrument for use in prehospital stroke diagnosis and trials of agents with minimal risk, such as some neuroprotective drugs, in which intervention could be commenced before hospitalization. We have demonstrated that the FAST has excellent interobserver reliability when used by a large number of paramedic crews in a routine clinical setting, and this lends further support for the use of FAST in clinical and research practice.

Acknowledgments
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References
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