Prehospital triage to stroke centres: Is it a solution to the problem?

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The problem

Thrombolytic therapy for acute ischemic stroke is receiving wide attention and has been advocated in emergency medicine literature[1] and by the Canadian Stroke Consortium, a national network of neurologists.[2] Unfortunately, because of late presentation to the emergency department (ED), most acute stroke patients are ineligible for thrombolytic treatment.[3] This situation is primarily caused by the public's lack of awareness of stroke signs and symptoms,[4,5] which leads to delays in presentation to the ED.[3,6,7]

Current Canadian guidelines recommend administration of thrombolytic therapy within 3 hours of stroke onset.[2] Because of this urgency, many facets of prehospital and ED care are being examined to discover ways of reducing time to treatment.[8] One broad recommendation is to develop specially trained stroke care teams to respond to patients with apparent acute stroke.[9] This has led to an interest in prehospital stroke scales[10–12] that would enable paramedics to identify patients with acute stroke, and then pre-notify and triage that patient to the designated stroke centre.[13] Prehospital stroke scales are analogous to widely used trauma triage guidelines.

However, little information has been published describing the impact of stroke triage on stroke centres. Accordingly, we sought to evaluate the potential impact of a recently published stroke scale[10,11] on our urban emergency medical services (EMS) and ED system, which is considering prehospital triage to stroke "centres of excellence."

The evidence

The recently proposed Cincinnati Prehospital Stroke Scale[10,11] (CPSS) is a 3-item scale that was derived from the 15-item National Institutes of Health stroke scale. The items of the CPSS include the presence or absence of facial droop, arm drift and abnormal speech. An abnormality in at least one of these items was found to have a sensitivity of 100% and a specificity of 88% when tested by an emergency physician on a group of patients in which the prevalence of acute stroke was 25%.[11] The CPSS is also said to have excellent reliability when used by prehospital personnel and physicians to evaluate ED and neurology service patients.[10] In this study, where the prevalence of acute stroke or transient ischemic attack (TIA) was 29%, the scale was 63% sensitive and 88% specific. If these 2 studies provide a valid assessment of CPSS diagnostic parameters, then its actual sensitivity and specificity are likely to be approximately 80% and 88% respectively.

The assumptions

The prevalence of acute stroke in prehospital patients is far lower than 25% to 29% and may be as low as 0.7%.[14] Our assumption is that the prevalence of acute stroke in our EMS patients is roughly 1%. Since our EMS system responds to 125,000 emergency calls per year, EMS personnel would be expected to transport approximately 1250 acute stroke patients.

Not every EMS patient should be the subject of a prehospital stroke scale. Our EMS system uses the Medical Priority Dispatch System (MPDS),[15] which requires emergency medical dispatchers to assign patients into broad diagnostic and chief complaint categories. It was the consensus of 2 EMS physicians and 3 paramedics that acute stroke patients are likely to fall into the following MPDS categories: convulsions/seizures, diabetic problems, headache, sick person, stroke, unconsciousness/fainting, or unknown

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problem. These groups account for 43,000 calls per year and would include most of the patients requiring a stroke triage scale assessment. If 1250 of 43,000 transported patients have acute stroke, then stroke prevalence in this group is 3%.

Analysis and discussion

Table 1 illustrates what would happen to a cohort of 2500 patients triaged according to the CPSS (assuming a sensitivity of 80%, a specificity 88%, and a stroke prevalence of 3%). Note that the positive predictive value (PPV) is only 17%,[16,17] which means that for every 60 patients correctly triaged to a stroke centre 291 non-stroke patients would be incorrectly triaged to the centre. This equates to 4.9 "non-stroke" patients for every stroke patient.

The PPV of a diagnostic test is greatly influenced by the prevalence of the condition in the population being tested.[16] If we assume a higher stroke prevalence estimate of 10%, the CPSS would still triage 1.4 "non-stroke" patients to the stroke centre for every stroke patient. These "non-stroke" patients could seriously impact the ED and admitting service of a stroke centre. Most patients triaged as a "false-positive" stroke have serious medical problems such as urosepsis, aspiration, uremia, drug overdose, seizure and syncope.[11,18] These patients frequently require hospitalization, usually by a general internal medicine service rather than a neurology service. As well, no research has been published to indicate how many "true-positive" stroke patients actually meet current thrombolytic guidelines; however, it is probably a small minority. At our centre, patients not meeting thrombolytic guidelines are usually admitted by general internal medicine.

Finally, prehospital stroke triage may impact negatively on the care of "false-negative" stroke patients who have acute stroke but are not recognized as such by the paramedics. Table 1 suggests that, for every 4 stroke patients triaged correctly to the stroke centre, 1 patient with acute stroke will be triaged to a "non-stroke" centre, and this hospital will still be obligated to offer appropriate emergent stroke care.

Table 1. Cohort distribution of 2500 patients triaged according to a proposed prehospital stroke scale*

Paramedic stroke determination	Final diagnosis		
	Stroke	Non-stroke	Total
Stroke	60	291	351
Non-stroke	15	2134	2149
Total	75	2425	2500

*Assuming a prevalence of 3%, a sensitivity of 80%, and a specificity of 88%. Positive predictive value = 17% (60/351).

Conclusion and recommendations

Current stroke scales are not adequate tools for prehospital triage of apparent stroke patients to designated centres. There is a risk of overwhelming designated EDs and general internal medicine units with seriously ill "non-stroke" patients and stroke patients who do not meet thrombolytic guidelines. A prehospital stroke triage system does not obviate the need of "non-stroke centres" to provide high quality emergent stroke care to patients who are triaged incorrectly or "walk in" off the street.

Our recommendation for a more appropriate urban EMS system is for all hospitals to be "stroke ready." A tool such as the CPSS could be used for prehospital stroke identification, not triage, and to indicate the need to pre-notify a receiving ED of an incoming possible acute stroke patient. Once treatment has been administered, the EMS system should be prepared to rapidly respond to a request to transfer a patient to a designated stroke centre for ongoing care.

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DIAGNOSTIC CHALLENGE • DÉFI DIAGNOSTIQUE

Answer

Kirk Hollohan, MD

The correct diagnosis is number 2: Fitz-Hugh–Curtis Syndrome. While in the ED the patient's temperature spiked to 38.4ºC. After surgical consultation she was taken to the operating room with "probable" appendicitis. Laparoscopy revealed inflammation of the cecum, hepatic flexure and perihepatic region, as well as free pus in the peritoneal cavity. The appendix was normal, and cervical cultures taken in the ED subsequently grew *Neisseria gonorrhoeae*.

The Fitz-Hugh–Curtis syndrome (FHCS) is an extrapelvic manifestation of pelvic inflammatory disease (PID). Classically, it consists of adhesions (resembling "violin strings") between the liver capsule and the diaphragm or anterior peritoneal surface.[1] The incidence of FHCS in patients with PID may be as high as 15%. While it is predominantly a disease of women, cases have been reported in men. *Chlamydia trachomatis* and *Neisseria gonorrhoeae* are the main culprits, but the former is more common. Organisms are thought to reach the liver by lymphatic and hematogenous routes as well as by transperitoneal migration from the fallopian tubes.[2]

Symptoms usually include pleuritic right upper quadrant pain that is worse with movement. The most frequent associated symptoms are lower abdominal pain (salpingitis) and tenderness. In most patients, the upper abdominal pain begins concurrently with the lower abdominal pain, but in 30% of patients the upper abdominal pain may begin as long as 14 days later.[3]

Almost all patients have right upper quadrant tenderness and half exhibit guarding. A positive Murphy's sign is present in approximately 20% of patients. A hepatic friction rub is infrequently heard. Signs of PID may be marked or absent.

Laboratory studies are rarely helpful. The white blood count is elevated in about 30%, and liver enzymes are normal in the majority. The traditional gold standard for the diagnosis of FHCS is laparoscopic visualization of "violin string" adhesions around the liver.

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For the Challenge, see page 82.

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