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Diagnosis of Stroke by the Nonneurologist
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Background and Purpose—The first medical contact of an acute stroke victim is often a nonneurologist. Validation of stroke diagnosis made by these medical doctors is poorly known. The present study seeks to validate the stroke diagnoses made by general practitioners (GPs) and hospital emergency service physicians (ESPs).

Methods—Validation through direct interview and examination by a neurologist was performed for diagnoses of stroke made by GPs in patients under their care and doctors working at the emergency departments of 3 hospitals.

Results—Validation of the GP diagnosis was confirmed in 44 cases (85%); 3 patients (6%) had transient ischemic attacks and 5 (9%) suffered from noncerebrovascular disorders. Validation of the ESP diagnosis was confirmed in 169 patients (91%); 16 (9%) had a noncerebrovascular diagnosis. Overall, the most frequent conditions misdiagnosed as stroke were neurological in nature (cerebral tumor, 3; subdural hematoma, 1; seizure, 1; benign paroxysmal postural vertigo, 1; peripheral facial palsy, 2; psychiatric condition, 6; and other medical disorders, 7).

Conclusions—In the majority of cases, nonneurologists (either GPs or ESPs) can make a correct diagnosis of acute stroke. Treatment of acute stroke with drugs that do not cause serious side effects can be started before evaluation by a neurologist and CT scan. **(*Stroke*. 1998;29:1106-1109.)**

Key Words: cerebral ischemia ■ diagnosis ■ emergency room services ■ observer variation ■ stroke

General practitioners or emergency service physicians are usually the first medical doctors to be contacted by a stroke victim for diagnosis and treatment. If these doctors are able to diagnose stroke accurately, they can start treatment immediately, thus saving precious time lost in patient transportation and delay in admission to neurological consultation.[1] However, there are no prospective investigations of the accuracy of stroke diagnosis by GPs[2] and ESPs. In fact, previous studies on this topic were not prospective[3,4]: they include both stroke and TIA,[3] or the admitting diagnoses by ESPs were established with the help of CT information,[3] in some cases after neurological consultation.[3,4]

The objective of this investigation was to validate the stroke diagnoses made by nonneurologists and to identify factors that increase or decrease the likelihood of diagnostic errors.

Subjects and Methods

Stroke was defined as a focal neurological deficit of sudden onset occurring in a cerebrovascular territory distribution and lasting >24 hours (unless death occurred before this time), with causes other than vascular excluded.[5] The combination of a focal and a nonfocal symptom (eg, delirium) was accepted for the diagnosis of stroke. Subarachnoid hemorrhages were not included.

Validation of GP Diagnosis of Stroke

We used data from an ongoing epidemiological study of TIA and stroke carried out by 42 GPs in central and south Portugal[6,7] that covered the period from January 4, 1993, through March 31, 1995. If a presumed stroke was observed and a diagnosis made by one of the GPs in a patient under his care, he notified the coordinating center, indicating the patient's age and sex, diagnosis (TIA or stroke), degree of diagnostic confidence (certain or probable), vascular risk factors, neurological symptoms, ancillary procedures performed, and treatment. GPs were encouraged to refer these patients to the stroke outpatient clinic at HSM (unless the GP judged that transportation to the hospital was inconvenient, or the patient refused, or the patient had already been observed by another neurologist), where a final diagnosis (TIA, stroke, or noncerebrovascular disorder) was established by two neurologists. After reviewing the patient's history, physical and neurological examinations, and all ancillary procedures, the first neurologist wrote a case history and made a diagnosis. These notes were reviewed by a second neurologist. If the information provided by the first neurologist seemed unclear or incomplete or if there was disagreement about the diagnosis, discussion followed until a consensus diagnosis was established.

Validation of ESP Diagnosis of Stroke

The emergency room departments of the participating hospitals cover populations of about 800 000 (center 1, HSM), 500 000 (center 4, HFF) and 1 250 000 (center 5, HSJ). Approximately 600 patients are seen daily at center 1, 400 at center 4, and 700 at center 5. At the 3 participating hospitals, patients with acute stroke are first examined by a rotating emergency physician (either an internal medicine resident, a GP, or a nonstaff doctor engaged to work only in the emergency room). In 2 of these hospitals, a staff neurologist and a neurology resident are also on duty in 24-hour shifts. In the third center, a neurologist is on duty until 8 PM. After 8 PM, all patients

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Selected Abbreviations and Acronyms

ESP = emergency service physician
GP = general practitioner
HFF = Hospital Fernando da Fonseca, Amadora, Portugal
HSJ = Hospital de São João, Porto, Portugal
HSM = Hospital de Santa Maria, Lisbon, Portugal
TIA = transient ischemic attack

with strokes or suspected strokes are kept in the emergency department, and a neurological evaluation is performed the next morning. Patients with suspected strokes or TIAs are always referred for neurological evaluation, with an accompanying brief referral note, before admission or discharge is decided. Over a 6-month period, from January 4 through September 30, 1996, the 10 participating neurologists registered on a special form information about all patients referred with a diagnosis of "stroke" or "stroke(?)," including their age, sex, risk factors, any discrepancy between the history elicited by the ESP and the neurologist, symptoms and signs (motor/sensory; aphasia, neglect, alexia; stupor/coma; vertebrobasilar territory symptoms/signs; other), CT results (not performed, normal, early infarct signs, hemorrhagic infarct, hematoma, other), and the neurologists' diagnosis (ischemic or hemorrhagic stroke, TIA, other). Cases referred with a diagnosis of stroke or stroke(?) were compared with those referred with only a descriptive note over the same period and determined by the neurologist to have a stroke. At the weekly stroke rounds, case notes were reviewed by one of the participating neurologists to confirm the diagnosis of the neurologist who had examined the patient. In case of disagreement, a consensus diagnosis (TIA, stroke, or noncerebrovascular disorder) was reached.

Results

Validation of GP Diagnosis

The 42 participating GPs diagnosed 174 strokes during the study period. Twenty-one GPs (50%) referred 52 patients (30%) for neurological evaluation at the stroke clinic. The mean number of patients under the care of the GPs who referred patients to the center was 1432 (range, 962 to 1905). Each GP diagnosed a median number of 3 strokes (range, 0 to 17). The 21 GPs referred a median number of 2 patients (range, 1 to 6) to our hospital. GPs who referred patients to our hospital diagnosed more strokes than those who did not (5.7 versus 2.3; $t=3.26$; $P=0.0025$). The number of referrals was weakly correlated ($r=0.35$) with the number of strokes diagnosed. Diagnostic errors were not related to either the number of strokes diagnosed or the number of referrals. There were 27 fatal strokes (22%) among nonreferred strokes, whereas none of the stroke patients referred to the clinic died within 1 month of stroke onset ($\chi^2=12.5$; $P=0.0004$). Total anterior circulation strokes were more common among nonreferred patients (28 versus 2; $\chi^2=7.83$; $P=0.005$). There were no differences in age, sex, or diagnostic confidence between referred and nonreferred patients.

Stroke diagnosis was confirmed in 44 patients (85%). In 8 patients (15%; 95% confidence interval, 6.9 to 28.1) the diagnosis of stroke was incorrect. Three of these were TIA patients whose symptoms/signs lasted less than 24 hours, and 5 were patients with other neurological conditions (peripheral facial palsy in 2 cases, benign paroxysmal positional vertigo, somatoform disorder, and subdural hematoma). In 3 patients the neurologist's diagnosis was made on interview/examination; in 2 it was suspected on clinical grounds, but CT was required; and in the patient with a somatoform disorder (Table 1), prolonged in-hospital observation was necessary.

Twenty-six other patients referred with TIA or TIA(?) diagnoses turned out in fact to have stroke, because symptoms and/or signs lasted more than 24 hours. Compared with patients referred with a diagnosis of stroke or stroke(?), there were more males (20/26 versus 23/174; $\chi^2=4.19$; $P=0.04$), more cases with a probable diagnosis (TIA(?); $\chi^2=6.46$; $P=0.01$), more patients with only one or with no risk factors, and more first-ever cerebral vascular events among the group referred as TIA/TIA(?). These patients were also less disabled (Rankin scale score of 0 to 1 versus >1; 14/12 versus 13/31; $\chi^2=4.07$; $P=0.04$) than those referred with a diagnosis of stroke/stroke(?).

Validation of ESP Diagnosis

During the study period, 185 patients with diagnoses of stroke (129 patients) or stroke(?) (56 patients) were referred for neurological evaluation by ESPs. Median time between stroke onset and neurological evaluation was 12 hours: 12% were evaluated up to 3 hours after onset, 25% within 6 hours, and 91% within 48 hours. Center 1 (HSM) contributed with 61 cases, center 4 (HFF) with 106 and center 5 (HSJ) with 18 cases. Fifty-nine patients had been referred to these centers from other hospitals. The neurologist confirmed the history elicited by the ESP in 70% of the notes. CT scan was performed in the emergency service in 161 patients (87%): 58 (36%) were normal, 47 (29%) showed focal hypodensity or other early infarct signs, 1 (0.6%) showed a hemorrhagic infarct, 13 (8.1%) an intracerebral hematoma, and 39 (24%) other lesions. In addition, CT disclosed 3 intracranial tumors. The participating neurologists confirmed the diagnosis of stroke in 169 (91%) patients. Sixteen cases (9%; 95% confidence interval, 5 to 13.7) were diagnosed as follows (Table 2): cerebral tumor (3 patients), seizure (1), and other medical (7) or psychiatric (5) conditions. Diagnostic errors were significantly more common if the history gathered by the ESP was inaccurate (12/56 versus 4/129; $\chi^2=16.4$; $P=0.0001$) and if the patient had no vascular risk

TABLE 1. Misdiagnosis of Stroke by GPs

Age/Sex	Diagnostic Confidence	Risk Factors	Symptoms	Diagnostic Procedures	Final Diagnosis
59/M	Not specified	HP, hyperlipidemia	Facial palsy	...	Bell's palsy
57/M	Probable		Facial palsy	...	Bell's palsy
77/F	Not specified	HP, AF	Vertigo, unsteadiness	CT	Conversion disorder
42/M	Not specified		Fainting, L-sided weakness	CT	Postural vertigo
76/M	Certain		Confusion, L-sided weakness	CT	Subdural hematoma

HP indicates hypertension; AF, atrial fibrillation.

TABLE 2. Misdiagnosis of Stroke by ESPs

Age/Sex	Center	ESP Diagnosis	Risk Factors	ESP Description of Clinical Features	Clinical Features Confirmed by Neurologist	CT Scan	Final Diagnosis
58/M	HFF	Stroke	DM+cardiac disease	L arm weakness	No	No	Syncope
48/F	HFF	Stroke	No	Dysarthria+L-sided weakness	No	No	Anxiety attack
88/F	HFF	Stroke(?)	?	Dysarthria+drowsiness	No	No	Hyponatremia
74/F	HFF	Stroke	?	L-sided weakness	No	Yes	Pneumonia+erisypela
70/M	HFF	Stroke	HP	Facial palsy	No	No	Lipoedema
87/F	HSM	Stroke(?)	?	Aphasia+R-sided weakness+jerks	Yes	Yes	Meningioma
82/M	HSM	Stroke	Cardiac disease	Dysarthria+behavioral changes	No	Yes	Delirium
58/F	HSM	Stroke	HP	Precordial pain+bilateral numbness	No	No	Anxiety attack
71/F	HSM	Stroke(?)	HP	Balance problem	No	No	Depression
79/F	HSM	Stroke	No	Balance and cognitive impairment	No	No	Dehydration
83/M	HSM	Stroke(?)	HP+cardiac disease	Coma	Yes	No	Metabolic coma
47/F	HFF	Stroke(?)	No	L-sided weakness	No	No	Conversion disorder
61/F	HFF	Stroke(?)	HP	L-sided weakness	No	No	Conversion disorder
79/M	HFF	Stroke(?)	HP+DM+cardiac disease	Seizure (?)	No	No	Seizures
59/M	HSM	Stroke	No	Progressive R-sided weakness	Yes	Yes	Cerebral metastasis
27/M	HSM	Stroke	No	Progressive L-sided weakness	Yes	Yes	CNS lymphoma

DM indicates diabetes mellitus; HP, hypertension; and CNS, central nervous system.

factors (4 versus 8; χ^2 [Yates]=5.85; P=0.016). Two (8%) of the 25 patients referred within 3 hours were misdiagnosed with stroke, but accuracy of diagnosis was not influenced by time to neurological evaluation, whatever the interval (<3 hours, <6 hours, <48 hours) considered. In 8 of these cases the neurologist's diagnosis was established on interview and examination; in 3 cases laboratory data confirmation and in 5 cases CT data confirmation was necessary.

Compared with cases referred as "stroke," patients labeled "stroke(?)" were less frequent in the nonuniversity center (HFF, 19%) than in the university centers (HSM, 38%; HSJ, 72%) (χ^2=23.4; P<0.0001). They were also less common when the neurologist confirmed the history elicited by the ESP (32/129 versus 24/56; χ^2=6.02; P=0.01). Seventy-three patients with a diagnosis of stroke by the neurologist were referred with only a descriptive note of symptoms and signs. Compared with patients referred with a stroke or stroke(?) diagnosis, these descriptive referral notes were more common among females (43/73 versus 81/185; χ^2=4.89; P=0.087), in vertebrobasilar territory strokes (21/73 versus 22/185; χ^2=7.24; P=0.007), if the content of description notes was not confirmed by the neurologist (34/73 versus 56/185; χ^2=6.40; P=0.01), and in 2 of the participating hospitals (HSM 53%, HFF 6%, and HSJ 14%; χ^2=51.9; P<0.0001).

Discussion

The present investigation indicates that a diagnosis of stroke, as validated by two neurologists, can be made accurately in the vast majority of patients by the doctors who are more likely to be their first medical contact—either their GP or an ESP. Conditions more often misdiagnosed as stroke were other acute neurological diseases and psychiatric and medical disorders. In a few patients, a correct diagnosis was established only after CT revealed an intracranial mass. Validation of the ESP's diagnosis was performed in a "real-life" clinical practice setting: they were not aware of the ongoing study, and all suspected stroke cases (including those referred only with a descriptive note) were examined by the neurologists. On the other hand, GPs referred only one third of their stroke patients. The referred sample was not random, because it included few severe cases. Also, subjects who died shortly after stroke onset were not referred, because they were managed at local hospitals. This bias might have increased the likelihood of diagnostic errors, because of referral of mild and doubtful cases. On the other hand, nonreferral of very severe cases could also decrease the error rate, because comatose or moribund patients may be mislabeled as stroke cases. Nevertheless, the error rate of GPs was similar to that of ESPs, indicating that referral biases were probably of limited significance.

Despite its importance for the organization of acute stroke services, there are few studies concerning the accuracy of stroke diagnosis by nonneurologists. Norris and Hachinski[8] mentioned a 15% misdiagnosis of stroke. In the Oxfordshire Community Stroke Project,[2] only 682 (52%) of 1306 patients noted by GPs as having suspected strokes were first-ever stroke cases, but the authors do not present figures on those with nonvascular cerebral pathology (except for 7 cases in which CT disclosed other intracranial lesions). A few nonstroke intracranial lesions were also reported in the SEPIVAC study[9] and in the UK-TIA Trial,[10] pointing out that interview and clinical examination enables the establishment of an accurate diagnosis of stroke.

Paramedics of ambulance or hospital emergency services can also be the first medical contact of stroke victims. Kothari and colleges[11] investigated retrospectively the accuracy of prehospital diagnosis of acute stroke or TIA made by these professionals. In 72% of the study's 86 stroke patients, prehospital diagnosis by an emergency medical technician or paramedic was in agreement with final diagnosis. The accuracy of the stroke diagnosis

by emergency medical service dispatchers did not go beyond 37%. These professionals failed to identify stroke in 35% of the patients. The same authors investigated retrospectively the accuracy of stroke diagnosis made by emergency physicians.[3] Their admitting diagnosis was correct in 96% of the patients. Nineteen cases were misdiagnosed as stroke, and 5 strokes were initially misdiagnosed as other conditions. However, emergency physicians asked for a CT scan in all cases and a neurological consultation in some before making the admitting diagnosis. Because CT was available to them, it is not surprising that these ESPs identified all hemorrhagic strokes and that conditions misdiagnosed as stroke did not include intracranial tumors. Libman et al[4] reviewed 411 consecutive patients initially diagnosed as having stroke by an acute stroke intervention team (with a neurologist among its members in 25% of the cases) and found that 19% of the patients had conditions mimicking stroke, the majority of which involved postictal states, systemic infections, tumors, and toxic metabolic disturbances. Decreased consciousness increased the odds of these mimicking conditions, whereas a history of angina decreased the odds. In the present study, diagnostic errors were associated with inaccuracy of the history gathered by ESPs and the absence of vascular risk factors. Horn et al[12] recently reported the following data from the ongoing VENUS Trial: 244 (73%) of 333 patients enrolled by GPs (67% with CT or MR performed) were evaluated, and their diagnosis was confirmed by a neurologist. Eighteen patients showed no symptoms of either stroke[11] or other diagnosis,[7] including 4 with intracranial mass lesions.

GPs referred as TIAs several stroke cases (in particular, first-ever, nondisabling strokes in males, with only one or no vascular risk factors), thus confirming our previous observation that nonneurologists often label minor strokes as TIAs.[7]

Among ESPs, uncertainty about the stroke diagnosis and absence of diagnosis were more frequent if the history elicited by the ESP was inaccurate, although they were less frequent in the nonuniversity center, where no interns or residents work in the emergency services. This seems to indicate that practice and training decrease diagnostic uncertainty. Absence of diagnosis was also more common in vertebrobasilar strokes, the diagnosis of which seems to be a harder task for the nonneurologist.

From previous investigations and the present study, several conclusions can be drawn. The majority of stroke victims can be identified and a diagnosis made on clinical grounds by nonneurologists. The majority of conditions that mimic acute stroke are other primary or secondary neurological disorders. Most are benign, but a few are serious conditions, and their diagnosis requires neurological consultation and neuroimaging. Furthermore, nonneurologists are uncertain about their diagnosis in a sizeable number of acute stroke cases. These results have implications on acute stroke trials and the organization of acute stroke services. To avoid delays in the areas of referral and patient transportation[1,13,14] and to make acute stroke treatment more universal, acute stroke therapeutic interventions that do not cause increased risk of bleeding or other serious adverse effects can be implemented by the first medical authority to have contact with the stroke victim, before neurological consultation or CT scan. For potentially dangerous treatments, such as thrombolysis,[15] both CT scan and neurological consultation are necessary to prevent the possibility of a nonstroke patient receiving a hazardous drug. Centers delivering such treatments should have both readily available at all times in the emergency department.

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