Background and Purpose—In the last 10 years, stroke has become a medical emergency. Subsequently, early recognition of stroke symptoms and rapid activation of the medical system are essential. We sought to investigate what witnesses or victims of an acute stroke syndrome recognize and report in the actual situation.

Methods—We analyzed the recordings of all patients admitted to our stroke unit via the Emergency Medical System (EMS) dispatch center in Nuremberg within 1 year. With a structured evaluation form, the calls were screened for symptoms reported and for any diagnosis or other facts mentioned spontaneously or in response to a question by the dispatcher. We also evaluated data about EMS response and patient condition on admission.

Results—Of 482 patients treated in our stroke unit, 141 calls were evaluated. Main symptoms reported included speech problems (25.5%), motor deficits (21.9%), and disturbances of consciousness (14.8%). In many cases, a fall (21.2%) was presented as the main problem. Sensory deficits (7.8%) and vertigo (5.6%) were rarely mentioned. In 28 calls (19.8%), stroke was mentioned as a possible cause of the acute health problems. The dispatcher suspected a stroke in 51.7% of all cases.

Conclusions—This is one of the first studies to investigate emergency calls in acute stroke. We found that motor deficits and speech problems were the most dramatic symptoms that led to activation of the EMS. Other symptoms were less frequently reported, or atypical descriptions were given. Educational efforts are needed to improve recognition of atypical stroke symptoms by stroke victims and EMS professionals. (Stroke. 2003;34:1005-1009.)

Key Words: diagnosis ■ education ■ emergency medical services ■ signs and symptoms ■ stroke, acute

Acute stroke management has changed over the past 10 years with the development of new therapeutic strategies toward rapid evaluation and treatment. Some therapies such as thrombolysis can be administered only within certain time windows. Still, the vast majority of acute stroke patients do not receive effective treatment in time primarily because of prolonged time between onset of first symptoms and first attempts at seeking medical attention.1,2 Thus, immediate recognition of stroke symptoms and activation of the medical system is a crucial factor in improving outcome for acute stroke patients. Accordingly, rapid recognition of stroke warning signs is also the first part of the “stroke chain of survival” in the American Stroke Association’s Operation Stroke.3 Limited knowledge of signs, symptoms, and risk factors for stroke was noted as a factor associated with delay in activation of the medical system.4–6 To face this dilemma, educational programs have been initiated,4,7 and various studies have investigated knowledge of stroke symptoms in the general population7–9 and in risk groups9,10 through the use of structured questionnaires or telephone interviews. Data from this work may not exactly reflect what is actually happening if somebody really activates the emergency medical system (EMS) in case of a possible stroke. The knowledge people gain from educational programs or recall in answering interview questions may be somewhat different from what they actually recognize in the unexpected situation of somebody next to them sustaining a stroke or transient ischemic attack (TIA). Subjects involved and calling for help could differ from those targeted and reached by public awareness projects. On the other hand, people may realize that there is something wrong and call for medical help even if they have no idea that the problem is a sign of stroke or what stroke means at all. Little is known about how people really act if a stroke or TIA happens to someone in their surroundings because we normally cannot watch and analyze such situations. Posthoc interviews might draw a distorted image because remembering an exciting and frightening situation will not produce a true description.

Therefore, we conducted a prospective study in cooperation with the EMS and analyzed emergency calls of patients treated in our stroke unit to investigate what witnesses or victims of an acute stroke syndrome recognize and report in the actual situation.

Materials and Methods

In Germany, organization of the EMS is under the control of the federal states. To organize its EMS, the state of Bavaria is divided...
into 26 districts. Within each district, 1 dispatch center is responsible for all EMS activities. Seeking urgent medical help, people call the telephone number 19222 and are connected directly to the dispatch center closest to them. Once the call is registered and completed, the dispatcher activates the closest appropriate ambulance unit. Ambulance units are operated by organizations like the Bavarian Red Cross, the Workers’ Samaritan Foundation, and St John’s Ambulance and are staffed with at least 1 fully trained paramedic and 1 or 2 emergency medical technicians (EMTs). In contrast to many other countries, in Germany an emergency physician is on call 24 hours a day to be sent out to the scene and meet the paramedics in cases of severe and potentially life-threatening events.

According to state law, all telephone calls coming in to the dispatch center and the radio communication between dispatcher and ambulance units in the district are tape recorded for documentation and liability reasons.

Erlangen University Hospital is located in the Nuremberg EMS district but also receives patients from neighboring districts. There are 2 EMS ambulance stations based in the city of Erlangen and at least 1 in every large neighboring community. One ambulance unit, based at the University Medical Center, transports the EMS physician and 2 paramedics. In neighboring cities, EMS physicians leave the local hospital or their offices in separate cars and meet the paramedic ambulance unit at the scene (rendezvous system).

Every patient admitted to the Stroke Unit of the University Hospital in Erlangen (Department of Neurology) after calling the EMS dispatch center in Nuremberg through 19222 within 1 year was included in this study. The patient and the person calling the EMS were asked for informed consent for evaluation of the call. After informed consent was given, analysis of the tape recordings at the dispatch center was begun. Calls were screened with a structured evaluation form for symptoms reported, any diagnosis or medical syndrome named by the caller, information about onset and duration of symptoms, and other facts mentioned spontaneously or in response to questions by the dispatcher. Descriptions of symptoms were transcribed from the tapes without any change by the EMS center and later categorized by the investigators. We also evaluated reactions and decisions by the EMS dispatcher. Data about the resultant EMS response and especially symptoms and history documented were extracted from EMS records. On admission to the stroke unit, all patients received a standardized examination, including a detailed history, physical and detailed neurological examination, and scores for the Glasgow Coma Scale (GCS) and National Institutes of Health Stroke Scale (NIHSS).

Emergency calls with any healthcare professional reporting to the dispatcher were not analyzed. The study was approved by the headquarters of the Bavarian Red Cross, which operates the Nuremberg EMS dispatch center, and by the university.

Results

Of 482 patients treated in our stroke unit during the study period, 196 (40.7%) came in after activation of EMS. Because 57 cases were brought in from other EMS districts or we could not identify the person calling or obtain informed consent, 141 calls concerning 137 different patients (139 cases) were finally evaluated. Mean age of patients was 65.4 years (range, 21 to 91 years); 56.4% were male.

Mean duration of all calls was 1 minute 23 seconds (range, 38 seconds to 4 minutes 12 seconds). Median latency from onset of symptoms to call was 38 minutes (2 to 960 minutes). In 26.2% of all calls, only 1 symptom was reported; in 36.8%, 2 symptoms were identified; in the remaining cases, ≥3 symptoms were presented. We found that 41.1% of all callers were the patient’s spouse; in 23.4% of the calls, other relatives placed the call; in 19.8%, neighbors, colleagues, or friends called; in 8.5%, a person not related to the patient placed the call; and in 7.1% of all calls, the patients themselves made the call. Mean age of callers was 53.4 years; 58.2% of them were female.

Symptoms most frequently reported included speech problems (25.5%), limb weakness (21.9%), and disturbances of consciousness (14.8%). In many cases, a fall (21.2%) was presented as the main problem.

Problems with sensation (7.8%) and vertigo (5.6%) were rarely mentioned. Any information about onset or duration of symptoms was given by 14.1% of all callers and was documented in 28.7% of all EMS records. Most symptoms were reported spontaneously by the person calling. After dispatcher inquiry, only speech problems and alterations in consciousness were elicited as additional symptoms in a relevant number of calls. Figure 1 shows the frequency of symptoms spontaneously reported by callers and after query by the dispatcher. Figure 2 gives some examples of typical statements made in calls.

Exact percentages of symptoms reported in calls are given in Table 1. Together with symptoms documented in EMS records and findings on admission to the stroke unit. Many symptoms were more frequent on scene than reported in calls.
and even more frequent on admission. NIHSS score was 4.34 points on average (range, 0 to 22) and GCS score was 14.2 points (range, 9 to 15) on admission to the stroke unit.

In 28 calls (19.8%), stroke was mentioned as a possible cause of the acute health problems. In 9.9% of all cases, other medical conditions besides stroke (eg, myocardial infarction) were mentioned. The dispatcher assumed and coded for stroke in 51.7% of all analyzed cases. Other diagnoses coded included cardiac diseases (15.6%), syncope (4.9%), and unconsciousness (3.5%). In records of EMS physicians, a cerebrovascular disorder was coded in 83.7% of all documented cases (n=1100574). Final diagnosis at discharge from the Department of Neurology was ischemic stroke in 63.3%; 13.0% were coded as intracerebral hemorrhage; and 15.8% had had a TIA.

We found that 7.9% (n=11) had a nonstroke diagnosis. Symptoms reported in cases with a nonstroke diagnosis were suggestive mainly of a possible stroke (see Table 2) and similar to those reported in cases with a final diagnosis of cerebrovascular disease.

In the resulting EMS response, the priority of activations was high (lights and sirens) in 79.3% of all 140 EMS runs. In 52.8%, an EMS physician was at the scene with the paramedics; in 22.8%, only a paramedic unit was sent to the scene; and in 17.8%, only an EMT unit was sent. The helicopter, which is staffed with a physician and paramedic, was activated in 6 cases (4.3%).

Median time from call to arrival on scene was 12 minutes (range, 5 to 57 minutes) and from arrival on scene to first hospital arrival was 51 minutes (range, 23 to 70 minutes). In 21 cases, the first hospital arrival of the patient was outside the Department of Neurology at the University of Erlangen. Those patients were brought to a different hospital or to the Department of Internal Medicine at the University Hospital. Median delay from time on scene to arrival at our stroke unit was 72 minutes (range, 23 to 403 minutes). See Figure 3 for a view of the time flow.

Discussion

This is one of the first studies to investigate emergency calls in cases of acute stroke. To gain sufficient information about clinical presentation on admission and to obtain informed consent from patients and their relatives, we decided to investigate calls about patients seen in our stroke unit. This cohort may be biased because there are stroke cases in the covered region that are not included in this study, especially in outlying regions where some of the patients were seen exclusively in general hospitals. In Erlangen, where almost two thirds of all cases happened, most stroke patients are seen by the Department of Neurology, whether primarily (85.3%)11 or after transfer if a diagnosis of stroke was made. An additional bias may exist in that cases analyzed in this study are only those with primary activation of the EMS system. In these cases, the event was already recognized as an emergency, in contrast to situations in which individuals seek help by calling or visiting their primary care physician’s office or by calling friends or family members. Unfortunately, in a study setting like ours, it is impossible to analyze what the latter group recognized and thought when seeking medical attention because calls and conversations such as those in physician’s offices are not documented on a regular basis.

Symptoms reported by callers included various descriptions of different neurological or nonneurological disturbances. See Figure 2 for examples.

TABLE 1. Symptoms Noted at Various Stages of Stroke Care

<table>
<thead>
<tr>
<th>Present</th>
<th>Reported in Emergency Calls, % (n=141)</th>
<th>Documented on Scene, % (n=140)</th>
<th>Found on Admission, % (n=139)</th>
</tr>
</thead>
</table>
Transcribed into categories of neurological deficits, speech problems and motor deficits were the categories most frequently reported. Motor deficits such as a sudden weakness and especially speech problems such as incoherent answers or the inability to talk are dramatic symptoms. They interfere with daily life and are therefore rapidly recognized. Even more so, these symptoms may imply that something serious is happening, leading to activation of the EMS.

Motor problems were often reported by their consequences, resulting in a person sinking or falling down, noted as “fall” in Table 1 and Figure 1. Falls were the symptom category most frequently reported spontaneously. When limb weakness and fall are taken together, descriptions of motor deficits were the most frequently reported neurological symptoms in our calls.

Other symptoms such as sensory deficits or dizziness or vertigo were less frequently reported. In more than one fourth of cases, other nonstroke symptoms like chest pain, dyspnea, or paleness were reported with or without stroke symptoms.

Most symptoms and descriptions were reported spontaneously. Only a small additional number was obtained after questioning by the dispatcher mainly in the symptom categories of speech problems and consciousness. Standard questionnaires at the dispatch center include mainly vital signs such as heartbeat, breathing, and consciousness. Stroke symptoms are currently not included. Routine questioning for such symptoms not only would increase number of symptoms reported to more than 1 or 2 but could clarify the background of symptoms, eg, that a fall goes with a paresis.

Compared with findings on initial examination in our stroke unit, most symptom categories were more frequent on admission than reported on calls and even more frequent on admission than documented in EMS records. Especially for symptoms such as sensory deficits or facial paresis for which the frequency was ≈5 times higher on admission than reported in calls, this shift may indicate that symptoms are underrecognized by the person calling for help. On the other hand, impaired consciousness and confusion have higher frequencies in calls and even higher frequency in EMS reports than on admission. It is possible that all these confused or stuporous patients improved. However, we found that some of them had symptoms of aphasia not documented before hospital admission. It appears that aphasia is sometimes misinterpreted as altered consciousness by the public and even trained staff, including physicians, in the prehospital setting.

A direct comparison of the frequency of symptoms in emergency calls, in EMS records, and on admission seems problematic. One reason is that they are fixed at different time points and that there is a mean latency of 1 hour 40 minutes between call and admission to the stroke unit. Within this time, symptoms may improve or disappear, or new symptoms may arise. Given the fact that some of our patients had a TIA and sometimes arrived without any symptoms, it may be speculated that the higher rates of symptoms documented on admission will be due not only to worsening strokes but also to symptoms not recognized or documented.

A second cause limiting comparison of symptom frequency is the different quality of their sources. Callers just report symptoms that they are most aware of, many times only 1 or 2 symptoms. On the other hand, symptoms on admission are findings from a structured neurological examination for acute stroke patients, including administration of NIHSS. On-scene documentation is normally done by the physician, if involved, or the paramedics using standardized documentation forms on a different level. These forms do not provide special reminders for stroke symptoms. Physician documentation forms provide tick boxes for the GCS and for muscle strength of legs and arms, whereas paramedic forms only ask for consciousness as a special neurological condition. All other information about stroke symptoms is given by free notes, which are added optionally. So, what is documented as symptoms by EMS staff, whether paramedics or physicians, could be a mixture of symptoms, findings, and history. The impression emerging from our data that stroke symptoms are, if not unrecognized completely, sometimes

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**Table 2. Symptoms Reported in Nonstroke Cases**

<table>
<thead>
<tr>
<th>Final Diagnosis</th>
<th>n</th>
<th>Dispatcher Coding</th>
<th>Symptoms Reported in Calls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epileptic seizure</td>
<td>4</td>
<td>Stroke (3), seizure (1)</td>
<td>Limb weakness, reduced consciousness, confusion, stroke mentioned in 2 calls</td>
</tr>
<tr>
<td>Psychosomatic disorder</td>
<td>3</td>
<td>Stroke (2), cardiac disease (1)</td>
<td>Sensory deficit, limb weakness, dizziness/vertigo</td>
</tr>
<tr>
<td>Vestibulopathy</td>
<td>2</td>
<td>Stroke (1), cardiac disease (1)</td>
<td>Dizziness/vertigo, nausea</td>
</tr>
<tr>
<td>Transient global amnesia</td>
<td>1</td>
<td>Seizure</td>
<td>Disorientation</td>
</tr>
<tr>
<td>Pneumonia/dehydration</td>
<td>1</td>
<td>Unspecified medical disease</td>
<td>Speech problem, dyspnea</td>
</tr>
</tbody>
</table>

n=11.

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**Figure 3.** Time flow from first symptoms to hospital arrival (median values).
not documented very well by EMS staff is due partially to the methods and forms of documentation.

In only 19.8% of all calls was any word indicating stroke or TIA mentioned. So, only every fifth person involved in a stroke emergency was aware of a possible stroke. A recent study from the United States reported a much higher rate of callers mentioning stroke,12 The sample size of that study was smaller, and in contrast to our findings, family members of patients were the minority of callers. Additionally, that work was conducted in an urban population, whereas our study area was partially rural. However, the infrequent use of the word “stroke” is a hint for insufficient knowledge about stroke symptoms in the population of our study area, and the people calling for help in the previous work12 were probably younger and better educated.

Dispatchers coded for stroke after the call in more than half of our cases, a rate similar to the identification rate of EMS dispatchers in the Cincinnati area.13 Furthermore, the vast majority of cases received a high-priority response often as a potentially life-threatening event requiring the presence of an emergency physician on scene. Contrary to previous findings,12 in our study, a stroke seems to be taken as a serious event by the dispatchers, who are usually fully trained paramedics with several years of experience in the field.

To summarize, there is a striking need for educational efforts to improve recognition of especially nondramatic and atypical stroke symptoms in the general population but also in family members of patients at high risk for stroke. More public information on stroke pathology and risk factors is necessary. In addition, EMS dispatchers’ knowledge about typical and atypical stroke symptoms should be increased, and stroke symptoms must be included in routine questionnaires for EMS dispatchers. Paramedics and EMS physicians in the field should receive training in evaluating stroke patients, and documentation of signs and symptoms present on the scene should be emphasized.

Acknowledgments
This work is dedicated to the memory of Peter Rück, a close friend and colleague, paramedic, and emergency physician, who died far too early 5 years ago. We want to thank all EMS dispatchers, paramedics, and physicians in the Nuremberg district, as well as our patients and their relatives, or whoever took the phone to get a stroke patient to treatment, for taking part in this study. We also want to thank Dr. Heike Schmolck for her support and advice in preparing this manuscript.

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Emergency Calls in Acute Stroke
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