Neurol Sci (2001) 22:357–361

ORIGINAL

M. Camerlingo • L. Casto • B. Censori • B. Ferraro • G. Gazzaniga • T. Partziguian
M. Signore • C. Panagia • A. Fascendini • B.M. Cesana • A. Mamoli

Experience with a questionnaire administered by emergency medical service for pre-hospital identification of patients with acute stroke

Received: 12 April 2001 / Accepted in revised form: 23 October 2001

Abstract We prospectively verified whether an ad-hoc questionnaire administered by phone supports pre-hospital suspicion of stroke in order to reduce the time before care is given. From June 1996 to May 1997, physicians of the Emergency Medical Service in the area of Bergamo, Italy asked all people calling for a patient with symptoms and signs suggesting a cerebral vascular injury to immediately answer some questions on common symptoms and signs of stroke. The medical records of the patients hospitalized at Ospedali Riuniti of Bergamo were reviewed at the end of the study by a single neurologist, skilled in stroke management and blinded to the questionnaires. Sensitivity and specificity, in addition to positive and negative predictive values, of single questions versus final diagnosis were assessed. Logistic regression analysis was also performed to identify those questions useful to suspect strokes. We collected 143 valid questionnaires, related to 63 men and 80 women, aged 34–99 years (mean, 71.8 years). The question concerning headache had the lowest sensitivity and specificity, respectively 57.1% and 36.5%, and the question concerning leg palsy had the highest sensitivity and specificity, respectively 82.0% and 52.4%. Multivariate analysis identified questions on facial and leg palsy as independent predictors of a final diagnosis of stroke. A few questions on motor deficits proposed by emergency medical service operators may be useful in the pre-hospital identification of stroke patients. Concordance of any questions versus final diagnosis of stroke was, however, far to be satisfying. Thus, our experience supports the need for an educational program to improve the efficiency of a pre-hospital diagnosis of stroke.

Key words Stroke • Diagnosis • Referral • Emergency medicine

M. Camerlingo (✉) • L. Casto • B. Censori • B. Ferraro
G. Gazzaniga • T. Partziguian • A. Mamoli
Department of Neurology
Ospedali Riuniti
Largo Barozzi 1, I-24128 Bergamo, Italy

M. Signore • C. Panagia • A. Fascendini
Emergency Medical Service
Ospedali Riuniti
Bergamo, Italy

B.M. Cesana
Epidemiological Laboratory
Maggiore Hospital
Milan, Italy

Introduction

Intravenously administered recombinant plasminogen activator is the first drug shown to be effective for acute ischemic stroke, but only when it is administered within the first 3 hours of symptoms [1–3]. Thus, a challenge for physicians facing acute stroke patients has been to reduce the time before initiating treatment [4]. Several studies have demonstrated that much time is lost outside the hospital [5–8]. The reasons for a delayed hospitalization were the attitude to contact general practitioner [5–7], residence at home [7], night hours [6, 7], and indecision or no recognition of stroke [5, 6, 8]. Consequently, the time to treatment initiation could be reduced by speeding-up the pre-hospital phase of stroke.

Emergency medical services (EMs) could be of help. EMs were shown to speed-up the treatment of patients with acute myocardial infarction by about 60 minutes [9, 10], and to anticipate the referral of stroke patients [7]. In this

prospective study, we evaluated whether some questions posed by EMs personnel to people calling because of a "stroke" may help to address a correct pre-hospital suspicion of a cerebrovascular accident.

Patients and methods

The Ospedali Riuniti in Bergamo, Italy is a 1205-bed general hospital with all the facilities for diagnosis and care, included EMs. The hospital serves an urban and rural area of about 1 000 000 people, and accounts for about 60 000 hospitalizations per year. Physicians on duty at EMs are anesthesiologists and resuscitators. They respond 24 hours a day, 365 days per year to the phone number 118, and readily send an ambulance with paramedics, plus physicians if particularly requested, to the call place.

The study was designed to determine whether a questionnaire on several common warning symptoms and signs of stroke (Fig. 1) helped to address a pre-hospital suspicion of stroke in order to alert emergency care and stroke units and to reduce time to treatment.

The questionnaire was administered to people telephoning the EMs for signs or symptoms suggestive of a cerebrovascular event, in particular:

- Symptoms and signs described as a possible apoplexy
- Patient found handicapped at home
- Patient suddenly fallen to the ground
- Language of the patient perceived to be confused or inappropriate.

For the present purposes, we limited the study to patients at first stroke aged older than 30 years. In addition, we considered only those patients admitted to our general hospital.

The study was prospective and lasted from 30 June 1996 to 31 May 1997.

At the end of the inclusion, a single author (LC), who is a neurologist skilled in cerebrovascular diseases, blinded to the questionnaires, reviewed all the medical records of those patients hospitalized in Ospedali Riuniti. Medical records of patients with a history of previous hospitalizations because of stroke were excluded.

Sensitivity, specificity, positive and negative predictive values, and Cohen's kappa agreement of each question were assessed. Answers (yes or no) to each question were matched with the final diagnosis using chi-square test with Yate's correction, assuming $p<0.05$ as limit of significance. Finally, logistic regression analysis was performed to qualify the questions independently related to stroke. Statistic tests were carried out with Statistical Package for Social Sciences (SPSS, Chicago, Illinois), version for Windows.

Italian Emergency Service by phone (#118)
Ospedali Riuniti, Bergamo

Project: Pre-hospital Diagnosis of Stroke Questionnaire

Date: _____ Time: _____

Surname: _____ Name: _____

Gender: M F DOB: _____

QUESTIONS

1. Is the patient awake?	Y	N
2. Is the patient complaining of headache?	Y	N
3. Is the patient complaining of vertigo?	Y	N
4. Is the patient able to understand questions?	Y	N
5. Is the patient able to respond to questions?	Y	N
6. Does the patient have one angle of the mouth lower?	Y	N
7. Does the patient have impaired movement of one arm?	Y	N
8. Does the patient have impaired movement of one leg?	Y	N

Fig. 1 Pre-hospital diagnosis of stroke questionnaire

Results

In the study period, the EMs received a total of 38 000 calls, of which 177 (0.47%) met the criteria for suspected cardiovascular event. The questionnaire was employed during these 177 calls, and the interviewed persons were always occasional rescuers, generally relatives.

Of 177 questionnaires, 34 were rejected: 12 for patients who were dead at ambulance arrival, 8 for patients who were transported to other hospitals, 12 for patients who had a previous stroke, and finally 2 for patients who were found to be younger than 30 years after the control of the medical records. Thus, 143 questionnaires were available for analysis.

The questionnaires referred to 63 men (44.0%) and 80 women (56.0%), aged 34–99 years (mean, 71.8 years). A final diagnosis of stroke was given in 89 of these patients (62.0%) (Table 1). Of the stroke patients, 81 (91%) showed signs of motor dysfunction. No patients had a transient ischemic attack (TIA).

In the same period, Ospedali Riuniti hospitalized a total of 738 stroke patients (1.2% all hospitalizations). Therefore, only 12.1% of stroke patients had used the EMs for hospitalization. No significant differences were found as for age, gender, and stroke subtype (ischemic or hemorrhagic) between stroke patients hospitalized through the EMs or not (Table 2).

The overall results from the tests investigating sensitivity, specificity, positive and negative predictive values and

Table 1 Final diagnosis for the 143 patients who had signs and symptoms of a cardiac event

Diagnosis	Patients, n (%)	
Stroke	89	(62.2)
Syncope	12	(8.4)
Hypoglycemia	10	(7.0)
Myocardial infarction	8	(5.6)
Pneumonia/sepsis	7	(4.9)
Hip fracture	4	(2.8)
Seizures	4	(2.8)
Brain tumor[a]	3	(2.1)
Hepatic failure	2	(1.4)
Uremia	2	(1.4)
Aortic dissection	2	(1.4)

[a] Two malignancies and 1 abscess

Table 2 Characteristics of 738 stroke patients hospitalized at Ospedali Riuniti of Bergamo in the period 30 June 1996 to 31 May 1997, by the use (or not) of emergency medical services (EMs, telephone number 118). No differences between groups were significant (chi-square test for gender and stroke subtype, and Mann-Whitney test for age)

	EMs use (n = 89)	No EMs use 649
Age, mean (SD), years	72 (12)	71 (13)
Women, n (%)	46 (51.7)	331 (51.0)
Stroke type, n (%)		
Ischemic	80 (89.9)	581 (89.5)
Hemorrhagic	9 (10.1)	68 (10.5)

Table 3 Analysis of single questions versus final diagnosis of stroke

Question	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	*p*	Cohen's kappa
1. Loss of consciousness	62.5	37.8	62.1	38.2	1.000	0.002
2. Headache	57.1	36.5	59.5	34.3	0.687	- 0.035
3. Vertigo	60.0	36.9	61.2	36.1	0.897	- 0.023
4. Comprehension	66.7	42.6	65.5	44.7	0.330	0.094
5. Speech	64.0	43.7	65.0	42.7	0.558	0.062
6. Mouth position	74.6	50.0	70.9	54.7	0.004	0.246
7. Arm	78.7	55.9.	74.4	61.7	0.001	0.349
8. Leg	82.0	52.4	73.7	64.1	0.001	0.325

PPV, positive predictive value; *NPV*, negative predictive value

agreements were far to be satisfying. In particular the question cincerning loss of consciousness, headache and vertigo, which were the ones associated with the worst results, achieved a sensitivity between 57.1% and 62.5% and a specificity between 36.9% and 37.8%, whereas the questions on motor signs, which were the ones associated with the best results, achieved a sensitivity between 74.6% and 82%, and a specificity between 50.0% and 55.0% (Table 3). Multivariate analysis selected facial (odds ratio 2.21, 95% confidence interval 1.04 to 4.67) and leg palsy (odds ratio 4.21, 95% confidence interval 1.89 to 9.41) as independent predictors of a final diagnosis of stroke. Together, these variables achieved a combined odds ratio of 9.31 (95% confidence interval, 3.38 to 25.65). No other association achieved statistical significance.

Discussion

Our experience suggests that a few questions administered by medical dispatchers from EMs can help identify stroke patients before hospitalization. Questions investigating facial and leg palsy turned out to be the most effective. Similarly, both Kothari et al. [11] and the Los Angeles Prehospital Stroke Screen collaborators [12] selected motor signs as the best items to be utilized for the out-of-hospital recognition of stroke. These results are likely due to the high frequency of sudden motor dysfunction as a reason for emergency calls. In our cases, that frequency was greater than 90%. On the contrary, questions regarding loss of consciousness, headache, and vertigo were of scarce utility, in agreement with the study by Feldmann and coworkers [8]. That study concluded, in fact, that headache, loss of consciousness, vomiting and seizures were not reasons for early referral of stroke patients.

However, even questions regarding motor deficits exhibited low levels of sensitivity and specificity in the present study. Despite the results from the multivariate logistic regression, both facial and leg palsy showed at best a moderate agreement with the final diagnosis according to the scale of evaluation by Landis and Koch [13]. This result seems to dampen the hope of a confident pre-hospital diagnosis of stroke by phone. On the other hand, in a retrospective study [14], EMs dispatchers correctly addressed the diagnosis of stroke only in 52% of patients, inducing the authors to suggest an accurate training of EMs personnel to improve pre-hospital identification of stroke patients. This should not apply to our EMs, since it is served by physicians trained in acute diseases such as stroke.

Our results probably reflect the difficulties in obtaining confident answers by phone when dealing with acute dis-

eases. Most of the patients of our series who had a final diagnosis different from stroke had indeed severe diseases needing emergency help. Moreover, the calling person for our cases was always an occasional rescuer. Imperfect communication exhibited by most acute stroke patients can increase the rate of misunderstanding of symptoms and signs. This could have been a reason for the utilization of EMs in our patients, but it also increased the rate of administration of the questionnaire to non-stroke patients. Moreover, all the "true" stroke patients suffered from a complete stroke, confirming the severity of the manifestations indicating an emergency call. Thereby, to improve the utility of the EMs and emergency care units for the earliest management of stroke, there is a need for interventions of health policy, for instance educational programs for the general population. One of the first demonstrations of the possible usefulness of education was the study by Alberts et al. [15], who verified that a public and professional education program could increase the rate of referral of stroke patients within 24 hours of symptoms from 37% to 86%. Other supports for education were the findings that indecision or no recognition of stroke was the most common reasons for delayed hospitalization [5, 6, 8], and that knowledge on stroke symptoms and signs was poor both at randomized phone interviews [16], and even after an event had occurred [17, 18].

Findings from our study are favoring of education. First, there was no difference, as for age, gender and stroke subtype (ischemic or hemorrhagic) between stroke patients utilizing or not EMs for hospitalization, thus excluding any bias of inclusion. Second, the proportion of people calling EMs for symptoms and signs of a potential stroke who did not receive a final diagnosis of stroke was 40%. Third, five calls were related to patients less than 40 years of age, an age when stroke is very rare (none of these 5 young patients had stroke). Finally, only 12.1% of the stroke patients hospitalized at Ospedali Riuniti in the considered period called EMs.

Thus, education could teach the general population about stroke and about the existence of services able to apply effective treatments when diagnosis is made closest to the onset of stroke. In conclusion, our experience seems to identify a few questions to be administered by EMs medical dispatchers potentially useful in a pre-hospital suspicion of stroke. However, at this time because of insufficient agreement with final diagnosis, those questions might only alert emergency care units of the arrival of potential stroke patients. A program of education of the general population is needed to improve the utility of EMs in stroke management.

Sommario *Abbiamo verificato in modo prospettico se un questionario somministrato per telefono potesse essere utile per indirizzare una diagnosi pre-ospedaliera di stroke al fine di risparmiare tempo per la cura dei pazienti. Nell'arco di 12 mesi, dal giungo 1996 al maggio 1997, medici del Servizio 118 degli Ospedali Riuniti di Bergamo hanno posto alcune domande sui principali sintomi e segni di vasculopatia cerebrale acuta a tuttti coloro che interpellavano il servizio per un "ictus". Un unico neurologo, esperto di cura dello stroke e cieco sui risultati dei questionari, ha riesaminato tutte le cartelle cliniche dei pazienti ricoverati presso gli Ospedali Riuniti di Bergamo. Sono stati valutati la sensibilità e la specificità, nonché il valore predittivo positivo e negativo, delle domande. Infine, è stato preparato un modello di regressione logistica per identificare quelle domande che erano indipendentemente correlate alla diagnosi di stroke. Sono stati considerati validi per l'analisi 143 questionari, inerenti a 63 uomini e a 80 donne, di età compresa tra i 34 e i 99 anni, media 71.8. La domanda sulla presenza di cefalea è stata quella con la minore sensibilità e specificità (rispettivamente 57.1% e 36.5%), mentre la domanda sulla presenza di paresi della gamba era quella con la maggiore sensibilità e specificità (rispettivamente 82.0% e 52.4%). L'analisi multivariata ha ritenuto le domande sulla presenza di paresi della bocca e della gamba quali fattori indipendentemente correlati alla presenza di uno stroke. Poche domande poste dai medici del Servizio 118 al telefono possono essere di aiuto per anticipare il sospetto di un ictus cerebrale. La concordanza di ogni domanda verso la diagnosi finale di ictus è comunque povera. Pertanto, sembra esservi necessità di un programma di educazione della popolazione generale per migliorare l'efficienza di un tentativo di diagnosi pre-ospedaliera di stroke.*

References

1. – (1995) The National Institute of Neurological Disorders and Stroke rt-PA Stroke Study Group: tissue plasminogen activator for acute ischemic stroke. N Engl J Med 333:1581–1587
2. Hacke W, Kaste M, Fieschi C, Toni D, Lesaffre E, von Kummer R et al for ECASS Study Group (1995) Intravenous thrombolysis with recombinant tissue plasminogen activator for acute hemispheric stroke. The European Cooperative Acute Stroke Study (ECASS). JAMA 274:1017–1025
3. Hacke W, Kaste M, Fieschi C, von Kummer R, Davalos A, Meier D et al for the Second European-Australasian Acute Stroke Study Group Investigators (1998) Randomised double-blind placebo-controlled trial of thrombolytic therapy with intravenous alteplase in acute ischaemic stroke (ECASS II). Lancet 352:1245–1251
4. Hill MD, Hachinski V (1998) Stroke treatment: time is brain. Lancet 352[Suppl III]:10–14
5. Rosen D, Tick R, Leicester J (1991) Delay in presentation of stroke patients. How long and why? Study design and interim results. In: International Conference on Stroke, Geneva, May 31- June 2, p 37
6. Ferro JM, Melo TP, Oliveira V, Crespo M, Canhao P, Pinto AN (1994) An analysis of the admission delay of acute stroke. Cerebrovasc Dis 4:72–75
7. Barsan WG, Brott TG, Broderick JP, Haley EC, Levy DE, Marler JR (1993) Time of hospital presentation in patients with acute stroke. Arch Intern Med 153:2558–2561

8. Feldmann E, Gordon N, Brooks JM, Brass LM, Fayad PB, Sawaya KL, Nazareno F, Levine SR (1993) Factors associated with early presentation of acute stroke. Stroke 24:1805–1810
9. Kereiakes DJ, Gibler WB, Martin LH, Pieper KS, Anderson LC and the Cincinnati Heart Project Study Group (1992) Relative importance of emergency medical system transport and the prehospital electrocardiogram on reducing hospital time delay to therapy for acute myocardialinfarction: a preliminary report from the Cincinnati Heart Project. Am Heart J 123:835–840
10. Weaver WD, Cerqueira M, Hallstrom AP, Litwin PE, Martin JS, Kudenchuk PJ, Eisenberg M (1993) Prehospital-initiated vs hospital-initiated thrombolytic therapy. JAMA 270:1211–1216
11. Kothari R, Hall K, Brott T, Broderick J (1997) Early stroke recognition: developing an out-of-hospital NIH Stroke Scale. Acad Emerg Med 4:986–990
12. Kidwell CS, Starkman S, Eckstein M, Weems K, Saver JL (2000) Identifying stroke in the field. Prosepctive validation of the Los Angeles Prehospital Stroke Screen (LAPSS). Stroke 31:71–76
13. Landis JR, Koch GG (1977) The measurement of observer agreement for categorical data. Biometrics 33:159–174
14. Kothari R, Barsan W, Brott T, Broderick J, Ashbrock S (1995) Frequency and accuracy of prehospital diagnosis of acute stroke. Stroke 26:935–941
15. Alberts MJ, Perry A, Dawson DV, Bertels C (1992) Effects of public and professional education on reducing the delay in presentation and referral of stroke patients. Stroke 23:352–356
16. Pancioli AM, Broderick J, Kothari R, Brott T, Tuchfarber A, Miller R, Khoury J, Jauch E (1998) Public perception of stroke warning signs and knowledge of potentials risk factors. JAMA 279:1288–1292
17. Kothari R, Sauerbeck L, Jauch E, Broderick J, Brott T, Khoury J, Liu T (1997) Patients' awareness of stroke signs, symptoms, and risk factors. Stroke 28:1871–1875
18. Williams LS, Bruno A, Rouch D, Marriott DJ (1997) Stroke patients' knowledge of stroke. Influence on time to presentation. Stroke 28:912–915