ORIGINAL ARTICLE

Role of a critical pathway for door-to-CT-completion interval in the management of acute ischemic stroke patients in the emergency room

Masaru Suzuki[1,5], Akira Imai[2], Masanori Honda[3], Kenji Kobayashi[1] and Shujiro Ohtsuka[4]

Departments of [1]Emergency Medicine, [2]Neurology, [3]Radiology, [4]Surgery, Saisei-kai Utsunomiya Hospital Tochigi, Japan

(Received for publication on April 5, 2004)

Abstract. Objective: Door-to-CT-completion interval (DCI) for acute ischemic stroke patients is one of the clinical indicators of quality assurance in an emergency room (ER). The aim was to clarify whether the critical pathway improves the DCI for acute stroke patients in the ER. Methods: The pathway describes each step in patient evaluation in sequence from the patient's arrival in the ER until the brain CT is completed. Whether to use the pathway when evaluating individual patients is left to the discretion of the physician. After excluding 8 cases with insufficient data, 52 cases diagnosed with acute stroke (29 males, 69.9 ± 12.4 y/o) in the ER between January and February 2003 were retrospectively identified. A logistic regression analysis was used to assess the impact of application of the pathway on achievement of an acceptable DCI (< 25 min). Results: The pathway was applied in 21.2% of the cases included in the study, and the median DCI was reduced from 48 minutes to 22 minutes as a result (P = 0.02). Comparing them with the DCI, the probability values for ambulance use, consciousness disturbance, history of stroke, and application of the pathway in univariate analyses were less than 0.10. These variables were entered into the logistic analysis, which that indicated application of the pathway was the strongest variable related to acceptable DCI (OR: 10.92, 95% CI: 1.22 to 97.96). Conclusion: Application of the pathway was associated with an improvement of the DCI. Use of the pathway will improve the quality of the process of care in the ER. (Keio J Med 53 (4): 247–250, December 2004)

Key words: critical pathway, cerebrovascular disorders, emergency care, quality indicator, computed tomography

Introduction

Critical pathways have been developed not only for nursing, but also for medical care, both to reduce costs and improve quality of care.[1,2] Many pathways for cardiovascular diseases have been developed to date, including for emergency cardiovascular care.[3–5]

Early thrombolysis is given first priority in the treatment of acute ischemic stroke in an emergency room, and there is considerable evidence of the importance of reducing the interval between symptom onset and the institution of thrombolytic therapy.[6–9] Based on the US National Institute of Neurological Disorders and Stroke trial (NINDS) protocol,[7] the American Heart Association (AHA) recommended that the goal of emergency care for acute stroke should be a door-to-CT-completion interval of less than 25 minutes.[8] Previous studies have reported that pathways significantly reduced consuming time relating to quality of care in the emergency room.[3,5] However, measuring time intervals as clinical indicators and application of critical pathways are not yet popular among physicians in Japan.

The purpose of this study was to determine whether application of a critical pathway in the emergency room would reduce the door-to-CT-completion interval in the management of acute stroke patients in a tertiary emergency center in Japan.

Present affiliation: [5]*Department of Emergency Medicine, School of Medicine, Keio University*
Reprint requests should be addressed to Dr. Masaru Suzuki, Department of Emergency Medicine, School of Medicine, Keio University, 35 Shinanomachi, Shinjukuku, Tokyo 160-8582, Japan, e-mail: suzuki@sc.itc.keio.ac.jp

Table 1 Critical Pathway for the Management of Acute Stroke Patients in the Emergency Room

Patient Name:	Date:
	Signature of Physician:
1. :	Arrival in the ER of a patient with suspected acute stroke
2. :	Immediate general assessment
	Vital signs, Blood glucose
	IV-line, CBC & blood chemistry
	12-lead ECG
	Establish time of onset of symptoms
	Review patient history
	Physical and neurological examination
3. :	Order urgent noncontrast CT scan
4. :	CT scan completion (goal < 25 minutes from arrival)

Methods

The present study was designed as a retrospective observational study and was conducted in a single tertiary emergency center of a community hospital, following the ethical guidelines for epidemiological studies (Ministry of Health, Labour and Welfare, 2002) based on the principles outlined in the World Medical Association's Declaration of Helsinki. Further, the ethics committee of the emergency center and the executive committee on clinical pathway of the hospital approved the present study.

The critical pathway

The critical pathway for the management of acute stroke patients is shown in Table 1. Use of the pathway when evaluating individual patients is left to the discretion of the physician. The pathway describes each step of the initial evaluation in sequence from the patient's arrival in the emergency room until completion of the brain CT scan. Physicians who use the pathway must fill in the actual time when each step of medical care was carried out.

Case series

Between January and February 2003, a total of 2,645 adults presented to the emergency room of Saiseikai Utsunomiya Hospital with an acute illness, and 60 (2.3%) of them were diagnosed with acute stroke and admitted to stroke care units. Eight cases were excluded, consisting of 6 had missing door time and 2 had missing brain-CT-completion time, the remaining 52 cases were identified as eligible and included in the study. The patients' characteristics are shown in Table 2. Of the 52 patients, 67.4% had acute ischemic stroke. None of those patients received intravenous thrombolytic therapy, because it was not approved for acute ischemic stroke in the hospital. Door time and brain-CT-completion time were recorded on the medical-order computer in our hospital.

Table 2 Patient Characteristics

	Patients n = 52 *number (%)*
Male	29 (55.8)
Age *median (range)*	72 (39 to 92) y/o
Type of stroke (discharge diagnosis)	
Thrombosis	24 (46.2)
Embolism	11 (21.2)
Intracerebral hemorrhage	9 (17.3)
Subarachnoid hemorrhage	8 (15.4)
Mode of transportation	
Ambulance	35 (67.3)
Door time	
Day (8:30 to 17:30)	32 (61.5)
Glasgow coma scale score < 15	19 (36.5)
Atrial fibrillation	8 (15.4)
History of stroke	15 (28.8)
Onset-to-door interval *median (range)*	2.2 (1 to 240) hours
Door-to-CT-completion *median (range)*	42 (12 to 201) minutes
Application of critical pathway	11 (21.2)

Statistical analysis

The statistical analysis, including calculation of median values and ranges, was performed using SPSS 11.5J software. Univariate analyses of variables were performed by using the χ^2 test for categorical data and the Mann-Whitney U-test for continuous data. Variables with probability values less than 0.10 were entered in a logistic regression model with backward elimination procedure to identify multivariate predictors of acceptable door-to-CT-completion interval (< 25 min).

Results

The pathway was applied in 11 (21.2%) of the 52 cases included in the study and the median door-to-CT-completion interval was shorter in the pathway group (24 minutes; range: 13 to 84 minutes) than in the no-pathway group (48 minutes; range: 12 to 201 minutes; Mann-Whitney U-test: $P = 0.02$). The proportion of patients with an acceptably short door-to-CT-completion interval (< 25 minutes) improved from 6.4% to 42.9% as a result of using the pathway (Table 3).

Ambulance use, consciousness disturbance, application of the pathway, and history of stroke were selected in the univariate analyses, and inserted into the logistic regression model (Table 3), which indicated application of the pathway as one of the independent variables of

Table 3 Univariate Analysis

	Door-to-CT-completion interval		
	<25 minutes n = 14 *Number (%)*	>=25 minutes n = 38 *Number (%)*	P-value
Male	9 (64.3)	20 (52.6)	0.54
Age *median*	64 y/o	74 y/o	0.21
Mode of transportation			
Ambulance	14 (100)	21 (55.3)	0.0002
Door time			
Day (8:30 to 17:30)	7 (50)	25 (65.8)	0.35
Glasgow coma scale score < 15	9 (64.3)	10 (26.3)	0.02
Atrial fibrillation	4 (28.6)	4 (10.5)	0.19
History of stroke	7 (50)	8 (21.1)	0.08
Application of critical pathway	6* (42.9)	5 (6.4)	0.05

* Odds ratio = 4.95 (95% Confidence Interval: 1.20 to 20.40)

the acceptable door-to-CT-completion interval (Table 4).

Discussion

Application of the pathway to patients suspected of acute stroke was shown to be the strongest independent variable in increasing the percentage of cases in which the ACC/AHA criterion was met.[8] Although there have been no reports on the role of the pathway for acute stroke patients in the emergency room, application of pathways has been reported to reduce door-to-drug intervals for patients with acute myocardial infarction receiving intravenous thrombolytic therapy.[3,5] Door-to-drug intervals have been used as an indicator of the quality of medical care for acute myocardial infarction and acute ischemic stroke patients in the emergency room. Pathways have been valuable for continuously the improving quality of emergency care.[3,5,7–9]

Since acute ischemic stroke is one of the most common diseases treated in emergency rooms, realistic evaluation guidelines must be established in every institution. Critical pathways may clarify the goal of care not only for physicians but also for all medical personnel involved in providing emergency care. They also promote good collaboration among the entire emergency room team.[1]

Table 4 Multivariate Analysis

	Odds ratio	95% CI	P-value
Application of critical pathway	10.92	1.22 to 97.96	0.03
History of stroke	9.50	1.35 to 66.78	0.02

This is the first report from Japan on the application of a critical pathway in the emergency room to reduce the door-to-CT-completion interval as the emergency evaluation goal. The pathway used in this study clearly stated the process of patient care and rationalized the sequence of orders of treatment by medical personnel. Similar pathway sheets for patients with acute myocardial infarction that significantly reduced consuming time relating to quality of care in the emergency room have been previously reported.[3,5] Those pathways will be effective in reducing physician delay (door-to-physician evaluation interval), which is considered one of the reasons for in-hospital delay. Actually, the median door-to-CT-order-given interval in this study was shorter in the pathway group than in the no-pathway group (11 minutes, 33 minutes, respectively; Mann-Whitney U-test: $P = 0.006$), but order-to-CT-completion intervals between the groups was not different (6 minutes, 8 minutes, respectively; Mann-Whitney U-test: $P = 0.47$).

There were potential limitations in this study. First, it was a retrospective study conducted in a single center. Although the study includes some selection bias, consecutive cases were included in the study to reduce selection bias. Second, the sample size was small, but it was estimated to be sufficient to detect statistically significant differences. The criterion for significance (alpha) for 2-tailed test in this study was set at 0.05. The study had a power of 81% to yield a statistically significant result. Third, the patients had a variety of different types of acute stroke. It is difficult to diagnose the type of acute stroke solely on the basis of the clinical presentation.[10] A CT scan of the brain is the definitive test for differentiating ischemic stroke from hemorrhagic stroke, and thus the type of acute stroke may not influence the door-to-CT-completion interval. Finally, the proportion of the patients to whom the pathway was applied less than 25%. Although the actual reasons for this were not identified in this study (Table 5), physicians' reluctance use the pathway may be a contributing factor. It may be associated with unavailablility of intravenous thrombolytic agents for acute ischemic stroke in the hospital. Further, the fact that the pathway had to be applied at the initial evaluation may have decreased its use.

The effectiveness of the pathway on patients' outcome in Japan, where intravenous thrombolytic therapy for acute ischemic stroke has not yet been adopted, is limited, and the long-term outcome of the patients was actually not included in the analysis. However, the result of this study indicated that the pathway was valuable in reducing physician delay.

Table 5 Application of Critical Pathway

	Application of critical pathway		
	Pathway group n = 11 *Number (%)*	No-pathway group n = 41 *Number (%)*	P-value
Male	6 (54.5)	23 (56.1)	1.00
Age *median*	71 y/o	73 y/o	0.62
Mode of transportation			
Ambulance	9 (81.8)	26 (63.4)	0.30
Door time			
Day (8:30 to 17:30)	9 (81.8)	23 (56.1)	0.17
Glasgow coma scale < 15	3 (27.3)	16 (39.0)	0.73
Atrial fibrillation	1 (9.1)	7 (17.1)	1.00
History of stroke	4 (36.4)	11 (26.8)	0.71

References

1. Pearson SD, Goulart-Fisher D, Lee TH: Critical pathways as a strategy for improving care: problems and potential. Ann Intern Med 1995; 123: 941–948
2. Every NR, Hochman J, Becker R, Kopecky S, Cannon CP: Critical pathways: a review. Committee on Acute Cardiac Care, Council on Clinical Cardiology, American Heart Association. Circulation 2000; 101: 461–465
3. Cannon CP, Johnson EB, Cermignani M, Scirica BM, Sagarin MJ, Walls RM: Emergency department thrombolysis critical pathway reduces door-to-drug times in acute myocardial infarction. Clin Cardiol 1999; 22: 17–20
4. Kwan J, Sandercock P: In-hospital care pathways for stroke: a Cochrane systematic review. Stroke 2003; 34: 587–588
5. Nakamura I, Hori S, Suzuki M, Asakura Y, Yoshikawa T, Ogawa S, Aikawa N: Critical pathway improves arrival-in-cath-lab interval for patients with acute myocardial infarction in the emergency department. Jpn Circ J 2001; 65: 849–852
6. Barsan WG, Brott TG, Broderick JP, Haley EC, Levy DE, Marler JR: Time of hospital presentation in patients with acute stroke. Arch Intern Med 1993; 153: 2558–2561
7. Tissue plasminogen activator for acute ischemic stroke. The National Institute of Neurological Disorders and Stroke rt-PA Stroke Study Group. N Engl J Med 1995; 333: 1581–1587
8. Guidelines 2000 for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Part 7: the era of reperfusion: section 2: acute stroke. The American Heart Association in collaboration with the International Liaison Committee on Resuscitation. Circulation 2000; 102: I 204–216
9. Wardlaw JM, Zoppo G, Yamaguchi T, Berge E: Thrombolysis for acute ischaemic stroke. Cochrane Database Syst Rev 2003: CD000213
10. Gilman S: Imaging the brain. First of two parts. N Engl J Med 1998; 338: 812–820