ORIGINAL RESEARCH

Atrial fibrillation is a predictor of in-hospital mortality in ischemic stroke patients

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Background/purpose: In-hospital mortality rate of acute ischemic stroke patients remains between 3% and 18%. For improving the quality of stroke care, we investigated the factors that contribute to the risk of in-hospital mortality in acute ischemic stroke patients.

Materials and methods: Between January 1, 2007, and December 31, 2011, 2,556 acute ischemic stroke patients admitted to a stroke unit were included in this study. Factors such as demographic characteristics, clinical characteristics, comorbidities, and complications related to in-hospital mortality were assessed.

Results: Of the 2,556 ischemic stroke patients, 157 received thrombolytic therapy. Eighty of the 2,556 patients (3.1%) died during hospitalization. Of the 157 patients who received thrombolytic therapy, 14 (8.9%) died during hospitalization. History of atrial fibrillation (AF, $P<0.01$) and stroke severity ($P<0.01$) were independent risk factors of in-hospital mortality. AF, stroke severity, cardioembolism stroke, and diabetes mellitus were independent risk factors of hemorrhagic transformation. Herniation and sepsis were the most common complications of stroke that were attributed to in-hospital mortality. Approximately 70% of in-hospital mortality was related to stroke severity (total middle cerebral artery occlusion with herniation, basilar artery occlusion, and hemorrhagic transformation). The other 30% of in-hospital mortality was related to sepsis, heart disease, and other complications.

Conclusion: AF is associated with higher in-hospital mortality rate than in patients without AF. For improving outcome of stroke patients, we also need to focus to reduce serious neurological or medical complications.

Keywords: brain infarction, atrial fibrillation, outcome, risk factors, thrombolytic therapy

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Introduction

Stroke is one of the most important causes of death and disability worldwide. The in-hospital mortality rates were ~6%–9% for ischemic stroke patients and 22%–45% for hemorrhagic stroke patients.[1,2] However, these studies were conducted before the condition of stroke units was optimized and before intravenous recombinant-tissue plasminogen activator (rt-pa) was approved for use in acute stroke patients.

In recent years, there have been important advances in the management of acute stroke patients, such as availability of stroke units,[3,4] thrombolytic therapy, and endovascular therapy performed for stroke patients who are compatible with thrombolytic therapy guidelines.[5–7] Previous studies have reported that patient outcome and in-hospital mortality can be significantly improved if a patient is treated in a stroke unit.[3,4] Intravenous rt-pa and endovascular therapy are known to improve outcomes in stroke patients but do not improve mortality associated with stroke.[5,7] However, even with these advances in stroke management, the mortality rate of stroke patients during hospitalization remains between 3% and 18%.[4,6,8–10] The predictors of in-hospital

mortality were age, stroke severity, increased intracranial pressure (IICP), and pneumonia.[9,11] Hemorrhagic transformation (HT) in ischemic stroke patients was reported to be associated with an increased risk for death and disability. Large area infarction, cardioembolism, and high-level blood sugar were associated with HT.[12] Atrial fibrillation (AF) has been reported to be associated with poor outcome but not with in-hospital mortality.[13] However, Arboix et al[14] reported that AF is associated with higher in-hospital mortality rate in both ischemic and cardioembolic stroke patients. After thrombolytic therapy, patients with AF are at high risk of intracranial hemorrhage and death at discharge compared with patients without AF.[15] However, one study found no association of AF with outcome in thrombolyzed patients.[16] Thus, the question arises, whether AF may increase the risk of in-hospital mortality and the HT rate in stroke patients without thrombolytic therapy.

The purpose of this study was to identify the predictors of in-hospital mortality and to investigate the relationship between AF and in-hospital mortality and HT in ischemic stroke patients who were treated in stroke units, and to analyze the medical and neurological complications associated with in-hospital death.

Material and methods

Between January 1, 2007, and December 31, 2011, data of acute ischemic stroke patients admitted to the Department of Neurology of Chia-Yi Christian Hospital were collected prospectively during stroke registration. Chia-Yi Christian Hospital is an acute care, 1,000-bed teaching hospital in Southern Taiwan, Republic of China. The number of acute ischemic stroke patients treated in our hospital was >750 patients per year. All patients with acute neurological symptoms were initially attended in the emergency department. After neurological evaluation, brain computed tomography (CT) or magnetic resonance image (MRI) was performed, and stroke patients were admitted to the stroke unit, which is a part of the Department of Neurology. Blood cell count, biochemistry profile, chest radiography, and 12-lead electrocardiography were performed at the emergency department. Fasting blood sugar, cholesterol, and triglycerides were evaluated on the next day of admission. Neurological examination was performed every day. The National Institutes of Health Stroke Scale (NIHSS) was used to evaluate stroke severity. Modified Rankin Scale (mRS) was used to evaluate outcome. Good outcome was defined as mRS ≤2, whereas poor outcome was defined as mRS >2. Subtypes of stroke included large artery atherosclerosis

(n=634), small vessel occlusion (n=922), cardioembolism (n=387), and undetermined etiology (n=613). Only ischemic stroke patients were included in this study. Patients with transient ischemic attack, intracerebral hemorrhage, and subarachnoid hemorrhage were excluded from the study. No other exclusion criteria were applied for patient selection in the present study.

For each patient, demographic data (age, sex, and body mass index), vascular risk factors (hypertension, diabetes mellitus, AF, hyperlipidemia, smoking, and heart disease), stroke severity score (NIHSS), neuroimaging, carotid duplex, and outcome were recorded. Variables affecting the outcome of stroke were assessed. Age was categorized as <65 years, 65–74 years, 75–84 years, or >85 years. Hypertension was defined as either systolic blood pressure ≥140 mmHg, diastolic blood pressure >90 mmHg, self-reported history of hypertension, or use of an antihypertensive agent. Diabetes mellitus was defined as pathologically elevated fasting blood sugar, self-reported patient history of diabetes mellitus, or regular use of antidiabetic medications. AF was defined as history of AF or AF observed on electrocardiogram. Hyperlipidemia was defined as serum total cholesterol level >200 mg/dL or low-density lipoprotein level >130 mg/dL (measured during acute stroke stage). Patients who had history of ischemic heart disease or congestive heart failure were defined as having heart disease. IICP was defined as evidence of brain edema, mass effect, or brain shift syndrome in brain CT or MRI associated with clinical deterioration.[9] Transtentorial herniation was defined as brain CT or MRI showing brain edema associated with acute onset of unilateral or bilateral papillary dilation, loss of reactivity to light, and decline in the Glasgow coma scale ≥2 points.[17] HT was defined as any sign of hemorrhage on the brain CT or MRI scans.[18]

The patients who had AF and regularly used anticoagulant for >3 days per week were considered as anticoagulant user, otherwise were considered as non-user. In the first week of stroke onset, anticoagulant was not given except for patients with small infarct.

Outcome variables included infection, cardiac event, vascular event, or respiration disease. Causes of death were analyzed such as transtentorial herniation, pneumonia, cardiac event, sudden death, septicemia, unknown, brain stem infarction, and other causes.[19] If the patient had herniation and sepsis signs, and he (or she) died within 1 week of stroke onset, the cause of death was considered as stroke (IICP) related. If the patient had clinical evidence of systemic inflammatory response syndrome and died after 1 week of stroke onset without other causes for death, the cause of

death was considered as sepsis.[20] The data used in the study were collected from the Chia-Yi Christian Hospital acute stroke registry. This study has been approved by the Ethics Committee of the Chia-Yi Christian Hospital and written informed consent was obtained from each patient.

Statistical analysis

Chi-square test and independent Student's *t*-test were used for univariate analysis. *P*<0.05 was considered statistically significant. Multivariate regression (simultaneous regression) was used to identify independent risk factors of in-hospital mortality and HT. Analysis was performed using MedCalc statistical software Version 15. (MedCalc Software, Ostend, Belgium).

Results

During the 5-year period covered by this study, 3,107 patients were admitted due to ischemic stroke, of which 451 were excluded from the study because the final diagnosis was transient ischemic attack. Thus, 2,556 patients were included in this study. CT was performed in all 2,556 patients; CT and MRI were performed in 1,362 patients. Clinical characteristics of the enrolled patients are shown in Table 1. Patients' age ranged from 23 years to 101 years old (mean age, 69.6±11.9 years). Of the 2,556 patients, 814 patients (31.8%) were aged <65 years, 781 patients (30.5%) were aged 65–74 years, 732 patients (28.7%) were aged 75–84 years, and 229 patients (19%) were aged >85 years. Of the 2,556 patients, 1,482 (58%) were males and 1,074 (42%) were females, and 109 (4.3%) had no risk factor of stroke, 432 (16.9%) had one risk factor of stroke, 755 (29.5%) had two risk factors of stroke, 664 (26.0%) had three risk factors of stroke, and 596 (23.3%) had >3 risk factors of stroke. The most common risk factors were hypertension (80.3%), followed by hyperlipidemia (55.4%), diabetes mellitus (44%), heart disease (29.5%), stroke history (27.5%), and AF (17.1%). Types of stroke included large artery atherosclerosis (24.8% of patients), small vessel disease (36.1% of patients), cardioembolism (15.1% of patients), and undetermined etiology (24% of patients). NIHSS at admission was ≤5 in 54.5% of patients, 6–15 in 29.1% of patients, 16–25 in 10.7% of patients, and >25 in 5.7% of patients (Table 1). The median NIHSS score was 5. IICP was observed in 4.2% of patients.

Table 1 Characteristics of the study population (N=2,556)

Characteristics	Total (N=2,556)	Alive (n=2,476)	Dead (n=80)	*P*-value
Age, mean (SD), years	69.57 (11.99%)	69.42 (11.98%)	74.12 (12.09%)	<0.01
Age (years)				
<65	818 (32.0%)	805 (32.5%)	13 (16.2%)	
65–74	779 (30.5%)	760 (30.7%)	19 (23.8%)	
75–85	730 (28.6%)	695 (28.1%)	35 (43.8%)	
>85	229 (8.9%)	216 (8.7%)	13 (16.2%)	
Sex				
Males	1,482 (58.0%)	1,446 (58.4%)	36 (45.0%)	0.02
Females	1,074 (42.0%)	1,030 (41.6%)	44 (55.0%)	
Comorbidity				
Diabetes mellitus	1,126 (44%)	1,089 (44.0%)	37 (46.3%)	<0.01
Hypertension	2,051 (80.3%)	1,985 (80.2%)	66 (82.5%)	<0.01
AF	437 (17.1%)	398 (16.1%)	39 (48.8%)	<0.01
Previous stroke	703 (27.5%)	678 (27.4%)	25 (31.3%)	0.04
Heart disease	753 (29.5%)	697 (28.2%)	56 (70.0%)	<0.01
Hyperlipidemia	1,417 (55.4%)	1,384 (55.9%)	33 (41.3%)	0.01
Stroke severity (NIHSS)				
≤5	1,394 (54.5%)	1,388 (56.1%)	6 (7.5%)	<0.01
6–15	745 (29.1%)	736 (29.7%)	9 (11.3%)	
16–25	272 (10.7%)	248 (10.0%)	24 (30.0%)	
>25	145 (5.7%)	104 (4.2%)	41 (51.3%)	
Stroke subtype				
LAA	634 (24.8%)	607 (24.5%)	27 (33.8%)	<0.01
CE	387 (15.1%)	359 (14.5%)	28 (35.0%)	
SVO	922 (36.1%)	920 (37.2%)	2 (2.5%)	
UN	613 (24.0%)	590 (23.8%)	23 (28.7%)	

Abbreviations: AF, atrial fibrillation; NIHSS, National Institute of Health Stroke Scale; LAA, large artery atherosclerosis; CE, cardioembolism; SD, standard deviation; SVO, small vessel occlusion; UN, undetermined etiology.

The prevalence of hypertension, diabetes mellitus, and AF was higher in females than in males. Of the 2,556 patients, 157 received thrombolytic therapy. At discharge, 56.8% (1,451/2,556) of total patients had a poor outcome (mRS >2), and 94.4% (1,371/1,451) of those patients were alive. The overall in-hospital mortality was 3.13% (80/2,556), which included the 8.9% (14/157) of patients receiving thrombolytic therapy who died during hospitalization. The in-hospital mortality rate was 2.4% (36/1,482) in males and 4.1% (44/1,074) in females. In-hospital mortality was higher in females than in males (P=0.02). Stroke severity was higher in females than in males. Stroke severity was strongly associated with an increase in the risk of in-hospital mortality (Table 2).

In-hospital mortality was 6.28% (74/1,162) in patients with moderate-to-severe stroke (NIHSS >5) and 0.43% (6/1,394) in patients with mild stroke (NIHSS ≤5). The HT rate was higher in fatality patients than in nonfatality patients (P<0.001). Univariate analysis showed that AF, stroke subtype, stroke severity (NIHSS >15), and age ≥75 years significantly increased the risk of in-hospital mortality rate (Table 2). AF, stroke subtype, and stroke severity increased the risk of HT (Table 3). A multivariate regression analysis showed that AF, stroke severity, and stroke type were independent predictors of in-hospital mortality. AF, stroke severity, cardioembolism stroke, and diabetes mellitus were independent predictors of HT (Table 4). In comparison with large artery atherosclerosis, cardioembolic stroke increased the risk of in-hospital mortality with odds

Table 2 Predictors of in-hospital mortality (N=2,556)

Variable	In-hospital deaths, N (%)	HR (95% CI)	P (χ^2)
Total	80 (3.3)		
Comorbidities			
Diabetes mellitus			
No	43 (3.00)	I	0.77
Yes	37 (3.28)	1.18 (0.74–1.88)	
Hypertension			
No	14 (2.77)	I	
Yes	66 (3.21)	1.16 (0.63–2.12)	0.70
Previous stroke			
No	55 (2.96)	I	
Yes	25 (3.55)	0.98 (0.60–1615)	0.52
AF			
No	41 (1.93)	I	
Yes	39 (8.92)	1.81 (1.00–3.30)	<0.01
Hypercholesterolemia			
No	52 (3.66)	I	
Yes	28 (2.46)	0.66 (0.41–1.05)	0.15
Smoking			
Yes	53 (3.61)	I	
No	27 (2.47)	0.67 (0.42–1.08)	0.26
Stroke severity (NIHSS)			
≤5	6 (0.43)	I	
6–15	9 (1.20)	2.81 (0.99–7.92)	0.07
16–25	24 (8.82)	22.33 (9.03–55.20)	<0.01
>25	41 (28.27)	91.00 (37.76–219.30)	<0.01
Age (years)			
<65	13 (1.58)	I	
65–74	19 (2.43)	1.54 (0.75–3.15)	0.28
75–85	35 (4.79)	3.11 (1.63–5.94)	0.01
>85	13 (5.67)	3.72 (1.70–8.15)	<0.01
Stroke type			
LAA	27 (4.3)	I	
CE	28 (6.7)	1.75 (1.01–3.02)	0.04
SVO	2 (0.2)	0.05 (0.01–0.20)	<0.01
UN	23 (3.3)	0.87 (0.49–1.54)	0.66

Abbreviations: AF, atrial fibrillation; LAA, large artery atherosclerosis; CE, cardioembolism; NIHSS, National Institute of Health Stroke Scale; SVO, small vessel occlusion; UN, undetermined etiology; CI, confidence interval; HR, Hazard ratio.

Table 3 Predictors of HT (N=2,556)

Variable	HT (%)	Non-HT (%)	RR (95% CI)	P (χ^2)
Diabetes mellitus				
No	58	1,372	I	
Yes	58	1,068	1.02 (0.99–1.03)	0.18
Hypertension				
No	28	477	I	
Yes	88	1,963	0.98 (0.96–1.01)	0.22
Stroke history				
No	84	1,769	I	
Yes	32	671	I (0.98–1.09)	0.97
AF				
No	56	2,063	I	
Yes	60	377	1.01 (1.08–1.17)	<0.0001
Hyperlipidemia				
No	68	1,351	I	
Yes	48	1,089	0.99 (0.97–1.01)	0.49
Smoking				
No	74	1,393	I	
Yes	42	1,047	0.99 (0.98–1.0)	0.39
Stroke severity (NIHSS)				
≤5	18	1,376	I	
6–15	27	718	1.02 (1.00–1.04)	
16–25	41	231	1.16 (1.10–1.22)	
>25	30	115	1.25 (1.15–1.35)	<0.0001
Age (years)				
<65	35	783	I	
65–74	32	747	0.99 (0.98–1.02)	
75–85	33	697	1.0 (0.98–1.03)	
>85	16	213	1.03 (0.99–1.07)	0.30
Stroke type				
LAA	30	604	I	
CE	61	325	1.13 (1.08–1.18)	
SVO	0	922	0.95 (0.93–0.97)	
UN	25	589	0.99 (0.97–1.02)	<0.0001

Abbreviations: HT, hemorrhagic transformation; RR, relative ratio; CI, confidence interval; AF, atrial fibrillation; NIHSS, National Institute of Health Stroke Scale; LAA, large artery atherosclerosis; CE, cardioembolism; SVO, small vessel occlusion; UN, undetermined etiology.

Table 4 Multivariate regression analysis for risk factors of in-hospital mortality and HT

Variable	P-value	
	Fatality	HT
Sex (females/males)	0.53	0.27
Age ≥75 (yes/no)	0.31	0.09
Hypercholesterolemia (yes/no)	0.30	0.78
AF (yes/no)	0.006	0.03
Diabetes mellitus (yes/no)	0.43	0.03
Hypertension (yes/no)	0.67	0.29
Stroke history (yes/no)	0.60	0.11
NIHSS >15 (yes/no)	<0.001	<0.01
Smoking (yes/no)	0.62	0.50
Stroke type (cardioembolism)	0.15	<0.01

Abbreviations: HT, hemorrhagic transformation; AF, atrial fibrillation; NIHSS, National Institutes of Health Stroke Scale.

ratio 1.75 (Table 2). Of the 437 patients with AF, 62 patients used warfarin or other antithrombotic agents, 375 patients did not use any antithrombotic agent. There was no difference in the in-hospital mortality between the group that used antithrombotic agents and the group that did not use (6.45% (4/62) vs 9.33% (35/375), P=0.63). There was no significant difference in the hemorrhagic rate between the two groups (14.52% (9/62) vs 13.33% (50/375), P=0.84). Stroke-related complications such as transtentorial herniation and basilar artery occlusion were the most common causes of in-hospital mortality. Approximately 70% of in-hospital mortality was attributed to stroke severity (transtentorial herniation, basilar artery occlusion, and HT; Table 5). Middle cerebral artery occlusion-related fatality occurred mostly in the patients with large artery atherosclerosis, cardioembolism, and undetermined etiology. Multivariate logistic regression showed that only AF (P<0.001) and stroke severity (NIHSS >15; P<0.001) were independent risk factors of in-hospital mortality (Table 4). AF, stroke severity, cardioembolism stroke, and diabetes mellitus were predictors of HT (Table 4).

Table 5 Cause of in-hospital mortality (n=80)

Cause	Males (%)	Females (%)	Length of stay (day)	
			Males	Females
Herniation	16 (44.4)	19 (43.2)	7.9	7.5
Cardiac origin	2 (5.5)	3 (6.8)	24.0	7.5
Sepsis	5 (13.9)	9 (20.4)	16.7	15.7
Sudden death	5 (13.9)	5 (11.3)	12.6	11.8
Basilar artery occlusion	5 (13.9)	5 (11.3)	9.2	15.8
Unknown	2 (5.5)	2 (4.5)	14.0	11.5
Hemorrhage	1 (2.8)	1 (2.3)	4.0	15.0
Total	36	44	10.9	10.8

Note: Hemorrhage: hemorrhagic transformation.

Discussion

In-hospital mortality of acute stroke patients is affected by several factors including patient age, stroke type, stroke severity, travel time to hospital, and enrollment criteria.[21–26] A German study found that the risk of in-hospital mortality was 10% in patients treated with rt-pa and 4.6% in patients not treated with rt-pa.[8] A different study from Taiwan found that in-hospital mortality was 17.8% in patients treated with rt-pa.[6] In our study, the total in-hospital mortality was found to be 3.13%, which included 8.9% (14/157) of patients treated with rt-pa and 2.75% (66/2,399) of patients not treated with rt-pa. This in-hospital mortality is same as that found in previous studies.[1,27] Koennecke et al[9] found that their overall in-hospital mortality was 5.4%; however, >50% of their patients had moderate-to-severe stroke. In our study, the in-hospital mortality rate in patients with moderate-to-severe stroke was 6.28%, which is similar to the result of Koennecke et al study.

In our study, 35 patients died due to middle cerebral artery occlusion with brain edema and herniation, and ten patients died due to basilar artery occlusion with cerebellar edema and herniation. Fatality rates in patients with large middle cerebral artery infarct as high as 78% have been reported.[28] Infarct size has been reported as the major determinant of the development of life-threatening brain edema.[29] Decompressive surgery in patients <60 years old had been reported to reduce mortality and severe disability in patients with malignant middle cerebral artery infarction.[30] Our study found that ~60% of patients died in the hospital due to total middle cerebral artery occlusion or basilar artery occlusion with brain edema and herniation. Because most of the patients who died in hospital were older than 60 years, whether increased rate of decompressive surgery could reduce in-hospital mortality needs further investigation. This study showed that stroke severity is the most important factor of in-hospital mortality. When compared with large artery atherosclerosis, patients with cardioembolism had a high risk of death and small vessel occlusion had a lower risk of death (Table 2), which may be related to a cardioembolic occlusion of a large artery and lack of collateral circulation. Another cause for higher in-hospital mortality among patients with cardioembolic stroke may be related to recurrent embolism. Arboix et al[31] found that the in-hospital mortality rate in patients with early recurrent embolization is significantly higher than in those who did not develop attacks. Small vessel occlusion had lower rate of in-hospital mortality in our study similar to the results of Arboix et al;[32] they found that the mortality rate of lacunar infarct is significantly lower than other types

of stroke. Our study found that the in-hospital mortality is mildly lower in anticoagulant user and there was no significant difference in the HT rate between anticoagulant user and nonuser. The result is inconsistent with that of Rosand, et al[33] and Singer, et al[34] studies. Their studies found that warfarin is beneficial to patients for prevention and does not significantly increase the risk of intracranial hemorrhage. This result highlights the importance of the use of anticoagulant agent for patients with AF for the prevention of ischemic stroke. Old age had been reported as a predictor of in-hospital mortality and associated with poor outcome in stroke patients.[35] Our study also showed that older age of stroke patients has the tendency to increase the risk of in-hospital mortality. The study confirmed the result that old age is a predictor of in-hospital mortality and is also associated with poor outcome in stroke patients.

The in-hospital mortality rate in patient receiving thrombolysis was 8.9%, whereas the mortality rate in all the patients was 3.1% ($P<0.0001$). The higher mortality rate in thrombolysis patients is in contrast with the finding of ECASS II, which reported that there was no difference in 30-day and 90-day mortality in thrombolysis and non-thrombolysis patients,[36] which was a randomized trial. The result is consistent with the finding in a nationwide inpatient sample study. Bateman et al analyzed the data from the US nationwide inpatient sample for the years 1999 to 2002. Their results showed that thrombolysis patient had a higher in-hospital mortality rate compared with the nonthrombolysis patients (11.4% vs 6.8%).[37] The higher mortality rate in the thrombolysis group is most likely related to the baseline difference in the patient receiving thrombolysis.

Approximately 30% of in-hospital mortality was related to preventable factors. In particular, patients with septic shock (12 with pneumonia and two with urinary tract infection) showed 17.5% in-hospital fatality in this study and heart disease (cardiac event and sudden death) in about 15% of in-hospital mortality. History of angina and myocardial infarction before stroke were associated with in-hospital acute myocardial infarction and heart failure along with increased mortality at 3 months.[38] Our result is compatible with the findings of this study. In order to improve the outcome of stroke patients, close monitoring of cardiac function, along with prompt diagnosis and treatment of the heart event may be necessary. A previous study showed that chest infection and urinary tract infection were frequent complications in stroke patients.[39] Because chest infection may be related to aspiration, dysphagia screening is necessary in stroke patients. Whether prophylactic antibiotics should be used

for the prevention of pneumonia or urinary tract infection in patients at a risk of infection needs further investigation.

It was reported that AF more likely occurs in female patients and old patients and has a higher fatality rate within 14 days.[13] We found that the frequency of AF was 17.1% in our patients; the result is in accordance with 15%–21% reported by other authors.[13,40–42] Wong reported that AF and ischemic heart disease were independent risk factors for in-hospital mortality.[2] In our study, AF was found to be the risk factors for in-hospital mortality and HT. Heuschmann et al showed that AF, age, and stroke severity are predictors of in-hospital mortality.[27] Our results also show that AF, cardioembolism type stroke, and stroke severity are predictors of in-hospital mortality. In our study, old age has the tendency to increase in-hospital mortality; however, in multivariate analysis, there is no significant difference. Our study found that AF, cardioembolism type stroke, stroke severity, and diabetes mellitus are predictors of HT. Our result is compatible with that of Wang et al,[43] who found that cardioembolism stroke, severity of stroke, and diabetes mellitus are predictors of HT. Our study also found that the number of patients dying due to septic shock (17.5%, 14/80) and sudden death (12.5%, 10/80) was higher than those dying due to acute myocardial infarction (6.25%, 5/80). It can be assumed that patients who died due to sudden death may have developed ischemic heart disease; however, this was not confirmed.

A previous study showed that females aged 45–64 years had lower risk of stroke-related in-hospital mortality than males.[44] However, some studies reported that female sex was associated with poor functional outcome at discharge.[13,42] These studies found that females with stroke were older and more likely to have AF, they also found that females experienced cardioembolic stroke more frequently than males. Our study found that in-hospital mortality in females was higher than that in males ($P=0.02$), which may be attributed to more frequent AF and cardioembolic stroke in females, and stroke severity was higher in females than in males. However, after adjusting for demographic and clinical factors, there were no differences between sexes with respect to mortality.

This study had some limitations. First, this was a retrospective analysis of stroke registration data and there may have been coding error. However, the errors are unlikely to be systemic. Second, this study only included patients with ischemic stroke and did not include patients with hemorrhagic stroke. The strengths of our study are as follows: 1) all patients were managed in the stroke unit and by a neurologist, and all data were collected in a prospective and uniform manner. Data were designed for continuous

monitoring of stroke. 2) All physicians in our stroke unit had experience using rt-pa in stroke patients, and all patients who were eligible for thrombolytic therapy received thrombolytic therapy.

In the study, stroke severity and AF were found to be independent predictors of in-hospital mortality in routine clinical practice of acute ischemic stroke. AF, stroke severity, cardioembolism stroke, and diabetes mellitus were predictors of HT. Our study found that AF may increase risk of in-hospital mortality and increase HT in acute stroke patients. When we treat patients with AF and acute stroke, we need to cautiously use anticoagulants, especially in patients with large infarct, previous hemorrhagic stroke, and low platelet count of high sensitive c-reactive protein (hsCRP) level.[45] Approximately 30% of in-hospital mortality in acute ischemic stroke patients was found to be associated with serious neurological or medical complications. Thus, during the management of acute stroke patients, we also need focus to reduce serious complications after stroke to reduce in-hospital mortality rate. In particular, care must be targeted toward the prevention of infection and IICP.

Conclusion

From our results, we conclude that stroke in patients with AF is associated with higher in-hospital mortality rate than in patients without AF. These findings emphasize the importance of prophylaxis of stroke in patients with AF as soon as AF is diagnosed. For improving the outcome of stroke patients, we also need focus to reduce serious neurological or medical complications.

Acknowledgment

Disclosure

The authors report no conflicts of interest in this work.

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