Mortality and Predictors of Death Poststroke: Data from a Multicenter Prospective Cohort of Lebanese Stroke Patients

Rachel Abdo, PhD,*,†,‡ Halim Abboud, MD,§ Pascale Salameh, PhD,‡,¶ Taghrid El Hajj, MD,¶,|| and Hassan Hosseini, MD**

Background: Despite efforts to reduce stroke mortality rates, the disease remains a leading cause of death in Lebanon highlighting the importance of understanding risk factors and subsequent mortality. We examined mortality rates during the first year after acute stroke and the major short-term (1-month) and long-term (1-year) mortality predictors. *Methods:* Data were collected prospectively on hospitalized stroke patients from 8 hospitals in Beirut during a 1-year period. Patients were followed up for 1-year or until death. Mortality rates were assessed at 1-month and at 1-year poststroke and predictors of death were evaluated using Cox proportional hazard model. *Results:* A total of 191 stroke patients were included. Survival data were completed for over 97% of patients. Cumulative mortality rates were 14.1% at 1-month and 22% at 1-year. Predictors of short-term and long-term mortality in univariate analysis were low socioeconomic status, intensive care unit admission, decreased level of consciousness, stroke severity, and presence of complications. Marital status also predicted short-term mortality, while age greater than 64 years, atrial fibrillation, coronary heart disease, hypertension, Bamford and TOAST classifications and surgery need were also long-term mortality predictors. In multivariate analysis, stroke severity and presence of complications were predictors of death at 1-month and at 1-year. Low socioeconomic status, dependency in daily living activities, and the presence of comorbidities were additional predictors of 1-year mortality. *Conclusions:* Approximately 1 over 5 of patients did not survive 1-year after stroke. There is a need for public awareness campaigns to improve stroke knowledge, warning, and prevention which may reduce this high stroke mortality rate in Lebanon.

Key Words: Stroke—mortality—predictors—short-term—long-term—Lebanon

Introduction

Stroke is the third leading cause of death[1] with an annual 6 million fatal events worldwide.[2] Most of these stroke deaths are found in the developing countries and account for as much as 87% of all the stroke deaths.[3]

According to the World Health Organization, 15 million people suffer a stroke worldwide each year. Of these, 5 million die, and another 5 million are left permanently disabled.[4]

The prognosis after acute stroke varies greatly in individual patients, depending on stroke severity, stroke

From the *Laboratory of Clinical and Epidemiology Research, Faculties of Pharmacy and of Public Health, Lebanese University, Beirut, Lebanon; †Doctoral School of Life and Health Sciences, Paris-Est University, Creteil, France; ‡INSPECT-LB (Institut National de Santé Publique, d'Epidémiologie Clinique et Toxicologie—Liban), Faculty of Public Health, Fanar, Lebanon; §Department of Neurology, Faculty of Medicine, Saint Joseph University, Beirut, Lebanon; ¶Faculty of Medicine, Lebanese University, Beirut, Lebanon; ||Department of Neurology, Rafic Hariri University Hospital, Beirut, Lebanon; and **Department of Neurology, Henri Mondor Hospital AP-HP, Creteil, France.

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Address correspondence to Rachel Abdo, PhD, Laboratory of Clinical and Epidemiology Research, Faculties of Pharmacy and of Public Health, Lebanese University, Beirut Lebanon. E-mail: rachelabdo@hotmail.com.

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characteristics (location and size), and on the patient's premorbid condition, age and poststroke complications.[5] In fact, poststroke complication is a leading cause of death accounting for 23%-50% of total deaths in patients with ischemic stroke.[6]

Stroke mortality is an important outcome measure in stroke epidemiology studies and clinical trials, and data on stroke mortality are critical for monitoring disease trends and planning public health interventions. Furthermore, identifying predictors of mortality after acute stroke is of paramount importance for clinicians, so that specific therapies and management strategies can be applied to patients at high risk of dying with a consequent reduction in stroke mortality and disability.

There is paucity in literature in regards to the data about stroke mortality due to lack of studies in Lebanon.[7] The aim of this study was to investigate the stroke mortality rates and examine its major potential predictors of short- and long-term mortality in a multicenter hospital-based cohort of Lebanese stroke patients.

Methods

The ethical committees of all the participating hospitals approved the study. Participants (or their responsible caregivers where not possible) provided written informed consent.

Study Design

Stroke patients aged greater than or equal to 18 years, admitted during 1-year period from August 2015 in 8 different hospitals in Beirut (6 private university hospitals, 1 private community hospital, and 1 public university hospital) were included prospectively in this study and followed up for 1 year or until death. Stroke was defined according to the International Classification of Diseases (10th revision) including subarachnoid hemorrhage, intracerebral hemorrhage, and cerebral infarction; transient ischemic attack was defined as a brief episode of neurologic dysfunction resulting from focal temporary cerebral ischemia and not associated with cerebral infarction.[8] Transient ischemic attack patients, patients admitted after 7 days of symptoms onset or those who refused to give their consent were excluded. Patients were also excluded if they were suffering from severe pathologies with unfavorable 1-year prognosis (cancer, fatal renal, hepatic, or respiratory insufficiency), or having a moderate to severe cognitive decline before their stroke.

Study Tools

A structured data form including demographics, characteristics, and diagnostic tests performed was completed for all patients. Stroke severity on admission was assessed with the National Institute of Health Stroke Scale (NIHSS)[9] and classified as no stroke symptoms (score of 0), mild (score of 1-4), moderate (score of 5-14), moderate/severe (score of 15-20) and severe (score of $\geq$21). Clinical classification of the ischemic stroke was assessed using Oxfordshire Community Stroke Project (Bamford classification),[10] and clinical outcome was assessed using modified Rankin Scale (mRS).[11] Patients were classified into 3 groups according to mRS (independent [0-2 points], dependent [3-5 points], and dead [6 points]) and to 4 groups according to Barthel Index (BI) (independent [96-100], mild dependence [75-95], moderate dependence [46-74], and severe dependence [0-45]).[12] Stroke etiology was classified using to the Trial of Org 10172 in Acute Stroke Treatment (TOAST) criteria.[13]

Mortality rates were prospectively assessed by a researcher pharmacist (R.A.) at 1-month and at 12-months poststroke by visiting each patient at the place he/she was residing at that time (home, institution, rehabilitation center, or hospital).

Risk Factors Assessment

The presence of a previous stroke was determined on the basis of history and review of medical records. The existence of concurrent medical illness was determined by history, physical examination, laboratory data, and review of medical records. Risk factors such as hypertension, diabetes mellitus (type 1 or 2), dyslipidemia, and atrial fibrillation were defined by the use of medications for these conditions at the time of study enrolment or at hospital discharge. The data for baseline information on smoking status were also collected.

Education level, employment status, and monthly personal income were used as indicators of socioeconomic status (SES).

Statistical Analysis

Cumulative mortality rates at 1-month and 1-year follow-ups were calculated for all stroke patients. Differences in baseline variables between survivors, nonsurvivors and lost to follow-up at 1-year after the stroke were assessed with the $\chi 2$ test (or exact Fisher) for proportions and analysis of variance test (or Kruskal Wallis) for between-group comparison. Determinants of death were evaluated using the Cox proportional hazard model at 1-month, 1-year, and overall death. Univariate associations between mortality and each of the individual variables that were identified as possible predictors of mortality were assessed using Kaplan-Meier survival analysis and significance determined using the log-rank test. The identified predictors with a univariate $P < .2$ were subjected to multivariate Cox regression analyses using forward stepwise selection. Hazard ratios for mortality were determined by univariate and multivariate Cox proportional hazards regression analyses, with data presented as hazard ratio with 95% CIs. Log minus log plots were evaluated to test the validity of the

proportionality of hazards assumption over time; all variables met this assumption. The Kaplan-Meier overall mortality curve was presented. At 1-year follow-up, data analysis was conducted only for 1-month survivors. The P value of $\leq .05$ was considered statistically significant. Analyses were performed with the SPSS 21.0 software (IBM Corporation, Armonk, NY, USA).

Results

One hundred and ninety one patients were included in this study (approximately 5% of patients did not give their written consent and were therefore excluded from the study); the mean age was 69 ± 13 years and 57% were men (Table 1). Survival data during the study period were complete for over 97% of patients. No significant difference was observed between lost to follow-up and followed up patients concerning sociodemographic and clinical characteristics (Tables 1 and 2).

Cumulative rates of mortality were 14.1% at 1-month and 22% at 1-year follow-up. The risk of death was highest in the first month. For 1-month survivors, the mortality rate during 3, 6, and 12 months after the stroke was approximately 4.9%, 1.3%, and 3.2% respectively. Fifteen of the 164 survivors at 1-month (9.1%) did not survive 1-year after the stroke. Overall mortality curve is shown in Figure 1.

Table 1 presents the sociodemographic characteristics of the study population according to survival status at 1-month and 1-year. Survivors at 1-month (85.9%) and at 1-year (75.4%) were significantly younger than the deceased (mean age: 68 ± 12 years for 1-month survivors versus 77 ± 12 for 1-month deceased, $P = .001$; 67 ± 12 years for 1-year survivors versus 76 ± 12 for 1-year deceased, $P < .001$). Gender, education and living status were not statistically significant factors for mortality. However, the proportion of 1-month deceased patients was significantly lower among married patients, compared with single/divorced/widowed patients ($P = .036$). Higher 1-month and 1-year death occurred in housewife and unemployed patients compared to employed and retired patients ($P = .050$ and .004 respectively) and in patients with low monthly personal income compared to high monthly personal income ($P = .040$ and .017 respectively).

Table 2 presents the clinical characteristics of the patients by survival status at 1-month and 1-year. No statistically significant difference was noted between survivors and nonsurvivors regarding stroke types. Hypertension was the only risk factor statistically significant between survivors and nonsurvivors for mortality at 1-year ($P = .009$) Hypertensive patients had higher stroke mortality rates (27.1% versus 8.7%). No statistically significant difference was observed for other common risk factors such as diabetes mellitus, dyslipidemia, atrial fibrillation, coronary heart disease, recurrent stroke, and smoking. Stroke severity and infectious complications were significantly associated to mortality at 1 and 12 months ($P < .001$). The mRS was significantly lower and BI was significantly higher among alive patients compared to deceased at 1-month and at 1-year. Cardio-embolic and atherosclerosis stroke had the highest mortality rates between ischemic strokes and the highest mortality rates were found for patients with total anterior circulation stroke.

Variables identified in the univariate survival analysis as independent predictors of death at 1-month, 1-year, and overall mortality are presented in Table 3. Decreased level of consciousness, high NIHSS score and the presence of infectious complications were predictors of 1-month, 1-year, and overall mortality. Marital status, low monthly personal income, and intensive care unit (ICU) admission were additional 1-month mortality predictors. High mRS, low BI score, surgery need (coiling, craniotomy, shunt, carotid endarterectomy, gastrostomy, and tracheostomy), and the presence of comorbid conditions such as recurrent stroke, atrial fibrillation, and coronary heart disease were additional 1-year mortality predictors. Additional predictors of overall mortality were age greater than 64 years, low monthly personal income, employment status, ICU admission, surgery need, TOAST and Bamford classifications (for ischemic strokes), and the presence of hypertension as a comorbid condition.

Variables identified in the multivariate survival analysis as independent predictors of death at 1-month, 1-year, and overall mortality are presented in Table 4. Stroke severity and infectious complication occurrence were predictors of death at 1-month (aHR = 1.1, $P = .004$; aHR = 4.2, $P = .013$, respectively) and overall death (aHR = 1.1, $P < .001$; aHR = 3.0, $P = .007$, respectively); however, disability in daily living activities (low BI score aHR = .14, $P = .003$), atrial fibrillation (aHR = 4.6, $P = .035$), and recurrent stroke (aHR = 4.7, $P = .024$) were additional predictors of long-term mortality for patients alive 1-month poststroke.

Considering employed status as reference, unemployed patients had a significantly higher 1-year and overall mortality rate ($P = .003$ and .007, respectively).

In the multivariate analysis for ischemic stroke cases only, TOAST and Bamford were not statistically significant and were removed from the model (Supplementary material, Table 5).

Discussion

This prospective study was designed to find out both short- and long-term stroke mortality and their major determinants in hospitalized patients followed up for a year after an acute stroke.

Cumulative mortality rates for stroke patients increased from approximately 1 over 7 at 1-month to 1 over 5 at 1-year after the event. Almost 1 over 11 of survivors at 1-month did not survive at 1-year. In addition we found

Table 1. *Socio-demographic sample characteristics*

	At enrolment N = 191		Survivors at 1-month follow-up N = 164		Deceased at 1-month N = 27		*P* value*	Survivors at 1-year follow-up N = 144		Deceased at 1-year N = 42		*P* value**
	N./ mean	%/SD	N./ mean	%/SD	N./ mean	%/SD		N./ mean	%/SD	N./ mean	%/SD	
Age mean	69.2	12.6	68.0	12.3	76.6	12.2	.001	67.4	12.0	75.8	12.0	<.001
Gender							NS					NS
Male	109	57.1	96	58.5	13	48.1		83	57.6	22	52.4	
Female	82	42.9	68	41.5	14	51.9		61	42.4	20	47.6	
Marital status							.036					NS
Single/ divorced/ widowed	78	40.8	62	37.8	16	59.3		55	38.2	21	50.0	
Married	113	59.2	102	62.2	11	40.7		89	61.8	21	50.0	
Employment status							.050					.004
Employed	56	29.3	54	32.9	2	7.4		50	34.7	4	9.5	
Housewife	78	40.8	64	39.0	14	51.9		57	39.6	20	47.6	
Retired	20	10.5	17	10.4	3	11.1		15	10.4	4	9.5	
Unemployed	37	19.4	29	17.7	8	29.6		22	15.3	14	33.3	
Education							NS					NS
Illiterate	36	18.8	31	18.9	5	18.5		29	20.1	7	16.7	
Elementary	82	42.9	68	41.5	14	51.9		56	38.9	23	54.8	
Secondary	31	16.2	28	17.1	3	11.1		25	17.4	5	11.9	
High school	26	13.6	23	14.0	3	11.1		22	15.3	3	7.1	
University	16	8.4	14	8.5	2	7.4		12	8.3	4	9.5	
Monthly personal income (US$)							.040					.017
<500	131	68.6	107	65.2	24	88.9		92	63.9	37	88.1	
[500-1000]	39	20.47	38	23.2	1	3.7		35	24.3	2	4.8	
[1000-1500]	10	5.2	8	4.9	2	7.4		7	4.9	2	4.8	
>1500	11	5.4	11	6.7	0	.0		10	6.9	1	2.4	
Living status							NS					NS
With family	168	88.0	147	89.6	21	77.8		128	88.9	35	83.3	
Alone	23	12.0	17	10.4	6	22.2		16	11.1	7	16.7	

*Comparison patients with 1-month follow-up (n = 164) to dead at 1-month (n = 27).
**Comparison patients with full follow-up (n = 144) to dead (n = 42).

Table 2. *Clinical sample characteristics*

	At enrolment N = 191		Survivors at 1-month follow-up N = 164		Deceased at 1-month N = 27		*P* value*	Survivors at 1-year follow-up N = 144		Deceased at 1-year N = 42		*P* value**
	N./ mean	%/SD	N./ mean	%/SD	N./ mean	%/SD		N./ mean	%/SD	N./ mean	%/SD	
Type of stroke							NS					NS
IS	161	84.3	139	86.3	22	13.7		123	77.8	35	22.2	
PICH	14	7.3	11	78.6	3	21.4		10	71.4	4	28.6	
SAH	16	8.4	14	87.5	2	12.5		11	78.6	3	21.4	
Risk factors												
Hypertension							NS					
Yes	144	75.4	120	83.3	24	16.7	(.079)	102	72.9	38	27.1	.009
No	47	24.6	44	93.6	3	6.4		42	91.3	4	8.7	
Dyslipidemia							NS					
Yes	68	35.6	59	86.8	9	13.2		50	74.6	17	25.4	NS
No	123	64.4	105	85.4	18	14.6		94	79.0	25	21.0	
DM							NS					
Yes	79	41.4	69	87.3	10	12.7		59	76.6	18	23.4	NS
No	112	58.6	95	84.8	17	15.2		85	78.0	24	22.0	
AF							NS					
Yes	24	12.6	22	91.7	2	8.3		16	66.7	8	33.3	NS
No	167	87.4	142	85.0	25	15.0		128	79.0	34	21.0	
CHD							NS					
Yes	50	26.2	45	90.0	5	10.0		37	74.0	13	26.0	NS
No	141	73.8	119	84.4	22	15.6		107	78.7	29	21.3	
Smoker							NS					NS
Ex-smoker	28	14.7	24	85.7	4	14.3		20	71.4	8	28.6	
Current smoker	97	50.8	86	88.7	11	11.3		75	78.9	20	21.1	
Non smoker	66	34.6	54	81.8	12	18.2		49	77.8	14	22.2	
Previous stroke/TIA							NS					NS
Yes	31	16.2	27	87.1	4	12.9		21	70.0	9	30.0	
No	160	83.8	137	85.6	23	14.4		123	78.8	33	21.2	
NIHSS on admission							<.001					<.001
0	6	3.1	6	100.0	0	.0		6	100.0	.0	.0	
[1-4]	58	30.4	56	96.6	2	3.4		53	93.0	4	7.0	
[5-14]	67	35.1	63	94.0	4	6.0		57	87.7	8	12.3	
[15-20]	18	9.4	15	83.3	3	16.7		12	70.6	5	29.4	
≥21	42	22.0	24	57.1	18	42.9		16	39.0	25	61.0	

(*Continued*)

Table 2 (*Continued*)

	At enrolment N = 191		Survivors at 1-month follow-up N = 164		Deceased at 1-month N = 27		*P* value*	Survivors at 1-year follow-up N = 144		Deceased at 1-year N = 42		*P* value**
	N./ mean	%/SD	N./ mean	%/SD	N./ mean	%/SD		N./ mean	%/SD	N./ mean	%/SD	
mRS at discharge							<.001					<.001
[0-2]	50	26.2	50	100	0	.0		49	100.0	0	.0	
[3-5]	114	59.7	112	98.2	2	1.8		95	86.4	15	13.6	
6	27	14.1			25	92.6		0	.0	27	100.0	
BI at discharge					-	-	-					
[96-100]	40	24.4	40	24.7	0	0		39	100.0	.0	.0	<.001
[75-95]	29	17.7	29	17.9	0	0		29	100.0	.0	.0	
[46-74]	30	18.3	30	18.5	0	0		26	92.9	2	7.1	
[0-45]	65	39.6	63	38.9	2	100.0		50	79.4	13	20.6	
TOAST classification							NS					.057
LA	36	22.4	30	83.3	6	16.7		27	75.0	9	25.0	
CE	53	32.9	44	83.0	9	17.0		36	69.2	16	30.8	
SV	27	16.8	26	96.3	1	3.7		25	96.2	1	3.8	
UC	45	28.0	39	86.7	6	13.3		35	31.9	9	20.5	
Bamford classification							NS					.012
LACS	27	16.8	26	96.3	1	3.7		25	96.2	1	3.8	
POCS	31	19.3	26	83.9	5	16.1		21	67.7	10	32.3	
TACS	5	3.1	3	60.0	2	40.0		2	40.0	3	60.0	
PACS	96	59.6	82	85.4	14	14.6		73	77.7	21	22.3	
POCS + PACS	2	1.2	2	100.0	0	.0		2	100.0	0	.0	
Surgery							NS					.037
Yes	28	14.7	23	82.1	5	17.9		16	61.5	10	38.5	
No	163	85.3	141	86.5	22	13.5		128	80.0	32	20.0	
Infectious complication							<.001					<.001
Yes	62	32.5	40	64.5	22	35.5		29	48.3	31	51.7	
No	129	67.5	124	96.1	5	3.9		115	91.3	11	8.7	

AF, atrial fibrillation; BI, Barthel Index; CE, cardioembolism; CHD, coronary heart disease; DM, diabetes mellitus; IS, ischemic stroke; LA, large-artery atherosclerosis; LACS, lacunar syndrome; mRS, modified Rankin Scale; NIHSS, National Institution of Health Stroke Scale; PACS, partial anterior circulation stroke; PICH, primary intracerebral hemorrhage; POCS, posterior circulation syndrome; SAH, subarachnoid hemorrhage; SV, small-vessel occlusion; TACS, total anterior circulation stroke; TIA, transit ischemic attack; TOAST, Trial of Org 10172 in Acute Stroke Treatment; UC, unclassified.

There were 18 patients who were still in the hospital at 1 month, before discharge. Two of them were still alive at 1 month, while still in hospital but were discharged dead from hospital (after 1 month).

*comparison patients with 1-month follow-up (n = 176) to dead at 1-month (n = 27).

**comparison patients with full follow-up (n = 156) to dead (n = 42).

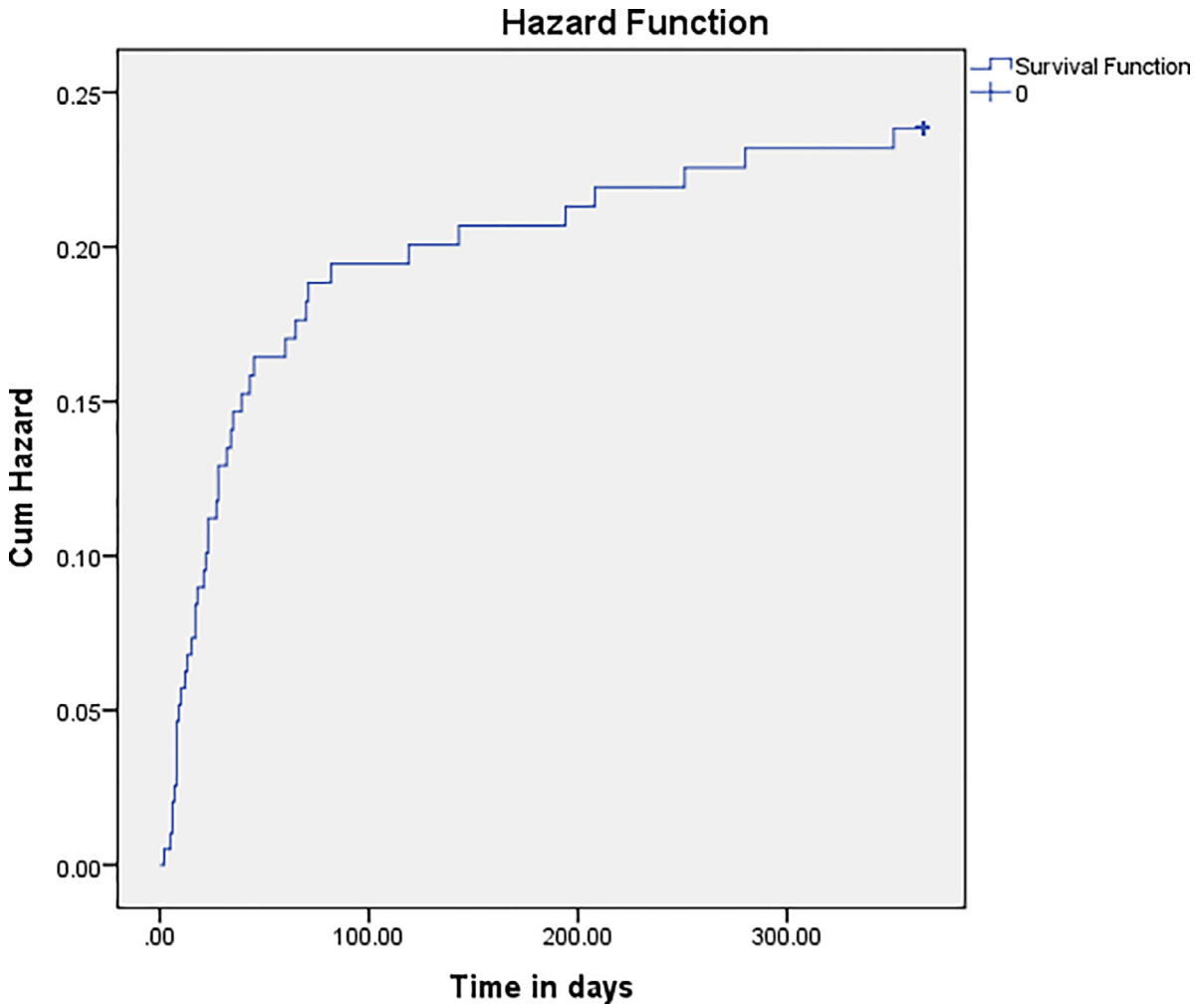

Figure 1. *Kaplan-Meier mortality curve for stroke patients at 1-year follow-up (overall mortality).*

that the first 2 weeks after stroke onset comprise a critical period for stroke patients since 12% and 31% died within the first and second week respectively. The nonsurvivor's percentage increased after the first 2 weeks getting to 64% by the end of 30 days. Our findings are not surprising. A Canadian study reported close 30-day and 1-year mortality rates after stroke of 13% and 24%, respectively[14] which are consistent with our findings. However prior studies have reported lower 1-month and 1-year mortality rates,[15,16] while others reported slightly higher rates than ours.[17,18]

Several factors are known to influence short- and long-term mortality. As expected, we found that initial stroke severity and infectious complications were independent determinants of short- and long-term mortality. Our findings support previous reports where stroke severity[14,16,19-21] and infectious complications[7,14,21,22] were independent strong predictor of short- and long-term mortality. Therefore, reducing stroke severity and the risk of infection will therefore be paramount in curtailing the mortality rate. Patients with high initial stroke severity or higher risk for infection may benefit from early treatment, preventative interventions, and sooner outpatient follow-up.

Recurrent stroke, hypertension, and atrial fibrillation are positively associated with poststroke death and this is consistent with previous studies.[23-25] Therefore, improved control of these modifiable risk factors can potentially prevent part of stroke mortality. Efforts should be also done on primary prevention measures in order to reduce stroke incidence and therefore stroke mortality.

Patients having a higher BI (being independent in daily living activities (DLA)) were significantly more likely to survive than those with a lower score. In fact, as proven in other studies,[26] BI is a useful predictor for 1-year mortality and being dependent in DLA increase the long-term mortality rate.

Unemployed patients had lower survival rate compared to employed patients. Many studies show that persons in lower socioeconomic positions, such as low-income groups, have higher risk of dying from stroke.[27,28] Understanding the causal associations between SES and stroke will allow interventions to be appropriately targeted and assessed.

Table 3. *Univariate Cox survival regression for determinants of 1-month, 1-year, and overall mortality in stroke patients*

	1-month mortality				1-year mortality*				Overall mortality			
	B	HR	95% CI	*P*	B	HR	95% CI	*P*	B	HR	95% CI	*P*
Age												
≤64 years		1 (Ref.)								1 (Ref.)		
>64 years	.9	2.4	[.9-6.3]	.068					.7	2.1	[1.0-4.4]	.045
Marital status												
Single/ divorced/ widowed		1 (Ref.)										
Married	−.8	.4	[.2-.9]	.038								
Monthly personal income (US$)	−.7	.5	[.2-1.1]	.053					−.6	.5	[.3-.9]	.022
Living situation												
With family		1 (Ref.)										
Other	.8	2.1	[.9-5.3]	.092								
Intensive care unit	2.4	11.1	[2.6-47.1]	<.001					1.4	4.1	[1.9-8.8]	<.001
Decreased level of consciousness	1.3	3.8	[1.8-8.2]	<.001	1.8	5.9	[2.1-16.7]	<.001	1.5	4.5	[2.4-8.2]	<.001
Stroke severity on admission (NIHSS)	.1	1.1	[1.1-1.2]	<.001	.1	1.1	[1.1-1.2]	<.001	.1	1.1	[1.1-1.2]	<.001
Infectious complications	2.4	10.7	[4.1-28.4]	<.001	1.7	5.3	[1.9-14.8]	<.001	2.1	7.8	[3.9-15.7]	<.001
Surgery**					1.3	3.6	[1.2-10.6]	.012	.7	2.0	[1.0-4.1]	.047
Barthel Index at discharge	N/A				−1.5	.2	[.1-.7]	.003	N/A			
Modified Rankin Scale at discharge	N/A				2.9	18.2	[4.8-68.6]	<.001	N/A			
Recurrent stroke					1.0	2.7	[.9-8.0]	.057				
Hypertension	1.0	2.7	[.8-9.1]	.084	1.7	5.5	[.7-42.0]	.063	1.2	3.4	[1.2-9.6]	.012
Atrial fibrillation					1.5	4.6	[1.6-12.9]	.001				
Employment status				.062				.053				.005
Employed		1 (Ref.)				1 (Ref.)				1 (Ref.)		
Housewife	1.6	5.2	[1.2-22.9]	.029	.9	2.6	[.1-7.1]	.250	1.3	3.9	[1.3-11.4]	.013
Retired	1.5	4.5	[.7-26.8]	.101	.5	1.6	[.04-4.13]	.689	1.1	3.1	[.8-12.3]	.111
Unemployed	1.9	6.6	[1.4-30.9]	.017	1.9	6.5	[2.7-51.8]	.022	1.8	6.3	[2.1-19.2]	.001
TOAST classification												.028
SV										1 (Ref.)		
LA									2.0	7.5	[1.0-58.9]	.057
CE									2.2	9.0	[1.2-67.8]	.033
UC									1.7	5.7	[.7-44.8]	.099
Bamford classification				.088								.005
LACS		1 (Ref.)								1 (Ref.)		
POCS	1.5	4.4	[.5-37.9]	.175					2.2	9.4	[1.2-73.2]	.033
TACS	2.7	14.8	[1.3-163.5]	.028					3.2	25.6	[2.6-246.2]	.005
PACS	1.4	3.9	[.5-30.0]	.185					1.8	6.2	[.8-46.1]	.74
CHD					1.1	3.2	[1.1-8.7]	.019				
Smoking status								.172				
Nonsmoker						1 (Ref.)						
Exsmoker					1.5	2.8	[.6-12.9]	.077				
Smoker					1.0	4.6	[.8-25.3]	.189				

CE, cardioembolism; CHD, coronary heart disease; HR, hazard ratio; LA, large-artery atherosclerosis; NIHSS, National Institution of Health Stroke Scale; SV, small-vessel occlusion; TOAST, Trial of Org 10172 in Acute Stroke Treatment; UC, unclassified.

The 2 patients who had POCS + PACS were grouped with PACS group for statistical analysis purpose.

*Among 1-month survivors only.

**Surgery types were: coiling, craniotomy, shunt, carotid endarterectomy, gastrostomy, and tracheostomy.

Table 4. *Multivariate Cox survival regression for determinants of 1-month, 1-year, and overall mortality in stroke patients*

	1-month mortality				1-year mortality*				Overall mortality			
	B	aHR	95% CI	*P*	B	aHR	95% CI	*P*	B	aHR	95% CI	*P*
Stroke severity on admission (NIHSS)	.1	1.1	[1.02-1.12]	.004					.1	1.1	[1.05-1.12]	<.001
Infectious complications	1.4	4.2	[1.3-12.8]	.013					1.1	3.0	[1.3-6.8]	.007
Barthel Index at discharge					−2.0	.14	[.04-.50]	.003				
Recurrent stroke					1.5	4.7	[1.2-17.6]	.024				
Hypertension									1.1	2.9	[1.0-8.3]	.050
Atrial fibrillation					1.5	4.6	[1.1-19.2]	.035				
Employment status								.003				.007
Employed					1 (Ref.)				1 (Ref.)			
Housewife					.2	1.3	[.1-11.6]	.828	.697	2.0	[.7-5.9]	.207
Retired					−.6	.5	[.03-10.9]	.696	.550	1.7	[.4-7.0]	.438
Unemployed					2.7	15.1	[1.7-131.3]	.014	1.684	5.4	[1.7-16.7]	.003

aHR, adjusted hazard ratio; NIHSS, National Institution of Health Stroke Scale.
*Among 1-month survivors only.

Even though age, decreased level of consciousness, and ICU admission were removed when entered in the multivariate Cox regression, they were positively associated with death at both 1-month and 1-year periods and with overall death in the univariate analysis. In fact, they emerged as predictors of stroke mortality in many previous studies.[15-20,24]

Strengths and Limitations of the Study

This study has some limitations. The first limitation is the small number of patients. In fact, Lebanon is a small country of approximately 4.3 million people in 2012.[29] Therefore, it was expected to have this number despite our effort to include all stroke patients in these 8 different hospitals in Beirut region. In addition, even though we have tried to screen all stroke patients in this study we might have missed some of them for different reasons (such as transferred patients to another hospital, etc.), which may also contribute to this small number of patient. However, we have no reason to believe that the associations we found would be different in larger more representative studies, except for some associations that may not show statistical significance because of the sample size of our study. Second, we did not include patients who were demented, died before hospitalization, or died within less than 24 hour from admission, which may give rise to a selection bias, and therefore we think that mortality rate is underestimated in our study. Third, even though patients came from all governorates, hospitals were limited to Beirut region. Future studies taking into account all the weak points and including a larger sample size from all Lebanon regions must be done to confirm our findings.

Conclusions

The important predictors of mortality found in our study were stroke severity and infectious complications. Low SES and the presence of comorbid conditions such as hypertension, atrial fibrillation, and recurrent stroke were also additional predictors of long-term mortality.

There should be public awareness campaigns to educate the public on stroke symptoms and risk factors and their modifiable nature. Primary and secondary prevention measures should be of utmost importance. This will reduce both the prevalence of stroke and the severity and therefore the mortality rate.

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Supplementary Materials

Supplementary data to this article can be found online at doi:10.1016/j.jstrokecerebrovasdis.2018.11.033.

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